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Table of Contents

Grand Intentions

Editorial

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Abstract: It is with the best of intentions that Australia embarked on a program of privatisation that commenced in the 1970s and continues today. Government's efforts over the past 40 years to divest itself of utilities and enterprises in a shift from a command economy to a broader market economy is to be applauded but only lightly for the implementation of the privatisation program has, at times, been a shambles resulting in failed legislation and regulation, unwanted outcomes, and a lack of competition. It is timely that Emeritus Professor Tevor Barr has authored a novel that was inspired by real events during the privatisation of Australian Government telecommunications assets. The aptly named and newly privatised Telco One has recruited a chief executive officer from New York and the business culture transition begins. Decades after the events described in Professor Barr's *Grand Intentions* the Australian telecommunications market remains in a state of constant flux with successive Governments failing to put in place a balanced, fair and open competitive market that would justify the privatisation program. The rationale for the National Broadband Network highlights the quagmire into which the Government of the day was forced to step and it will be another five to ten years before a future Government has the next opportunity to restructure the industry. Let us hope that they get it right this time around.

In This Issue

In this issue the *Journal* includes two reviews of Emeritus Professor Trevor Barr's novel *Grand Intentions* (ISBN 978-1-921030-16-1), five articles covering a range of current and historical technologies and a discussion of Telecom Australia's directory service.

A Review of Grand Intentions provides a review of Professor Barr's novel *Grand Intentions* that highlights the shift from a public service to a private sector culture within Telco One and how this affects the goals and aspirations of the employees and shareholders.

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The Trollope of Australian Telecommunications provides a review of Professor Barr's novel *Grand Intentions* that notes how the novel describes the ugly side of the neo-liberalism sweeping Australia in the 1990s and 2000s and the impact of the importation of the more ruthless US corporate culture.

The APT Frequency Arrangement in the 700 MHz: Reflections on the International Spectrum Management Regime reflects on the frequency arrangements in the 700 MHz band and out of band emissions of the mobile terminals below 694 MHz with the view that there should be a harmonisation of approaches in the various global telecommunication regions.

Conceptualising the Australian telecommunications industry self-regulation scheme in the context of Australian judicial system and administrative justice considers the future role of bodies including the Telecommunications Industry Ombudsman in the overall telecommunications self-regulation regime.

The Transformation of Telecom's "Ugly Duckling" is a historical review of Telecom Australia's directory publishing business and how this business transformed from a public service entity into a flourishing privatised business that eventually became a casualty of the Internet era.

Fifth Generation Cellular Networks provides a review of fifth generation mobile and as we draw closer to this next generation mobile cellular technology becoming available this article highlights some of the technical and regulatory issues that have yet to be finalised.

Social Practices of 3D Printing: Decentralising Control, and Reconfiguring Regulation considers the social practices of 3D printing by comparing consumer perspectives and practices with legal scholarship on intellectual property regimes.

Colour Television in Australia provides a historical paper from the Journal in 1976 regarding the colour conversion of transmitters in the National Television Service by Telecom Australia.

Grand Intentions

Emeritus Professor Trevor Barr has penned a fascinating novel about the period following the privatisation of the Australian Government's telecommunications assets during the 1990s. This stunning account of the goals and aspirations of those close to the heart of the recently privatised Telco One is the "Don's Party" of the telecommunications scene during a chaotic and unfulfilling era.

The novel *Grand Intentions* (ISBN 978-1-921030-16-1) centres around the lives of four people caught up in the whirlwind created by Telco One's recently appointed chief executive officer, who was recruited from New York to bring a shareholder value focused US corporate management style to Telco One.

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At the heart of *Grand Intentions* are the people affected by the underlying malaise created by failed Government privatisation policy, a problem that persists today. Professor Barr provides us with an inspired insider's view of the effect that business and political decisions have on everyday Australians.

The National Broadband Network is the most recent example of how Government, a generation after the events portrayed in *Grand Intentions*, has been forced to step into the quagmire created by successive failed attempts by earlier Governments to deregulate telecommunications and to put in place a more balanced, fair and open competitive telecommunications market. It will be another five to ten years before a future Government has the next opportunity to restructure the industry after privatising NBN Co.

We should be confident that our elected representatives will get it right the next time around or is it with the best of intentions they will fail yet again?

Looking Forward

The key theme for the December 2016 issue will be *International Telecommunications Legislation and Regulations*. As the global digital economy evolves it is timely to consider the different telecommunications markets and how each is coping with the transition to next generation networks – the 'gigabit race' – and how competition is being fostered with the market.

Papers are invited for upcoming issues and with your contributions the Journal will continue to provide the readership with exciting and informative papers covering a range of local and international topics. The Editorial Board values input from our readership so please let us know what themes you would like to see in the coming year.

All papers related to telecommunications and the digital economy are welcome and will be considered for publication after a peer-review process.

Mark A Gregory

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A Review of *Grand Intentions*

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Abstract: *Grand Intentions* by Trevor Barr is an exciting read that involves many themes and works at many levels. It concerns a fictitious telephone company, Telco One, which is undergoing major change as the Government privatises it. Telco One is in the throes of moving from a traditional culture based on public sector, even public service, values to a commercial entity subject to the overwhelming imperative of shareholder value. The twists and turns as Telco One transforms from its previous culture into a dynamic commercial entity are transfixing. This is a must-read book for those with an interest in what could become a dystopian drama if not for the emergence and re-emergence of grand intentions and praiseworthy aspirations of the characters themselves.

Keywords: Review, Telecommunications, History

Review

This is the first work of fiction by Trevor Barr, a professor emeritus from Swinburne University in Melbourne who has taught and written about communications themes for a life-time.

Grand Intentions (Barr, 2016) involves many themes and works at many levels. It concerns a fictitious telephone company, Telco One, which is undergoing major change as the Government privatises it. Telco One is in the throes of moving from a traditional culture that is based on public sector, even public service, values to a commercial entity subject to the overwhelming imperative of shareholder value.

The board of directors is as rent by demands as diverse as those affecting the organisation. The Board determines that change must start at the top and retains international recruiting consultants to scour the field. The existing Australian CEO is not even short-listed. This is how the underdone chairman, Nathan Thompson, meets the preferred candidate – even the only candidate – Clint Mason. (Yes, the international recruiters have dudded the Board. Happens a lot.)

The story that unfolds will resonate strongly with those who have followed the recent fortunes of Telstra, Westpac, Consolidated Press and other companies that have sought to transform themselves though importing overseas – and especially American – chief executives. The story will

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resonate even more with those who have been in organisations subjected to this brand of short-term radical transformation.

Trevor Barr seeks – and largely succeeds – to present the complications that accompany radical organisational transformation. He does not treat the matter of cultural clash in the simple terms that some might consider appropriate. There are many complexities to be teased out.

The story is told at many levels as the different paths of a range of characters become entwined and their values play out. Most really do have grand intentions to do good, at least in their own terms, or to achieve something that is better than whatever they have started with. There is Clint Mason, the New Yorker, who has a track record of organisational change in the telecommunications industry in the United States and is recruited after an international search (which sounds like a search that was poorly specified and executed) as the CEO of Telco One. There is not a lot to like about Clint – who is clearly modelled on many imported managers with a shallow draft and a determination to apply the methods they have adopted in the United States to anything they find abroad. Trevor Barr has nicely caught Clint's unswerving belief in the superiority of anything from the United States and its application anywhere else in the world. Clint is not interested in the organisational culture that he finds himself in, or even in the broader Australian culture that he has temporarily joined. He is a superior person. One exception is with certain aspects of indigenous culture, but this is left as an inexplicable exception in the novel. For Clint, most of what he finds has no utility other than as a surface to paint over.

Reminiscent of other foreign CEO takeovers, Clint brings with him a team of compatriots – not all at once, but over the journey. The most conspicuous is Brad Botein, a hatchet man from way back, and his Australian deputy from the beginning of his term. Clint Mason takes little time to remove many of the incumbent senior managers, especially those who appear not to immediately accept his so-called vision for the company – or those who do not immediately "get on board". New senior managerial recruits also include Australian managers who are attracted by material rewards – not all are American. The slash and burn redundancy program is rolled out very quickly.

In stark contrast to Clint Mason, Brad Botein and recent senior appointees, is the long-serving head of Customer Relations, Gordon Hunt. Gordon also has grand intentions, and has had them for over thirty years. Prior to Clint's arrival he employs two non-telco people who are professional counsellors – Paul Brookes and, at Paul's insistence, his long-time friend and fellow counsellor, Max Groves. Gordon Hunt is trying to develop new ways of engaging with customers, especially given that old ways of doing so are clearly not working. The level of complaints is steadily rising. He is responding as well to the recent highly publicised death of an asthmatic, Thomas Bowie, when the continued poor performance of a residential telephone service meant that emergency medical help arrived too late. This incident recalls a real-life similar situation not so many years ago for Telstra. It seems that large organisations may not be motivated to act in any effective way except in response to highly publicised and dramatic situations such as this. Grand intentions are only part of a corporate response when accompanied by trauma of an extended kind – such as the enquiry and public outcry following Thomas Bowie's death.

Paul and Max are very motivated to change Telco One into an organisation that truly engages with its customers and starts by listening carefully to what they have to say. They recommend to Gordon

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that a Consumer Advisory Council be established with representation from all major consumer segments. Gordon takes the idea up, and Clint agrees.

There are many parallels between the appointment of Clint Mason as CEO and of Paul Brookes as counsellor. In both cases they are insistent that their associates be appointed with them. Trevor Barr does not take this particular parallel further, but it does provide opportunities for dialogue between like-minded people, which might otherwise have been difficult to credibly cover in the third person. It is interesting that the author has noted a tendency to select teams, even teams of two in the case of Paul and Max, to undertake transformative projects.

The relationship of Telco One to its customers is contrasted with the relationship of a community radio station with its listeners and supporters. Max's partner, Karen (Kaz) is made station manager in difficult circumstances knowing that the money is about to run out. The station appeals to its supporters and listeners and raises a relatively large amount in pledged support through a radio-thon. But its hand to mouth existence is set to continue. It is a band-aid at best. But the engagement is real and reciprocal.

To say more about the way that the situation unfolds, at various levels, would be to give away the plot. Not that this is crime fiction with potential surprises towards the end. Clint Mason's vision, including the substantial human suffering associated with mass redundancy programs, has consequences. And these become clear as the story continues. At the level of the individual characters, one might be surprised by the turn of events in the novel, but what happens is to be expected.

Trevor Barr has a good ear for the industry and for the way in which issues are expressed. If there was a failing in this novel – and I am not saying there is, mind you – it is that the characters not only talk the same language they often sound like each other – even the Americans. They often adopt each other's tone. Their collective favourite conversational gambit is "So tell me about it" and sometimes "So, tell me the top three things about it". This is not a problem if, like me, you learn to count back to whoever is last named and work out who is speaking from that. It only works if the characters take turns to speak and if there are only two of them.

Trevor Barr's substantial experience is on display through each of the characters in the novel as they grapple with issues that confront them. He particularly picks up on the phoney nature of a lot of "management speak" associated with conveniently massaged visions and passions. It contrasts with the need for real engagement with people. There is a scene in which Clint runs a CEO forum for over 650 Telco One staff in a large facility, extended via links to cover State capitals. Clint runs his mantra on vision and convinces himself that he has responded well to questions, but the reality is somewhat different.

Grand Intentions is an enjoyable novel, with many messages. Perhaps some will be more discernible to people who are in the telecommunications industry. Or who might have been, before being made redundant. It is fiction with substantial messages that transcends the characters and the specific situation of Telco One. Globalisation and technological progress have human costs and serve to increase the difficulty of engagement between people in traditional ways. How the challenges are addressed is important. Clint Mason's way is via disconnection and reconnection to the short-term imperatives of shareholders. Others in the novel want to cling to the past. Others want to be guided

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by changing customer preference. All approaches are underpinned by personal characteristics that add to complexity. Personal relationships add to the stresses at all levels.

The world that Trevor Barr is describing as coming into being could easily become a dystopia, were it not for the emergence and re-emergence of grand intentions and praiseworthy aspirations of the characters themselves. The title might be sardonic, but it is the source of hope that improvement is possible.

I commend this novel to you.

References

Barr, T. (2016). *Grand Intentions*. Melbourne, Australia: Sid Harta Publishers

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The Trollope of Australian telecommunications

Book review of Trevor Barr's *Grand Intentions*

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Abstract: Trevor Barr's page-turner of a novel *Grand Intentions* tackles the ugly side of the neo-liberalism sweeping Australia in the 1990s and 2000s. It examines the privatisation of an incumbent telecommunications carrier, and the drastic impact of its imported US corporate culture on several individuals. He deploys a cast of plausible fictional characters while allowing the narrative to be driven by an echo of real events in the Australian telecommunications industry.

Keywords: Trevor Barr, Grand Intentions, book review, Australian telecommunications, dramatic fiction.

Just as Anthony Trollope's *The Way We Live Now* exposed the financial scandals of the British stock market in the 1870s, Trevor Barr's page-turner of a novel *Grand Intentions* (Barr, 2016) tackles the ugly side of the neo-liberalism sweeping Australia in the 1990s and 2000s.

The case study for Barr's novel is the privatisation of a government-owned carrier, Telco One, and the imposition of ruthless American corporate values on the culture of a 1980s-era Australian middle management and workforce. Like Trollope, Barr invents a cast of plausible fictional characters while allowing the plot to be driven in part by an echo of real events – in this case, the successive restructuring and privatisation of Telstra between 1991 and 2010, and its drastic impact on many individuals.

Barr brings to bear his extensive knowledge of the Australian telecommunications industry and its massive changes in those two decades. Telecoms industry insiders will delight in picking up the relationships between events in this parallel, fictional universe with those in the real world.

The book begins with the death of an asthmatic young man in country Victoria, after his parents were unable to use their phone to call for an ambulance. This mirrors the case of a

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real casualty in 2002, of huge concern then to the Telecommunications Industry Ombudsman (TIO) and to Telstra's management.

Amongst other 'real world' industry events alluded to in *Grand Intentions* are the rising numbers of customer complaints with the TIO concerning mobile services (in particular, poor mobile coverage and bill shock), up until recent years; the contempt – or, at best, incredulity – articulated by US imports Sol Trujillo and Phil Burgess for Australia's competition and workplace regulations; the legendary success of the 'phone for everyone at affordable cost' campaign (better known as the Telecom 2000 project, commenced in 1975 and completed by 1990); and the closing down of Telstra Research Laboratories in 2006, after 83 years of service as a national resource of in-depth technical expertise on telecommunications.

These incidents from the 'real life' of Australia's telecommunications industry, condensed into perhaps three years in the fictional world of this novel, draw the reader into a narrative which seems to have two major underlying motivations.

The first aim appears to be to capture the flavour of the cultural clashes in the 1980s and 1990s between Telecom Australia's (and its successor Telstra's) dominant engineering culture ('build it and they will come') and the pro-customer initiatives introduced by some of its executives and staff.

The cultural contrasts concerning the priority of 'the customer' must have been palpable to the author, Trevor Barr, as the external Co-Chair of the Telstra Consumer Consultative Council for several years. The imprints of his personal experiences are evident throughout the novel, most strikingly in his choosing to list all the members of his fictional Telco One Consumer Council, complete with their organisational affiliations, on p.106 of his book!

But where the novel gains its real narrative excitement is in capturing the much more lethal culture clashes – in career terms – between the brutal US corporate culture of the Trujillo 'three amigos' regime at Telstra, and the traditional Telecom-era culture. The latter can be characterised (by one who lived through it) as being marked notably by two-way loyalty between management and workers, longevity of tenure, teamwork across the organisation, and putting greater priority on serving the national interest than on maximising short-term commercial returns, e.g. by cross-subsidising new network infrastructure to achieve maximum national coverage. (Again, to be fair, Trujillo did as much as any of his predecessors in prioritising national infrastructure investment, in his investment in mobile network technology – as reflected in this novel.)

Grand Intentions introduces dramatic tensions between a minority of independent-minded Telco One Board members, especially in the character of lawyer Jennifer Ralston, and those

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captivated by the new American CEO, Clint Mason, most prominently the Chairman, Nathan Thompson. It must be said that the character of Clint Mason has little in common with the flamboyant Sol Trujillo; nor is there any character based upon Trujillo's colourful amigo Phil Burgess, a truly Falstaffian figure, to pep up the plot. And several of the industry events echoed in the novel pre-dated Trujillo's arrival in Australia by several years, some belonging to the less turbulent era of Frank Blount, Telstra's first American CEO – and even before then.

The more important example of the clash between US-corporate versus Aussie-cultures is given a slow fuse, in the character of Max Groves, a somewhat anarchistic and charismatic community organiser introduced in chapter 4. The potential conflict between Max and Clint's values is evident from the beginning, and is cleverly developed throughout the novel, with a satisfying explosive denouement near the end.

Let me return to my analogy with Anthony Trollope – the most prolific author to have ever served as an employee of the British Post Office. Trollope was a very successful writer in his day (the mid-19th century), not for great eloquence of literary style but for his ability to develop compelling dramas from the everyday events in institutional life. He introduced his readers to the arcane politics of the Church of England in the *Barsetshire Chronicles*, and to the shocking world of London's ruthless financiers and their dupes in *The Way We Live Now*.

In a similar way, Trevor Barr has used his extensive knowledge of the Australian telecommunications industry to dramatically highlight some events occurring over two decades in the progressive privatisation and restructuring of Telstra – condensed to some three years in this novel. The characters and plot he has invented will of course fascinate all telecoms industry insiders.

The more interesting question is whether this novel will attract a broader group of readers. The book will interest some as a rare literary case study of the ugly side of the neo-liberalism that has swept through Australia, and through most of the English-speaking world, since the 1980s. Because a central concern of the novel is for the innocent victims of corporate change who 'get in the way'.

But to others, it will probably be enjoyed as quite an exciting novel, in which personal relationships and careers are torn asunder – or deftly manage to survive – under the intense turmoil of corporate change.

References

Barr, T. (2016). *Grand Intentions*. Melbourne, Australia: Sid Harta Publishers

The APT Frequency Arrangement in the 700 MHz: Reflections on the International Spectrum Management Regime

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Abstract: The conflict over the frequency arrangements and out-of-band emissions (OOBE) of the mobile terminals below 694 MHz, taking into account the allocation of the 694-790 MHz band to the mobile service, has revealed the emerging tendency of countries in Regions 1 and 2 to align themselves with Region 3 to lower the cost of end-user equipment. Moreover, the discussion has highlighted that global harmonisation is at the heart of modern spectrum policy given that the ITU-R decision-making procedures are mostly based upon consensus with the possibility of few countries blocking the discussion. There is also a need to revise the current ITU-R structure of three regions as convergence is emerging between them. The paper's main argument is that in this era of globalisation, it is not beneficial for a country or a group of countries to act separately from the rest of the world even if they could.

Introduction

African and Arab countries made their voice heard during the World Radiocommunication Conference of 2012 (WRC-12)[1] when they called for an immediate allocation of the 694-790 MHz band to mobile service to meet growing demand for broadband. The European countries opposed the proposal, arguing that the band is heavily utilised by broadcasters in their countries. Eventually, the conference approved the allocation, which was effective immediately after WRC-15 (El-Moghazi, Whalley & Irvine 2013).

Following WRC-12, a discussion has emerged with regard to the frequency arrangements in the 700 MHz band, and the limits of the out of band emission (OOBE)[2] values of mobile devices in the 700 MHz band. During these discussions, it was evident that the influence of the Asia-Pacific Telecommunity (APT) countries (http://www.aptsec.org/), which lie in ITU-R Region 3[3] within the ITU-R, has been extended to Regions 1 and 2. In particular, it seems that the APT frequency arrangement and OOBE values in the 700 MHz in Region 3 had consequences on the discussions in the other regions. Accordingly, the overarching research question of this paper is formulated as: 'What are the policy implications of the 700 MHz band mobile allocation in Regions 1 and 2 given the APT activities in Region 3?' More specifically, the paper examines the influence of the APT plan for 700 MHz on the other ITU-R regions and the role that was played by geographical isolated countries such as Australia and New Zealand. Additionally, the paper reflects on the decision-making procedures of the ITU-R and the three regions system.

The rest of the paper is organised as follows. The following section explores the literature review on the 700 MHz issue and is followed by a section that outlines the adopted research method. This is then

followed by two sections that examine the frequency arrangements in the 700 MHz and OOBE values respectively. After discussing the different policy implications of the 700 MHz issue, the paper ends with a concluding section.

Literature Review

The ITU is the main institution of the international telecommunication regime[4] (Cowhey & Aronson 1991). One of the main norms[5] of the international regime is organising global commons (e.g. spectrum) while the regime's decision-making procedures are based on one vote for every country within the ITU (Cowhey 1990). The Radiocommunication Sector of the ITU (ITU-R) discusses the wireless industry main issues through World Radiocommunication Conferences (WRC), which aims at reviewing and revising the international Radio Regulations (RR) (Gregg 2009).

WRC is one of the ITU-R conferences that consider specific radiocommunication matters. Regional organisations usually present common proposals to the WRC on behalf of their member states as proposals must have the support of more than one administration to be considered (Contant & Warren 2003). There are six main regional organisations in the ITU-R, namely: European Conference of Postal and Telecommunications Administrations (CEPT), the Asia Pacific Telecommunity (APT), the inter-American commission of telecommunications (CITEL), the Arab Spectrum Management Group (ASMG), the African Telecommunications Union (ATU), and the Regional Commonwealth in the field of Communications (RCC).

The WRC-12 witnessed the success of Arab and African countries in acquiring an additional allocation to the mobile service in the 700 MHz band in Region 1 so that growing demand for broadband could be met (Standeford 2012b, 2012c). The European countries opposed such proposals because the 694-790 MHz band is mainly used for broadcasting service in their territories and a large investment had already been made to fund the transition to digital television (El Moghazi et al. 2015). Eventually, WRC-12 decided to allocate the 694-790 MHz frequency band in Region 1 to mobile service on a primary basis in addition to the existing primary broadcasting service and to identify the band for IMT (ITU-R 2012b).

Historically, most of the UHF band (470-862 MHz) was planned for analogue terrestrial broadcasting service in Region 1. In 2006, the Regional Radiocommunication Conference 2006 (RRC-06) planned the digital terrestrial broadcasting service in Region 1 and in the Islamic Republic of Iran to be in the frequency bands 174-230 MHz and 470-862 MHz (ITU, 2006). Shortly after that, the WRC-07 approved an additional allocation in the frequency band 790-862 MHz to mobile service effectively from 17 June 2015 (ITU-R, 2007).

Following WRC-12, the ITU-R studied the channelling arrangements for the mobile service adapted to the frequency band below 790 MHz taking into account the existing arrangements in Region 1 in the frequencies between 790 and 862 MHz, the harmonisation with arrangements across the three regions, and the compatibility with other primary services to which the band is allocated including in adjacent bands. To achieve that, the Joint Task Group 4-5-6-7[6] (JTG 4-5-6-7) was established (Stirling 2012).

Methodology

In order to answer the main research question, this paper adopts a qualitative methodology that examines the case study of the APT countries regarding the 700 MHz mobile allocation in the period until WRC-15. More specifically, the paper focuses on two main issues from the APT perspective, namely, OOBE values and frequency arrangements in the 700 MHz band. Case studies require conducting a detailed investigation of specific case(s) in order to obtain a closer insight into the context and processes involved in the research subject (Meyer 2001).

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The paper also adopts an inductive approach where the theory is developed based on the observations or the findings of the research (Bryman & Bell, 2007). Inductive research is more suitable when the researcher intends to understand the nature of a problem and is concerned with the context in which events have occurred (Saunders, Lewis & Thornhill 2009). The context in this paper is the discussions related to the 700 MHz issue within the ITU-R.

The paper is based on primary data collected mainly through semi-structured interviews with 42 stakeholders that participated in the 700 MHz debate during and after WRC-12. Questions were asked regarding to the effectiveness of WRC decision making procedures in the light of the 700 MHz issue and the different views of the regional organisations (CEPT, APT, CITEL, ATU, ASMG, CITEL) and leading countries during WRC-12 and afterward with regards to frequency arrangements in the 700 MHz and the technical conditions related to the mobile allocation in the band. The paper also draws on the observations made by the lead author who attended meetings where the 700 MHz issue was discussed. In addition, the paper draws from secondary data from the APT countries' contributions in the various ITU-R working parties (WPs).

The difference between unstructured and semi-structured interview is that the former is similar to a conversation and could contain one question, while the later compromises a list of questions on specific topics (Bryman & Bell 2007). However, structured interviews have a rigid structure that cannot be easily modified (Bryman & Bell, 2007).

Interviews were selected for a variety of reasons (Saunders et al. 2009). Firstly, they enabled the interviewer to build on their responses and thus explore issues as they emerge in greater depth. Secondly, personal contact helps achieve a greater response rate as interviewees may hesitate when providing sensitive data or be reluctant to spend time explaining their answers. For confidentiality reasons, the names of the interviewees are not disclosed.

Frequency Arrangements

The first issue that is related to the 700 MHz mobile allocation is the frequency arrangements or channel planning in the 700 MHz band in Region 1 considering harmonisation with the other regions. Channel planning accommodates a type of channel duplex mode (Frequency Division Duplex (FDD) and Time Division Duplex (TDD))[7] and the width of the channel (e.g., 20 MHz). The issue of agreeing on one frequency arrangement in the 700 MHz band was quite important, as having different arrangements in the band would negatively influence global harmonisation between the three ITU-R regions.

In Europe, CEPT adopted a plan in the 800 MHz that operates in the bands 791-821 MHz, 832-862 MHz and provides 2x30 MHz for FDD operation. In addition, the US adopted a more complicated plan that compromises a mix of FDD operation in the bands 698-716 MHz, 728-746 MHz, 746-763 MHz, and 776-793 MHz and TDD operation in the band 716-728 MHz (ITU-R, 2012a). The US plan has the disadvantage of being highly fragmented and it offers less spectrum for mobile broadband use (Zehle 2013). In addition, there are interoperability difficulties between the different band blocks in the US plan (Standeford 2012a).

In Asia, initially there were views to partially harmonise with the US plan in the 700 MHz band (APT 2009). Meanwhile, the 700 band was of a critical importance to Region 3 countries because most of the 800 MHz band is used for application other than mobile (APT 2009). Eventually, the APT adopted a plan in the 700 MHz in 2010 that operates in the bands 703-748 MHz and 758-803 MHz and provides 2x45 MHz for FDD operation of broadband systems (APT 2010). Figure 1 (below) shows the APT plan and the guard band between it and the digital terrestrial TV (DTTV) in the UHF band.

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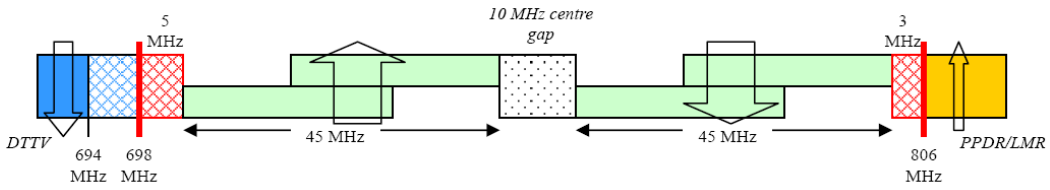

Figure 1 - Harmonised FDD Arrangement in the 698-806 MHz band (APT, 2010)

In Latin American, shortly before the WRC-12, CITEL countries adopted a new recommendation highlighting two options for frequency arrangements in the 700 MHz, mainly the APT FDD and the US plans (CITEL 2011). By 2013, the number of countries in Region 3 who decided to adopt the APT 700 MHz plan was 18 countries. In particular, all of the countries in Region 3 except for Bolivia decided to adopt the US band plan (Bateson 2014; Migwalla 2013).

The APT band plan is different than the other plans because it compromises of a dual-duplexer arrangement with 2x30 MHz for each one (APT 2010). The reason for adopting dual-duplexer is that the maximum bandwidth of a duplexer for a terminal at this frequency range is usually around 30-35 MHz (APT 2009). Therefore, it is difficult to have a user handset that covers the 2x45 MHz of the APT plan with only one duplexer.

The APT plan overlaps with the CEPT plan in the band 791-803 MHz, which means that countries cannot adopt both of the two plans at the same time and a choice between them has to be made. If a country decides to adopt the CEPT plan, it will not be able to utilise the large bandwidth of 45 MHz of the APT plan in the 700 MHz band. On the other hand, fully adopting of the APT plan would impact the harmonisation with CEPT plan as shown in Figure 2 (below).

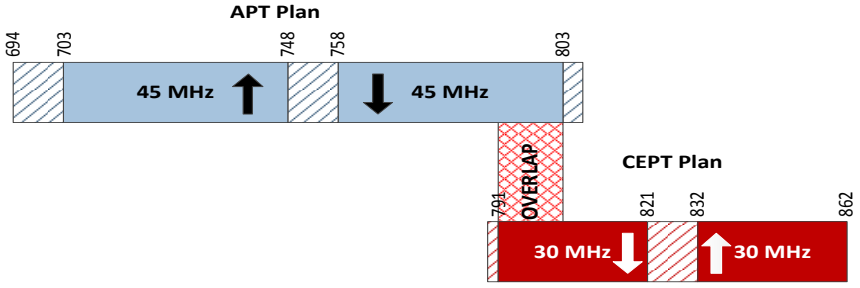

Figure 2 Overlap between the APT Plan in the 700 MHz Band and the CEPT Plan in the 800 MHz Band (Egypt 2012)

Similarly, adopting the CEPT plan in full would contradict with the CDMA or GSM plans in the 850 MHz band that is used by many countries in Africa, and using the CDMA 850 or GSM 850 band plans in their entirety would contradict with the plan of the 900 MHz band that is used for systems such as GSM900. Figure 3 (below) shows the different frequency arrangements in the 700 MHz, 800 MHz, 850 MHz and 900 MHz bands.

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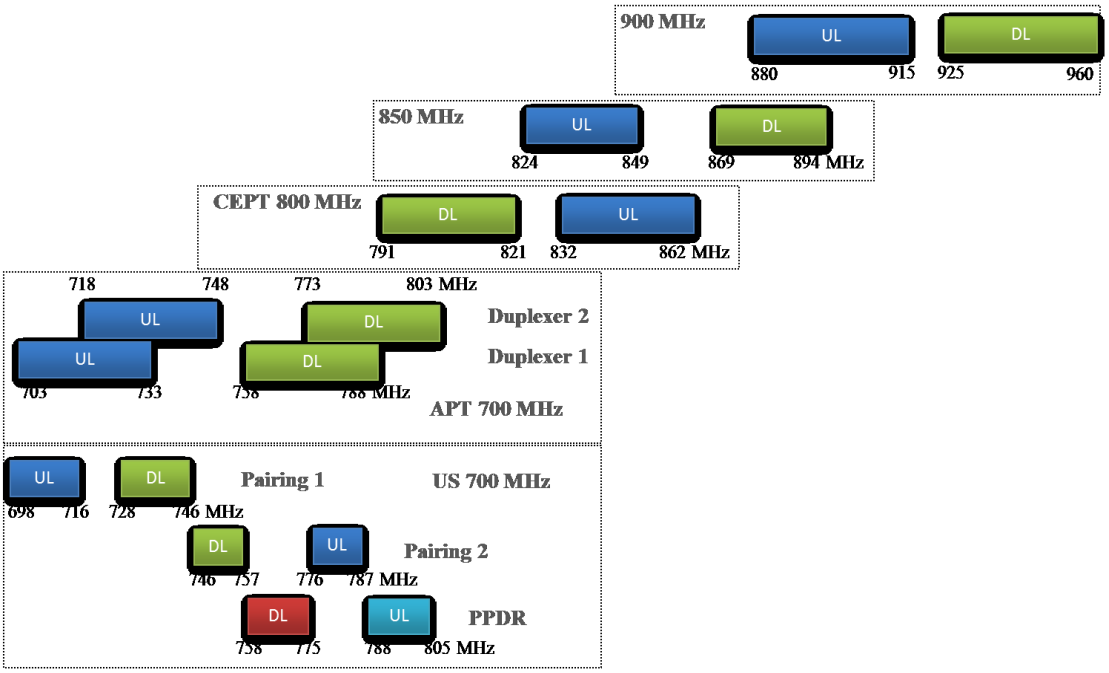

Figure 3 - Frequency Arrangements in the 700 MHz, 800 MHz, 850 MHz, 900 MHz Bands (Rancy, 2012)

Having said that, harmonisation between the CEPT 800 MHz plan and the APT 700 MHz plan is possible by adopting the lower duplex of the APT plan of the bands, 703-733 MHz and 758-788 MHz as shown in Figure 4. This implies that end user equipment can operate according to the APT plan in the 700 MHz band in the Asian countries while being able to roam in Europe on the 800 MHz band using the CEPT plan.

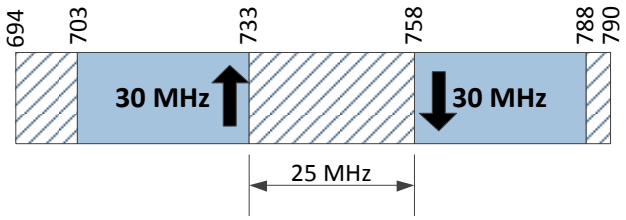

Figure 4 - Using the Lower Duplexer of the APT Plan (Egypt, 2012)

The issue of the preferred frequency arrangements in the 700 MHz in Region 1 was discussed extensively in the WP 5D following WRC-12 where there were 14 different proposed frequency arrangements that were fully or partially harmonised with the APT plan (Migwalla 2013). This indicates that harmonisation with the APT plan was more or less a common target in order to reap the benefits of economies of scale. In particular, at the beginning of the discussions, several African countries wanted to make the maximum use of the 700 MHz band by utilising most of the APT plan (e.g., 2x40 MHz), if not all (2x45 MHz), even if that would be on the cost of losing harmonisation with the CEPT plan in the 800 MHz band (Egypt 2013; Kenya 2014).

Meanwhile, CEPT countries made a proposal indicating their interest in a channelling arrangement for IMT in the 694-790 MHz band which consists of 2x30 MHz at the lower edge of the APT plan in addition to up to 20 MHz (738-758 MHz) for supplemental downlink (United Kingdom 2014). Eventually, it was agreed that channelling arrangements would consist of a common baseline arrangement: 2x30 MHz FDD (uplink: 703-733 MHz, and downlink: 758-788 MHz), which is the lower duplexer of the APT plan in the 700 MHz band

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(Working Party 5D 2014). Outside of the ITU, several countries announced that will adopt the lower duplex of the APT plan (Bateson 2013b; Youell 2014).

Out of Band Emission Values

The second issue that was discussed following WRC-12 is the OOBE values of the mobile service terminals in the band below the frequency 694 MHz, which are required for the protection of the broadcasting service. The issue with the OOBE values is that a too stringent OOBE limit would make it more technically challenging for IMT end user devices to meet them without further design complexity and cost increases. On the contrary, a less stringent OOBE limit may imply additional measures to protect the broadcasting service operating below 694 MHz such as filters on the broadcasting receivers (ITU-R 2014).

One of the first identified OOBE value in the 700 MHz band was determined in association with the APT plan in 2011 not to exceed -34 dBm/MHz below the frequency 694 MHz which is equivalent to -25 dBm/ 8MHz (APT 2011). Such a value was formally provided to the JTG 4-5-6-7 meeting by the APT (APT 2013). Several African countries and mobile industry entities supported adopting such a value (ECOWAS Administrations plus Cameroon 2013; GSMA 2013; Nokia Corporation 2013, 2014).

During the discussion, several Arab and African countries made a significant step, which was perhaps the first of its kind, by conducting detailed technical studies themselves to support their arguments. More specifically, five African countries conducted Monte Carlo simulations and provided evidence that for the urban environment, IMT OOBE value of -25 dBm/8 MHz represents an appropriate regulatory limit (Cameroon, Kenya, Lesotho, South Africa & Zimbabwe 2013). Similarly, five Arab countries made another contributions indicating the same result in terms of OOBE value (Bahrain, Egypt, Qatar, Kuwait & Emirates 2013).

Subsequently, perhaps for the first time in the history of the ITU-R, 30 African countries presented common proposals to a study group meeting. These 30 African countries proposed that a OOBE limit of –25 dBm/8MHz to be adopted as a suitable value for the protection of broadcasting service (Angola et al. 2014). On the other hand, some European broadcasters suggested OOBE values in the range -47 dBm/8 MHz to -52 dBm/8 MHz (Broadcast Networks Europe, 2014), and Russia made a proposal to establish OOBE limits not higher than -52 dBm/8 MHz, or -56 dBm/8 MHz (better), with a guard band not less than 9 MHz (Russian Federation 2014).

There was also a proposal to draft an ITU-R recommendation on the suitable values of OOBE. After extensive discussion, the draft recommendation accommodated that the OOBE of an IMT mobile station operating in Region 1 in the frequency band 703-733 MHz with an IMT channel bandwidth greater than 10 MHz should not exceed -25 dBm/8 MHz into the frequency band 470-694 MHz and that OOBE of an IMT mobile station operating in Region 1 in the frequency band 703-733 MHz with an IMT channel bandwidth of 10 MHz or less should not exceed -42 dBm/8 MHz into the frequency band 470-694 MHz (Chairman ITU-R Joint Task Group 4-5-6-7 2014). This means that CEPT countries could achieve the -42 dBm/ 8MHz value by limiting the use of larger channel than 10 MHz to frequencies higher than 713 MHz. In fact, the -42 dBm/8 MHz value was a political compromise within CEPT with the European broadcasters to provide further protection for their systems (Youell 2015).

It should be noted that the variance in the OOBE values is related to different factors. Firstly, countries that require lower values of OOBE tend to have extra protection to their services below 694 MHz (e.g., broadcasting). On the other hand, countries which plan to deploy mobile services in the 700 MHz band require higher values of OOBE to have less complexity for the mobile terminals operating in the band. Secondly, even for the countries that require lower or higher OOBE values, technical assumptions and models of simulations largely affect requirements for OOBE values.

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While most of the ITU-R countries attending the meetings supported such a recommendation, due to the opposition of a few countries, the recommendation could not be agreed. In particular, there were two views. The first view was that the recommendation was mature and should be adopted and approved. On the other hand, Russia and Iran had the view that the draft recommendation was not mature enough to be agreed. Eventually, the OOBE recommendation was approved in the Radio Assembly of 2015 (RA-15) with some changes to indicate that these OOBE values would facilitate protection of the broadcasting service in the lower UHF band (470-694 MHz) rather than directly protect it (ITU-R 2015).

Policy Implications

The 700 MHz mobile allocation issue has raised a lot of issues that need further examination. Firstly, it seems that the APT plan adopted in Region 3 did have an influence on the discussion on the 700 MHz mobile allocation in the other ITU-R regions. More specifically, the interviews with the main stakeholders revealed that although the European countries were initially against the 700 MHz mobile allocation during WRC-12 because the issue is not on the agenda of the conference and that the band is heavily used by other services especially broadcasting (El Moghazi et al. 2015). However, eventually they agreed to the allocation considering that the Arab and African countries may align themselves solely to the Asian APT band plan. If this occurred, the manufacturing industry in Europe would be the loser.

As further explained by one interviewee from an Arab country, the European countries were not ready at the WRC-12 in terms of having a suitable frequency arrangement. More specifically, APT and the US already had their frequency arrangements developed in the 700 MHz band. Moreover, adopting the APT band plan was perceived as being much more efficient in terms of lowering the cost and achieving roaming. A statement made by an interviewee conveys this current reality "*much of Africa and Middle East has probably more aligned East to West (Regions 2 and 3) rather than North and South*".

Furthermore, one senior interviewee from the APT region explained that the APT wants to be in line with other regions as much as possible and this is the reason why the APT was keen that other countries from other regions follow their 700 MHz channel arrangements. One other interviewee from APT explained that APT managed to develop a plan and there was interest in gaining momentum behind it. In particular, the Asian manufactures had a special interest in gaining market share in the Arab and African countries.

Meanwhile, several interviewees indicated that some non-European countries, including the African and Arab ones, which were interested in the 700 MHz band allocation, were also keen to have the European countries agreeing to the allocation. More specifically, although the African and Arab countries intended initially to have an immediate allocation even in their own territories, they also wanted the European countries to join the allocation in order to have a regional allocation for all Region 1 countries.

However, at the WRC-15 the European countries would be prepared and have their frequency arrangements in the 700 MHz band agreed. In fact, this is one of the reasons why the European countries requested to have the allocation activated by the time of WRC-15 and not immediately in WRC-12. In particular, one interviewee from CEPT explained that if the Asian, African and Arab countries were interested in that band, Europe would not miss the chance of having cheap handsets imported from Asia. One other interviewee from CITEL commented on the frequency arrangements proposed by the US and how it was expected that, at least, Canada and Mexico would follow the US to achieve economies of scales. However, Mexico, despite incredible pressure from the US government, decided to adopt the APT plan. One other senior interviewee from the US clarified that the US frequency arrangements originated from politicians rather than engineers. In fact, this highlighted the emerging importance of regionally coordinating spectrum management plans before applying them at the national level even in the case of large countries like the US.

http://doi.org/10.18080/ajtde.v4n3.56

The second issue that is worth examination is the role of geographical isolated countries such as Australia and New Zealand in the APT in leading the discussions in Region 3. Firstly, the APT plan emerged when New Zealand led several Asian countries to harmonise a frequency arrangement in the 700 MHz band. New Zealand was motivated by having its analogue TV services in the VHF bands, which made re-farming the use of part of the UHF band for the mobile service relatively easier (Newlands 2010a). In particular, the beginning was when the Australian Communications and Media Authority (ACMA) sought views on the best possible plan for the digital dividend in Australia and Telstra and Telecom New Zealand made a joint proposal that was endorsed later on by APT and ACMA (Vanston, 2013). In fact, Australia was motivated by having a harmonised band plan in the 700 MHz with the Asian countries to achieve economies of scales (Newlands 2010b).

Additionally, Australia was the first to have assignment in the 700 MHz in line with the APT plan (Bateson, 2013a) and the first to have a live network in the band via Telstra (Ericsson 2014). Furthermore, not only were the Arab and African proposals regarding OOBE values influenced by the APT decision on such values but also by the practical implementation in the APT region. For instance, in a regional African meeting, Egypt made a proposal to continue supporting the OOBE value of -25dBm/8MHz as a baseline for Region 1 considering the successful implementation of these values in Australia (NTRA of Egypt 2014). Similarly, Australia reported to the JTG meetings its practical experience in deploying the APT plan in the 700 MHz band (Australia 2013).

The third issue that needs close examination is the decision-making procedures of the ITU-R. More specifically, the discussions in the ITU-R are based on consensus, which means that it is possible for a few countries to block the discussion until they have their views included. In practice this is what happened regarding the ITU-R recommendation on OOBE. While the recommendation had the support of several African, Arab and European countries, it was not possible to obtain agreement regarding the recommendation during the ITU-R meetings.

In fact, consensus is related to one of the most important concepts in the telecom industry: harmonisation. If consensus is not possible, each group of countries would have their own solutions and economies of scales would not be achieved. However, consensus has the drawback of countries blocking the discussion even on the basis of linking the issue to other issues. What could be concluded on this issue is that countries are not totally independent in their decision-making when it comes to international spectrum management. In particular, while each country is sovereign in their territories regarding spectrum use, countries need the other countries agreement in order to have a regional or global harmonised use of spectrum. Otherwise, in most cases, countries do not have the scale to act alone in the telecom industry, and even if they have the scale, they still need their citizens to be able to roam in other countries

Consensus is also related to the concept of mutual interests, on which the international telecommunication regime is based. Zacher (1996) explains that the creation and durability of international regimes is based on the existence of important mutual interests in cooperation. The concept of mutual interest was quite evident in the issues of OOBE where the African and Arab countries intended to reach a win-win situation with the European countries, as having different OOBE values for each group of countries will increase the prices of the user terminals and make them more complicated.

Having said that, it could be argued that the ITU-R decision-making procedures do not enable a particular group of countries to impose their views on others, and it encourages the ITU-R countries to reach a compromise. Such a compromise could imply that all participants are equally happy and unhappy. This is the reason why voting has rarely been used in the ITU-R. Meanwhile, the decision-making procedures could be considered as a double-edged sword due to the capabilities of few countries to block the whole discussion. In such a case, these few countries could state their reservations in the final agreed documents or they could largely delay or even stop reaching a common agreement (such as approving an ITU-R

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recommendation). However, in practice, this rarely occurs, and countries may adopt different plans nationally than those agreed by the ITU-R while not causing interference to their neighbours. Such an issue may call for revising the WRC decision-making procedures to have more active role of the ITU-R BR to make sure that the discussion is purely technical.

The fourth issue that needs highlighting is the three regions system. In particular, while the 700 MHz mobile allocation discussion in the ITU-R was considered as a Region 1 issue, several entities from Regions 2 and 3 were involved. Firstly, Iran, a Region 3 country, as part of GE-06 plan, which covers Region 1 in addition to Iran, was interested in the discussion. In particular, while most of the region's countries (Arab, African, European) were keen to have the mobile allocation, Iran was more concerned with the protection of their terrestrial broadcasting service in the 700 MHz from the deployment of mobile in neighbouring Region 1 countries. Therefore, it could have been more convenient to have Iran as part of Region 1 instead of having this historical division between Regions 1 and 3 that is geographically unexplained.

In fact, the situation of Iran is complicated as explained by one of the interviewees. On the one hand, Iran is part of Region 3, which has already a mobile allocation in the 700 MHz band. On the other hand, Iran is also against having mobile allocation in the 700 MHz band in Region 1 unless its broadcasting service is fully protected. In other words, although the 700 MHz allocation in Region 1 should be a Region 1 decision, a country from Region 3 is involved in the discussion. One other issue that was raised is related to Russia, which is far away geographically from Africa and is still able to oppose decisions related to service allocation in Africa. As stated by one of the interviewees from Africa "*we are on the other side of the earth, we can't cause interference to the Russians*".

In general, it is argued that the three regions system does not accurately reflect the geographical situation where countries in Region 1 are quite close to countries in Region 3, and Region 1 accommodates different interests between countries in different stages of development. There is, therefore, a need for the ITU-R to revisit its current three region allocation. One possible way forward would be to divide both Regions 1 and 2 into two, while another would be to create six regions to reflect the six regional spectrum management organisations.

Conclusions

The main adopted band plan in the 700 MHz band is the APT one which provides 2x45 MHz for FDD operation of broadband systems but overlaps with the CEPT plan in the 800 MHz. While the African and Arab countries intended to follow the WRC-12 to fully harmonise with the APT plan, it was eventually agreed to partially harmonise with the APT plan by the adopting the lower duplex of it.

One of the first identified OOBE value in the 700 MHz was determined in association with the APT plan in 2011 to be not exceeding -34 dBm/MHz below the frequency 694 MHz. While the Arab and African countries supported the APT value, other countries and broadcasters suggested more stringent values. Eventually, the ITU-R recommendation on the OOBE values was agreed due to the support from most of Region 1 countries although it was met with resistance from a few countries.

The 700 MHz mobile allocation issue has shown that there is a tendency of African and Arab countries and the Latin American countries to align with the Asian market in instead of with the European and American ones respectively, largely to lower the cost of the end user equipment. In addition, it is shown how geographical isolated countries such as Australia and New Zealand have influence over the other countries in their region and even on countries located in other ITU regions.

The examination of the decision making procedures in the light of the 700 MHz discussion has revealed that although the countries are sovereign in their territories regarding spectrum

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use, they is still a need for the others countries in order to have a regional or global harmonised use of spectrum. Therefore, discussions in the ITU-R are mostly based upon consensus. Moreover, having this conflict of interest during the 700 MHz discussions between countries in different ITU-R regions raised a big question mark regarding the current ITU-R three regions system. In general, this paper has argued that, in this era of globalisation, it is not beneficial for a country or a group of countries to act separately from the rest of the world even if they could.

References

Angola (Republic of); Benin (Republic of); Botswana (Republic of); Burkina Faso; Burundi (Republic of); Cameroun (Republic of); Zimbabwe (Republic. (2014). *Modelling of Potential Interference from IMT Uplink to Fixed Rooftop Digital Terrestrial Receivers*. Paper presented at the Meeting of Fifth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

APT. (2009). *UHF Band Usage and Considerations for Realizing the UHF Digital Dividend*. Paper presented at the The 7th APT Wireless Forum Meeting, Phuket.

APT. (2010). *APT Report on Harmonized Frequency Arrangements for the Band 698-806 MHz*. Paper presented at the 9th APT Wireless Forum Meeting, Seoul.

APT. (2011). *APT Report on Implementation Issues Associated with Use of the Band 698-806 MHz by Mobile Service*. Paper presented at the 11th APT Wireless Forum Meeting, Chiang Mai.

APT. (2013). *Liaison Statement to ITU-R Joint Task Group 4-5-6-7 - Study of IMT User Equipment (UE) Out-of-Band (OoB) Emission Limits and Associated Implementation Issues with the Use of the Band 698-806 MHz* Paper presented at the Meeting of Fourth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

Australia. (2013). *Studies on Frequency Related Matters for IMT and Other Terrestrial Mobile Broadband Applications. Technical and Regulatory Framework in Australia to Protect Digital Terrestrial Television Broadcasting below 694 MHz*. Paper presented at the Third Meeting of the Joint Task Group 4-5-6-7, East London. www.itu.int

Bahrain (Kingdom of); Egypt (Arab Republic of); Qatar (State of); Kuwait (State of); Emirates, United Arab. (2013). *Compatibitility between the Mobile Service in the Band 694-790 MHz and the Broadcasting Service Operating below 694 MHz*. Paper presented at the Fourth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

Bateson, Ross. (2013a). Brazil Looks Set to Adopt APT 700 MHz Band Plan. *PolicyTracker*. Retrieved from PolicyTracker website: https://www.policytracker.com

Bateson, Ross. (2013b). UAE Adopts Hybrid Solution for 700 and 800 MHz Bands. *PolicyTracker*. Retrieved from PolicyTracker website: https://www.policytracker.com

Bateson, Ross. (2014). Analysis: Chilean 700 MHz Auction Provides First Step in South America. *PolicyTracker*. Retrieved from PolicyTracker website: https://www.policytracker.com

Broadcast Networks Europe. (2014). *IMT UE OOB Emissions Required to Protect DTTB Reception*. Paper presented at the Meeting of Fifth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

Bryman, A., & Bell, E. (2007). *Business research methods*. New York: Oxford University Press.

http://doi.org/10.18080/ajtde.v4n3.56

Cameroon (Republic of); Kenya (Republic of); Lesotho (Kingdom of); South Africa (Republic of); Zimbabwe (Republic of). (2013). *Application of Monte Carlo Statistical Analysis for the Assessment of IMT Uplink Interference into Fixed Rooftop Digital Terrestrial Television Receivers*. Paper presented at the Fourth Meeting of Joint Task Group 4-5-6-7; Geneva. www.itu.int.

Chairman ITU-R Joint Task Group 4-5-6-7. (2014). *Executive Report to Study Groups 5 and 6 on the Work of Joint Task Group 4-5-6-7*. Paper presented at the Meeting of Study Group 5, Geneva. www.itu.int.

CITEL. (2011). *Final Report (Item on the Agenda: 7)*. Paper presented at the CITEL Coordination Meeting San Juan.

Contant, Corinne M; Warren, Jennifer. (2003). The World Radiocommunication Conferences Process: Help or Hindrance to New Satellite Development? *Acta Astronautica, 53*(4).

Cowhey, Peter; Aronson, Jonathan D. (1991). The ITU in Transition. *Telecommunications Policy, 15*(4), 298-310.

Cowhey, Peter (1990). The International Telecommunications Regime: The Political Roots of Regimes for High Technology. *International Organization, 44*(2), 169-199.

ECOWAS Administrations plus Cameroon (Republic of). (2013). *Work on Agenda Item 1.2*. Paper presented at the Third Meeting of the Joint Task Group 4-5-6-7. www.itu.int

Egypt. (2012). *WRC-15 Agenda Item 1.2: Proposals for the Band Plan of the 700 MHz Band for Region 1*. Paper presented at the 14th ITU-R WP 5D meeting, Geneva.

Egypt. (2013). *Proposals Regarding the Frequency Arrangements of the 700 MHz Band*. Paper presented at the 15th ITU-R WP 5D meeting, Geneva.

El-Moghazi, Mohamed; Whalley, Jason; Irvine, James. (2013). *International Spectrum Management Regime: A Case of Regulatory Lock-in for the Developing Countries?* . Paper presented at the CPR Asia / CPR Africa, Mysore.

El-Moghazi, Mohamed; Whalley, Jason; Irvine, James. (2015). *The 700 MHz Mobile Allocation in Africa: Observations from the Battlefield*. Paper presented at the CPR Asia / CPR Africa, Taiwan.

Ericsson. (2014). Telstra and Ericsson Complete “World First” Live Test of APT 700 MHz Band

Gregg, D. C. (2009). Lessons Learned from the Spectrum Wars: Views on the United States’ Effort Going Into and Coming Out of a World Radiocommunication Conference. *CommLaw Conspectus: Journal of Communications Law and Policy*, 17

GSMA. (2013). *Modelling of Potential Interference from IMT Uplink to DTT;* Paper presented at the Meeting of Fourth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

ITU-R. (2007). *Article 5: Frequency Allocations*.

ITU-R. (2008). Article 5: Frequency Allocations *Radio Regulations* (Vol. 1).

ITU-R. (2012a). ITU-R Recommendation M.1036-4: Frequency Arrangements for Implementation of the Terrestrial Component of International Mobile Telecommunications (IMT) in the Bands Identified for IMT in the Radio Regulations (RR) *M Series. Mobile, Radiodetermination Amateur and Related Satellite Services*.

ITU-R. (2012b). WRC-12 Resolution 232. Use of the Frequency 694-790 MHz by the Mobile, Except Aeronautical Mobile, Service in Region 1 and Related Studies. *Provisional Final Acts - World Radiocommunication Conference (WRC-12)*.

http://doi.org/10.18080/ajtde.v4n3.56

ITU-R. (2014). *CPM Report on Technical, Operational and Regulatory/Procedural Matters to be Considered by the 2015 World Radiocommunication Conference*. Retrieved from www.itu.int.

ITU-R. (2015). *Chairman Ad-Hoc Group Plen 1 (M Series Recommendations). DRAFT NEW RECOMMENDATION ITU R M.[BSMS700]. Specific Unwanted Emission Limit of IMT Mobile Stations Operating in The Frequency Band 694-790 MHz to Facilitate Protection of Existing Services in Region 1 in the Frequency Band 470-694 MHz*. Paper presented at the Resolutions Radiocommunication Assembly (RA-15), Geneva. www.itu.int

ITU. (2006). Article 1: Definitions *Final Acts of the Regional Radiocommunication Conference for Planning of the Digital Terrestrial Broadcasting Service in Parts of Regions 1 and 3, in the Frequency Bands 174-230 MHz and 470-862 MHz (RRC-06)*.

Kenya (Republic of). (2014). *Channeling Arrangement for the 694-790 MHz for Agenda Item 1.2*. Paper presented at the 19th ITU-R WP 5D meeting, Halifax.

Krasner, Steven. (1982). Structural Causes and Regime Consequences: Regimes as Intervening Variables. *International Orginzation, 36*(2).

Meyer, Christine Benedichte. (2001). A Case in Case Study Methodology. *Field Methods, 13*(4), 329-352.

Migwalla, Elizabeth. (2013). *Regional Harmonisation and Channelling Arrangements for Band 694-790 MHz*. Paper presented at the 9th Spectrum Management Workshop in Africa, Kampala.

Newlands, Michael. (2010a). Asia Pac Countries Working on 700 Mhz Band Harmonisation *PolicyTracker.com*. Retrieved from website: https://www.policytracker.com

Newlands, Michael. (2010b). Australia Consults on Digital Dividend *PolicyTracker.com*. Retrieved from website: https://www.policytracker.com

Nokia Corporation. (2013). *Additional OOB Attenuation from LTE UE to Frequencies Used for DTT Broadcasting*. Paper presented at the Fourth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

Nokia Corporation. (2014). *Updated Simulation Results on the DTT Interference Probability at 700 MHz*. Paper presented at the Fifth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

NTRA of Egypt. (2014). *Views on IMT Deployment in the band 694-790 MHz*. Paper presented at the 2nd AfriSWoG Meeting, Nairobi.

Rancy, Francois. (2012). *Harmonisation of Digital Dividend Bands: Current Work*. Paper presented at the 2nd ATU Digital Migration and Spectrum Policy Summit, Accra.

Russian Federation. (2014). *Definition of Out-of-Emission Limit for Mobile Service Users Equipment under the Agenda Item 1.2*. Paper presented at the Meeting of Sixth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

Saunders, M; Lewis, P; Thornhill, A. (2009). *Research Methods for Business Students (5th edn.)*: Pearson Education Limited.

Standeford, Dugie. (2012a). FCC Moves to Unleash 700 MHz, 2 GHz Spectrum. *PolicyTracker*. Retrieved from: https://www.policytracker.com

Standeford, Dugie. (2012b). Mobile Broadband Tops Arab Countries' Agenda for WRC-12. *PolicyTracker.com*. Retrieved from website: https://www.policytracker.com

Standeford, Dugie. (2012c). WRC Agrees on Several Items but Mobile Broadband Issues Remain Unresolved. *PolicyTracker.com*. Retrieved from : https://www.policytracker.com

http://doi.org/10.18080/ajtde.v4n3.56

Stirling, Andrew. (2012). Africa is Pushing Ahead in the Race for 700 MHz. *International Journal of Digital Television, 3*(3).

United Kingdom of Great Britain and Northern Ireland. (2014). *Channeling Arrangement for the 694-790 MHz Band*. Paper presented at the 19th ITU-R WP 5D meeting, Halifax.

Vanston, Mark. (2013). Asia Pacific Telecommunity (APT) 700 MHz Whitepaper Telstra.

Working Party 5D. (2014). *Liaison Statement to Joint Task Group 4-5-6-7: Channeling Arrangements for 694-790 MHz for Agenda Item 1.2*. Paper presented at the Meeting of Sixth Meeting of Joint Task Group 4-5-6-7, Geneva. www.itu.int.

Youell, Toby. (2014). ECC Agrees on (Mostly) Harmonised 700 MHz Band Plan. *PolicyTracker*. Retrieved from: https://www.policytracker.com

Youell, Toby. (2015). Russia Has Doubts about 700 MHz Band OOBE Limits. *PolicyTracker*. Retrieved from: https://www.policytracker.com

Young, Oran R. (1982). Regime Dynamics: The Rise and Fall of International Regimes. *International Organization, 36*(2), 277-297.

Zacher, Mark W. (1996). *Governing Global Networks: International Regimes for Transportation and Communications*: Cambridge University Press.

Zehle, Stefan. (2013). The APT Band Plan, A Brief Introduction. Coleago Consulting Ltd.

Endnotes

[1] Decisions related to international spectrum allocation are taken during ITU-R WRCs.

[2] Out-of-band emission is emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process.

[3]The world is divided in terms of radiocommunication service allocation into three regions, where Region 1 comprises Europe, Africa, the Middle East west of the Persian Gulf including Iraq, the former Soviet Union and Mongolia. Region 2 covers the Americas, Greenland and some of the eastern Pacific Islands. Region 3 contains most of non-former-Soviet-Union Asia, east of and including Iran, and most of Oceania (ITU-R 2008).

[4]Young (1982) defines regimes as social institutions governing the actions of those interested in specifiable activities and international regimes as regimes pertaining to activities of interest to members of the international system.

[5]Regimes can be defined as sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations (Krasner 1982; Zacher 1996).

[6] The name of the group indicates the cooperation between four main study groups (SGs) in the ITU-R: SG 4 (satellite services), SG 5 (mobile services), SG 6 (broadcasting services), and SG 7 (science services).

[7] In FDD, the uplink and the downlink use a different frequency. In TDD, they use the same frequencies.

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Conceptualising the Australian telecommunications industry self-regulation scheme in the context of Australian judicial system and administrative justice

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Abstract: The public ombudsman plays an irreplaceable role as an important redress mechanism for individual grievances and as a "watch dog" to administrative justice.

Since the 1980s, private sector ombudsmen have emerged and proliferated. This rapid development has resulted in some significant controversies. Unfortunately, many of these controversies have not been sufficiently addressed to date. By analysing the Telecommunications Industry Ombudsman (TIO) as a case study, this article seeks to examine the nature of the private sector ombudsmen and its changing position in relation to administrative justice. Here, the key claim is that the TIO is substituting courts with respect to consumer matters arising from its service sector. Stemming from this claim, this article further argues that the current TIO scheme presents an inappropriate and unreliable situation where the private sector ombudsmen may provide differing rights and remedies from those available in the Courts. Furthermore, consistency in decision-making by private sector ombudsmen can be problematic, and fair procedure requirements remain untested by the courts. In order to resolve these issues, private sector ombudsmen, like the TIO, should be subject to a closer monitoring process. As a preliminary measure, an authoritative and standardised quality control assurance mechanism should be established to ensure that consumer complaints are effectively received and fairly handled.

Keywords: Telecommunications industry ombudsman, the TIO, public ombudsman, industry consumer dispute resolution.

Introduction

An ombudsman, as a distinctive method of alternative dispute resolution, has been widely adopted in the public sector of many countries (Commonwealth Ombudsman 2015a). The original function of the public ombudsman was to provide a redress to the grievance of citizens. However, over the years this role has been expanded to provide a forum for settling disputes by allocating a financial reward to the winning party. In the 1980s this shift became

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particularly prevalent with the development of industry self-regulation schemes in the private sector, signifying the beginning of the growth of private sector ombudsmen.

The tangible transplantation of industry-specific private sector ombudsmen initially commenced in key industries that were privatised from former state-owned businesses, such as banking, insurance and utilities. An illustrative example of the application of the public ombudsman into the private sphere is the world's first private sector ombudsman, the Insurance Ombudsman Bureau (IOB) in the United Kingdom, established in 1981. Birds and Graham (1988) while stressing the paucity of evidence, have argued that the IOB was founded on the intention of the owners of IOB to deter statutory intervention. Despite attracting criticism, the IOB became the inspiration and a model for a variety of private ombudsmen schemes worldwide (Tyldesley 2003).

The adoption of ombudsmen schemes has become pervasive in the private sector, but not without controversy. Johnson describes private sector ombudsmen as a cynical exercise, where ombudsmen become a substitute for structural reform in the operation of industry (Gill 2014). Similarly, Morris (1987) asserts, 'ombudsmen are destined to become permanent features in the private sector and indeed, at least in crude quantitative term, could eventually supplant the legal process as the primary form for the formal and informal resolution of disputes between business enterprise and consumers…'

Notwithstanding prolonged focus on the fundamental issues that these controversies expose, including the legal standing of the private ombudsmen in the judicial system and concerns over fair procedure, many of these issues remain unsettled after more than thirty years since the establishment of the IOB. Indeed, the principal aim of this paper is to contribute to the relatively under-represented body of research produced by Australian academics in the area of ombudsmen practice. Furthermore, this paper argues that the development of ombudsmen practice is progressive, in which the impact of earlier schemes was limited by the voluntary basis of their adoption.

The current landscape has changed considerably from the early days. Private sector ombudsmen have been established in almost all key service sectors throughout the world, including in Australia. Nowadays, there is a large number of private sector ombudsmen acting as statutory-based compulsory schemes – mandating firms to participate. Through the ubiquity of private sector ombudsmen schemes consumers have become better-informed about the number of services provided by the ombudsman.

Private sector ombudsmen schemes have been applied in different forms across various industries, resulting in multiple, differing processes for complaint handling. Therefore, it is beyond the scope of this paper to identify '*a*' particular preferred institutional model of the

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private ombudsman. Rather, this paper uses the Australian Telecommunication Industry Ombudsman (TIO) as a case study in order to reflect the broader issues and possibilities produced by the application of ombudsmen schemes into the private sector. This methodology not only provides a manageable scale of research but also presents an opportunity to provide direct benefits to the scheme studied.

The Australian telecommunications industry exemplifies both the proliferation of statutory-based compulsory ombudsmen schemes in the private sector and the reasonably high level of consumer engagement with the schemes. In 2015, the number of mobile services operating in Australia was 31.77 million (Australian Communications and Media Authority 2015) while the total population in the same year was approximately 23 million (Australian Bureau of Statistics 2015). These figures indicate that the entire Australian population are telecommunication consumers, with many operating more than one device and purchasing services from more than one provider. These statistics reflect the significance of having an effective redress scheme in this service sector. Additionally, these figures demonstrate the critical impact that a redress scheme can have on people's daily lives. Beyond the telecommunications industry, many other sectors can have a substantial impact on consumers and firms, such as in banking and utilities. It is therefore vital to have well considered industry schemes that are capable of delivering fair outcomes.

In summary, the research inquiry present in this paper is to study whether private sector ombudsmen, like the TIO, perform a similar role as the traditional public ombudsmen. If not, the objective is to understand what the legal standing of the private sector ombudsman is in the judicial system and the administrative structure. In order to do so, **Part One** of this paper provides context for later discussion as a background to the rise of private sector ombudsmen so as to situate the Australian experience within global trends. **Part Two** examines the processes and practices of the TIO in detail, while **Part Three** establishes the key claim that the TIO is operating as a substitute to the judicial system on consumer matters arising from this service sector. Stemming from this key claim, **Part Four** explores five related aspects of the TIO's decision making process, including the TIO's power to expand its jurisdiction; consistency of decision making; procedure fairness within an informal forum; and problems with using the term 'ombudsman' as its name. Finally, **Part Five** concludes by summarising the findings from previous sections and making suggestions for moving forward.

Context

The intensification of industry self-regulation has presented many different regulatory forms ranging from a single industry code of practice to more sophisticated dispute resolution

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schemes, such as an industry specific ombudsman scheme (Gunningham & Rees 1997). In the 1980s, the trend of industry self-regulation occurred within a context whereby 'the corporation' was increasingly becoming and being understood as an object of protection in Western capitalist societies. The past thirty years have witnessed a surge in self-regulatory regimes in the United States, Europe, and other advanced economies including Australia (Kagan 1982). In particular, industry self-regulation grew out of the understanding that firms will voluntarily make agreements that lead to the 'socially optimal resource allocation and output mix' in order to avoid negative impacts on consumers and society, and to improve their marginal costs (Coase 1960: p.96). Indeed, whenever problems of 'negative externalities' such as pollution or systemic risk in unregulated finance, are perceived to be not just limited to the practices of a single firm but rather endemic to an industry, concerted action is necessary. Many industries today engage in various acts of self-regulation, with which they claim to contribute to the mitigation of the respective problems that their industry creates (Flohr et al 2010). Few industries remain disengaged in organising around a formally established framework that sets self-prescribed standards for ethical conduct within their industry (Sammeck 2012).

The shift in regulatory bodies from a public ombudsman to industry specific self-regulation schemes developed alongside the privatisation of publicly- owned services. At the time of widespread privatisation, a common feature involved an independent ombudsman acting as a referee or a sort of backstop when internal complaints procedures in private industry firms failed. Many of these early schemes were purely voluntary, while others had a statutory basis. The schemes were usually free and decisions were binding on the firm rather than the consumer. Broadly, the ombudsman scheme is characterised by a tiered approach with an initial assessment stage to determine the eligibility of the complaints. If a complaint meets the eligibility criteria it is forwarded to the conciliation process and then to the final determination stage.

The TIO

The TIO was established in 1993 when competition was first introduced to the telecommunications industry in Australia. The TIO was recognised under the *Telecommunications Act 1991* (Cth) which mandated the creation of an organisation to handle telecommunication services related complaints, and that such an organisation should be independent of the industry, the government and customer organisations. The TIO scheme is exclusively funded by industry and its services are provided free of charge for consumers (TIO 2015e).

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The TIO's complaint process starts with consumers filing complaints with the TIO after their attempts to solve the matter directly with the individual service provider fail. To enliven the TIO's jurisdiction a complaint must be about a matter less than two years old (six years old in some cases) (TIO 2014b). Furthermore, the extent of the TIO's authority to resolve complaints is up to the value of $50, 0000. These resolutions are binding on the providers if accepted by the complainant. Additionally, the TIO can also make recommendations to the complainant's telecommunications provider up to the value of $100,000, although the provider is not obliged to accept the recommendation. (TIO 2015i). In dealing with complaints, the TIO primarily gives regard to relevant laws, good practice, and what are fair and reasonable working principles (TIO 2015d). Additionally, the TIO considers industry dispute benchmarks as a factor in finalising decisions (TIO 2015a).

As a primary forum of individual telecommunications consumer dispute resolution, the TIO has received a large numbers of complaints over the years (TIO 2015c). Between 2014 and 2015, the TIO received 124,417 complaints (TIO 2015j). The TIO assists providers and the industry more broadly in the improvement of the provision telecommunication services by identifying, investigating and monitoring systemic issues in the sector, in order to make recommendations to the service providers (TIO 2015a).

The TIO operates independently with no formal relationship to the industry, consumers, regulators, the judiciary or the administration. The TIO's decisions may be appealed on points of law to the court. The decisions of the ombudsman are based on a number of factors, including relevant laws, the terms of the contract and industry codes, as well as what is fair and reasonable in all the circumstances of the case (TIO 2015f). Thus the TIO has greater flexibility and discretion to apply fair rulings that are not necessarily based on precedent than that of the court. The complainants are able to register complaints via the phone or the internet and have their claims processed without the oftentimes laborious or time consuming paperwork and the risk of costly representation fees involved in attending court. In other words, by operating outside the court system, the TIO is able to approach dispute resolution in a way that abates some of the criticisms often leveled at the court and of the judges.

The TIO process of deciding on a complaint encompasses many distinctive features that differ from the court system. For instance, in the process of making decisions, the TIO are able to consult with the disputing parties and all other relevant persons, which is indicative of an 'inquisitorial power' absent from Australian judges. The TIO is not obligated to follow "*the established laws*", rather the TIO makes its own decisions and enacts changes at any given time as it is not bound by the "*precedent*". The TIO may resolve disputes by making decisions based on only written evidence and/or verbal conversations over the phone. No

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physical presence at a hearing is required and the TIO freely decides on whether the evidence is admissible.

The TIO can also pre-empt certain situations based on industry data and best practices, while courts normally refuse to consider hypothetical cases. That is, the TIO may choose to actively intervene to reduce or prevent disputes from arising by identifying systemic issues and communicating these issues with the industry and consumers. For example, in 2011, telecommunications provider Aero Telecom was found by TIO to be misrepresenting its service to consumers and consumers were inadvertently switching providers without realising this until receiving their first bill. TIO contacted Aero Telecom and requested that they modify their company practice to ensure they are receiving informed consent; as a result Aero's sales scripts were amended accordingly and staff were provided with a quality assurance program (TIO 2012).

Additionally, the TIO is able to look consciously at and therefore prioritise public interest considerations, rather than leaving this task to policy makers or established law. TIO works closely with the industry regulator on the consumer-related policy agenda and development. Free consumer access to the TIO encourages service providers to act more effectively in accordance with the industry code than the court system, where consumer access may only become possible with according to a certain level of cost and time.

The TIO provides an effective model in providing a party with a meritorious, substantive complaint redress, including compensation, within a short timeframe. Despite the efficiency of the TIO, the question remains whether a private sector ombudsman, such as the TIO, has legal standing in the judicial system and the administrative structure. To seek the answer the following part examines two parallel relationships: the relationship between the TIO and the court; and the relationship between the public ombudsman and the court. This comparative analysis aims to test the key claim of this paper, that private sector ombudsmen are substituting the judicial system in regards to consumer matters and assess what impact this change has on the consumer, the provider and the industry.

Is the TIO is fundamentally different from the public ombudsman?

To examine the relationships between public ombudsmen, the TIO, the courts and the administration, an important jurisprudence concern must be considered. That is that public sector ombudsmen are not regarded as alternatives to the courts, which sets a critical theoretical position for the assessment of private sector ombudsmen such as the TIO.

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Public Ombudsman vs. the Court

A widely accepted feature of the public ombudsman is that public ombudsmen do not function as substitutes to the courts, but rather as act as part of the administrative process (Nobles 2001; Bames 1993). This important foundation amplifies the legality of the public ombudsman. This paper outlines four key reasons to support this argument.

Firstly, matters dealt with by the public ombudsman are different from matters dealt with by the court. Public ombudsmen largely deal with complaints against bodies that are directly or indirectly subject to democratic accountability. For instance, in Australia, the Commonwealth Ombudsman investigates complaints about the actions and decisions of Australian Government departments and agencies. These investigations can include complaints registered against the quality of service delivered by private contractors hired by the Australian Federal government or the provision of oversight of complaint investigations by the Australian Federal Police. In addition, The Ombudsman can also investigate complaints about delays in processing Freedom of Information requests (FOI) and complaints about FOI charges (Commonwealth Ombudsman 2015b). The States and Territories in Australia also have their own Ombudsman offices with similar jurisdiction as the Commonwealth Ombudsman, except over State and Territory government authorities. All these matters are beyond the scope of the Australian courts.

Secondly, the role of the ombudsman is different from the role of the judge. A public ombudsman is an official, usually (but not always) appointed by the government or Parliament, who is charged with representing the interests of the public by investigating and addressing complaints reported by individual citizens (Commonwealth Ombudsman 2015a). This form of representation is derived from the widely understood imbalance of power between the agencies of government and those in which it governs. In practical terms the role of the public ombudsman is to provide redress for individual grievances and improve the standards of administration (Seneviratne 2002). However, the role of the judge is to act within their capacity as a public official to preside over matters of the law and administer justice.

In theoretical terms, Abraham argues that the public ombudsman "*humanises the state administration*" (Abraham 2008), by "*supervising the administrative activities of the executive*" (Reif 2004). While others have suggested that the public ombudsman also enhances government accountability to the public (Paunio 2009), strengthens the bond of trust between the citizen and the state (Kirkham, Thompson & Buck 2009) and provides a safety net for when public administrations underperform or overreach. Ultimately, as Gilling

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states, "*ombudsmen represent the possibility for ordinary people to bring to account the leviathan of the modern state*" (Gilling 1998).

The concept of the ombudsman as an independent person who is able to investigate and resolve disputes between citizens and the agencies of the government has spread to over 120 countries and is seen to be an essential accountability mechanism in democratic societies. The role of the public ombudsman in redefining the constitutional relationship between public services and the public is as important as ever, given the growing reach of government into every aspect of citizens' lives.

Thirdly, citizens' perception of using public ombudsmen is different from their perception of using the courts. In general, a citizen may register a complaint with a public ombudsman about a particular grievance that may not be necessarily based on legal factors. For example, one can file a complaint with the Postal Industry Ombudsman as a branch of the Commonwealth Ombudsman (as Australia Post is a government-owned agency) about the loss, redirection or damage of post. Many of these forms of complaints are in nature not directly related to the decisions of the public administration. The ombudsman may be able to make recommendations about these types of issues (Australian Administrative Law Policy Guide 2015); however, these types of issues are difficult to present to the courts as "*legal issues*". A party who seeks the aid of an ombudsman does so with an expectation of quick, inexpensive, and confidential counselling as to how to navigate the bureaucracy and red tape facing the party. The ombudsman may intervene for a party who has been frustrated by the system so that the party's needs might be addressed.

Moreover, the legal effect of the public ombudsman's decision is different from the decision of the court. The majority of public ombudsmen make non-binding recommendations rather than legally binding decisions, this is due to the fact that citizens who complain to the public ombudsmen rarely do so because they are seeking to enforce legal rights. Rather, the substance of complaints received by public ombudsmen are typically about the quality, delivery and function of a particular government service as opposed to criminal or civil mistreatment. This seems to be a natural consequence of the development of the public ombudsman as an institution, from the first public ombudsman, the Parliamentary Commissioner for Administration in the United Kingdom, which was regarded as a means of supplementing the work undertaken by Members of Parliament on behalf of aggrieved constituents (Wyatt 1961). Although some citizens' complaints may duplicate matters, which could be the subject of applications for judicial review, they do not usually involve matters that may be the subject of actions in contract (Seneviratne 1994).

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TIO vs. the Court

The use of the term "ombudsman" for both private sector and public ombudsmen creates the impression that they perform similar roles. However, as the following part will illustrate in keeping with the example of the TIO, the public and private sector ombudsmen perform rather different roles and function.

Firstly, *matters dealt with by the TIO are similar to the matters dealt with by the court*. The nature of complaints filed varies based on the particular industry. In the case of the TIO the complaints are overwhelmingly concerned with billing, service provision, and service contracts (TIO 2015g). These matters are private matters between the complainants and the industry members and are well within the jurisdiction of the traditional courts. That is, the complaints filed with the public ombudsman differ greatly from the complaints registered with the TIO.

Secondly, *the role of the private sector ombudsman is similar to the role of the judges*. The TIO has significant decision-making powers with the ability to decide on resolutions of up to the value of $50,000 and recommendations of up to the value of $100,000 (TIO 2015i). The fiscal value of the TIO's resolution is substantially more than the jurisdictional limit of the local court in its Small Claims Division ($10,000), and the fiscal value of the TIO's recommendation matches with the jurisdictional limit of the local court in its General Division ($100,000) (NSW Local Court Act 2007). Comparatively, the public ombudsman does not usually have the power to grant fiscal awards this large.

Thirdly, *the consumers' perception of using private sector ombudsmen is similar to the perception of using the courts*. Complainants using TIO's services seek to have disputed matters redressed and/or financially compensated. Accordingly, the perceptions of the TIO's outcomes are more linked to financial award than the outcome of a matters addressed by the public ombudsman, which is more likely to result in a higher quality service or the resolution of the particular matter at hand. In fact, TIO's 2015 annual report reveals that almost 65 per cent of its recorded outcomes had either only a financial outcome or both a financial and non-financial outcome (TIO 2015c).

Fourthly, *the legal effect of the private ombudsman's decision is different from but comparable to the decision of the court, particularly in that the TIO's resolutions are binding to participating service providers if accepted by the complainants*.

These four distinct comparisons demonstrate key differences between the public ombudsman and private sector ombudsmen in the judicial system. It also recognises a particular resemblance between the private sector ombudsmen and the Courts. That is, both

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the TIO and the Court have the jurisdiction to hear the cases of the type normally presented to the TIO in the form of a complaint The TIO and the court have powers to grant fiscal awards to the winning parties in the dispute. Consumers access the TIO's service to get the matter redressed or compensated and the TIO's decisions are binding to participating firms once accepted by the complainants. Therefore, the function of the TIO has evidently deviated from the traditional public ombudsman service.

Nobles summarises the way in which the previous comparisons have highlighted the expansion of the TIO into the role of substituting the Court, "private sector ombudsmen offer an alternative to the pursuit of remedies through existing courts and tribunals. The use of ombudsmen is no longer limited to the provision of non-legal remedies, that is to grievances for which there is no (or hardly ever) a remedy at law, but the provision of alternative remedies to those available at law' (Nobles 2001). By the same token, Morris and James also argue that: "the second generation of ombudsman (private sector ombudsman) provided a genuine alternative to the courts dealing with cases which the complainant might otherwise have taken to court." (Morris & James 2002). Thus, a key claim of this paper can be justified at this point – as a private sector ombudsman, the TIO performs a fundamentally different role to the traditional public ombudsman, and is in fact substituting the judicial system for consumer matters arising from its service sector.

Five Critical Features Represented in the TIO Model

If the TIO is established as an alternative to the court, as evidence suggests above, several fundamental issues arise in regards to this expansion of the TIO. These issues include but are not exclusive to the following five examined aspects of the TIO's operation as an alternative to the Court.

1. To what extent can the TIO provide different rights and remedies from those that may be available in courts?

When comparing private sector ombudsmen to the Courts, one must consider the role played by the Courts in modifying apparently settled rules of law or specific legal arrangements in accordance with general ideas of justice, fairness and reasonableness. This includes techniques ranging from developing the common law to adopting liberal or restrictive styles of interpretation. As Nobles points out: "*... the question here is thus not whether ideas of fairness may or may not restrict or extend the apparent scope of legal duties, but whether this may or may not be done by someone who is not a judge* (Nobles 2001).

Relating this point to the TIO in the context of the established key claim above, one might wonder who are the people that make real decisions in the TIO? Indeed, are they legally

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trained or do they *need* to be legally trained? These questions, on face value appear simple to answer; however locating answers has been rather difficult.

Firstly, who are the decision-makers in the TIO? For an organisation the size of the TIO, there is surely a complex internal structure in place to resolve the large number of complaints received. The ombudsman would not be the only person to decide on the matters presented. The number of people deciding matters at the TIO is not publicly available. However, the TIO's 2015 annual report indicated that the TIO had a total of 191 employees at that time and the majority of its staff engages in dispute resolution (TIO 2015g). Therefore, the decision making process, unlike in the Court system, is decentralised among many people who may differ in their experience and in their subjective interpretation of what is reasonable and fair in individual cases.

Follow on questions may include – are these decision-makers legally trained? Indeed, should they be legally trained? The answers to these questions are unclear from the TIO's website. Nonetheless, reading the position description of an 'enquiry officer' on TIO's career website indicates that the position does not require possible candidates to have any legal background. Rather, candidates must rather demonstrate experience in customer service, additionally knowledge of the telecommunications industry is desirable. (TIO 2015b). Thus, the TIO's employment policy expresses the view that the 'idea of fairness' raised by Nobles does not need to be administered solely by a judge in the area of telecommunications, but can be delivered by those who have experience in dealing with customer complaints (Nobles 2001).

A previous study on the TIO scheme conducted by Widdowson and Li collected a series of TIO's decisions by inviting submissions (decided cases) from the TIO's members. The findings from examining the TIO's decisions, in that particular project revealed that remedies decided by the TIO could be very different from the possible considerations from a legal point of view (Widdowson & Li 2013).

Therefore, what is at stake here goes beyond the accessibility and convenience of utilising the TIO as opposed to Court. Rather as it is suggested here, the TIO may be providing different rights and remedies than those available in courts and tribunals, which as a matter of structural principle, should be the subject of profound exploration and monitoring.

2. Why can the TIO freely expand its own powers?

Important consideration must also be given to the TIO's capacity to expand its own powers. Currently, the TIO is able to expand its powers at its own discretion. A recent example of this expansion of powers is in regards to the limit of time that a customer has in order to make an

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eligible complaint. TIO extended the time frame significantly, allowing customers to raise complaints about certain circumstances that occurred two years ago (up from the previous limit of one year). This change in TIO policy resulted in an extra 359 consumer complaints than would not have been possible in the previous year (TIO 2014a). The expanded powers followed a series of reviews of the TIO's complaint handling policy, which also included an increased value of fiscal amounts possible for dispute and the adoption of a more flexible approach for defining a small business (TIO 2014a).

Whether or not these power expansions are beneficial is a different issue, but the fact that a private institution, substituting the judicial system, is able to expand its powers at its own discretion certainly creates some real concerns. An important question can be asked on this point – should the current system allow a private dispute settlement scheme with significant powers to further expand its powers and jurisdiction; and if so, what would be the social, economic and constitutional rationale for it? This question becomes more critical when considering that the TIO is the only consumer scheme available in this service sector and that it is compulsory for the service providers to participate. Thus, expanding the jurisdiction of the TIO to further potential complaints might add an unnecessary financial burden to the service sector as a whole.

3. How can the consistency of decisions made by the TIO and the quality of the TIO's decision-making be maintained?

The power to "do justice in an individual case" has become something of a hallmark of private sector ombudsmen as they do not follow the doctrine of precedent and therefore are able to take considerations of substantive fairness into account in their decision-making. This is an important power in the service sectors, where there is often inequality of bargaining power between the service provider and the consumer. The TIO has made clear that it is "not bound by previous decisions, and considers each enquiry or complaint on its individual merits" (TIO 2015d). In general, the overriding criterion to be used in dispute resolution is for the ombudsman to do "*what is, in his opinion, fair and reasonable in all the circumstances of the case*" (TIO 2015d).

This, however, is not an uncontroversial power (Morris & Hamilton 1996). When forming a view, assessing any evidence, or making a decision, the ombudsman must also take into account "the relevant law, regulations and good practice". The advantages of this type of equitable jurisdiction, however, must be set against the opposing value of legal certainty and associated rule of law considerations (Nobles 2001). This has been recognised in the past by ombudsmen who have stated that they sought to achieve consistency of decision-making

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while retaining the ability to depart from usual practice where deemed appropriate (Smith & Wood 2009).

It may be easier to ensure consistency when decisions about similar products are being made within the same institution, but the sheer size of the institution will also have an impact on the mode of decision-making. The fact that the TIO dealt with 138,946 new complaints in a single calendar year (TIO 2014a) makes it fair to assume that this is an institution where a number of subsidiary ombudsmen (or case officers) are required to make consistent decisions within a highly formalised managerial structure, and where the ombudsman fulfills a function more akin to that of a corporate style Chief Executive Officer than a quasi-judicial decision-maker. In the interests of ensuring that similar cases are treated alike, private sector ombudsman institutions like the TIO should have in place internal procedures including regular meetings and training, and moderation or crosscheck processes to make sure that decision-making principles are well understood and appropriately applied by all decision-makers. Whether or not these policies have been adopted by the TIO is not published on their institutional documents or media accounts and thus examining and evaluating on the TIO's practice in this aspect is not feasible.

On the other hand, there is often a fine balance to be struck between the rational application of rules to ensure consistency and an over-reliance on rules, which may lead to a failure to exercise discretion in individual cases (Hilson 2002). If the TIO were to lean too far towards a strict rules-based approach because of the size of its operation and delegation arrangements, it may pave the way for challenges on the ground against a fettering of discretion through the rigid application of decision-making principles or rules. Thus, the challenge for private sector ombudsmen, like the TIO, is defined by the extent in which they are able to balance their discretionary power being exercised by delegated decision-makers, and to ensure that general decision-making principles are appropriately applied across the entire institution.

This challenge is endemic to the functioning of private sector ombudsmen (Morris & James 2002). Merricks has proposed the development of particular benchmarks to measure the accuracy and consistency of decision-making in individual cases and to identify instances where individual discretion was exercised (Merricks 2001). Unfortunately, 15 years have since passed and Merricks' proposition has not become standard industry practice and many industry ombudsmen, including the TIO, are yet to adopt benchmarking.

The other relevant matter here that speaks to the capacity of private industry ombudsmen to administer fairness and reasonableness is the maintenance of quality in decision-making. In order to make a full assessment of the quality of the TIO's decision-making process, the

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reasons and details of the particular cases processed by the TIO are necessary. However, these records are unavailable to the public and there has been little interest or scrutiny from academics, in particular legal scholars, to increase the accountability of their processes. Additionally, despite being a scheme pre-empting review by a Court there has not been a considerable amount of legal scrutiny of the TIO, nor is there a standing mechanism upon which the private sector ombudsmen schemes are regularly reviewed. The lack of accountability, scholarly inquiry and judicial scrutiny has resulted in a process that is remote from consumers that emphasises the process over the substance of decision making. As the TIO is a cheaper and quicker option, there is a risk of creating a two-tier system of justice delivery or an institutional bias whereby the literate and technology savvy class are more able to navigate the Courts or dispute decisions made by the TIO, while the elderly, the working class or the disabled are given fewer options. Although it might be cheaper to avoid hearings, the question remains whether denying consumers a 'day in court' may eventually erode public confidence in the private sector ombudsmen schemes. At present, however, the consumer has nowhere else to go.

The TIO has put in place programs to train and educate staff to improve the services they are able to provide and their decision making processes. For example, TIO's 2014-15 annual report, launched in 2014 includes an educational program, which awards a Graduate Certificate in Dispute Resolution together with the Box Hill Institute in Victoria. This program focuses on developing the dispute resolution, case management, communication and legal skills of dispute resolution officers and aims to improve the quality of the TIO's services in the long term (TIO 2015g). Programs like this may not fundamentally resolve the issues of quality or consistency of decisions or decision-making processes. However, increasing the skills of dispute resolution officers will bring some benefits to the TIO and its member firms, as well as to telecommunications consumers at large. To further improve the TIO's service and so to gain public confidence and industry support, developing a particular sectorial staff training program is essential. It is a good way to start but there is a lot more that needs to be done in this regard.

4. How is it possible to improve procedural fairness within informal dispute resolution schemes like the TIO?

As one would expect, the rules on complaint handling are heavily influenced by requirements of procedural fairness by the ombudsman office. For example, in the TIO, if the ombudsman decides that an investigation is necessary, the ombudsman provides both parties with an opportunity to make representations during the investigation stage, and sends a provisional assessment to both parties giving them a time limit within which to respond. If either party

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indicates disagreement with the provisional assessment the matter then proceeds to determination (TIO 2015d). There is considerable autonomy on the part of the ombudsman to decide the evidence required, whether it should be written or oral, and how it should be presented. The ombudsman may exclude evidence which would be admissible in court, or conversely include evidence that would be inadmissible. The private sector ombudsman may accept information in confidence so that a summary or edited version only is submitted to the other party; the ombudsman may also take into account the failure of either party to provide information and make a decision on that basis, and may dismiss a complaint if a complainant fails to supply required information (Morris & James 2002).

These procedures are designed to fit a largely paper-based inquisitorial investigative method of operation, which is the norm within the TIO. How the courts might view this approach if judicial review challenges the issues of fair procedure and the extent to which the fair procedure requirements will impinge on the established processes of the ombudsman remains untested. The courts and judiciary have not always proved sympathetic to ombudsmen (Ackner 1993) and if cases come before them the courts may seek to impose more formal procedures, as the court's procedure normally requires. Given the emphasis placed on speed and minimum formality by the TIO and private sector ombudsmen more generally, the intervention of the Court into their decision making processes is likely to damage the confidence and trust that the users have in the decision-making processes of private sector ombudsmen (Financial Ombudsman Service 2000). Indeed, consumers may decide to go directly to Court on issues that have a legal basis.

Moreover, the desire to resolve disputes quickly has led to the prominence of early resolutions. Private ombudsman institutions have invested considerable resources in the initial contact stage and place great emphasis on "taking the earliest opportunity to resolve an incipient complaint and nip it in the bud" (Merricks 2001). This speedy dispute resolution may entail, for example, helping someone formulate their initial complaint to the service provider concerned after directly approaching the TIO, or using mediation or conciliation techniques rather than embarking on a full investigation (Financial Ombudsman Service 2002). Currently, the TIO have set particular key performance indicators (KPIs) in accordance with standard industry practice to measure the period of time it takes to resolve matters. For instance, both the Communications Ombudsman Services and the Communications and Internet Services Adjudication Scheme (CISAS) in the UK have identified early resolution as the most critical data set of the KPI's. The Communications Ombudsman Services published in its 2015 annual report that all individual complaints were resolved within eight weeks and that 97 per cent of complaints were resolved within six weeks (TIO 2015g). Additionally, in its quarterly reports CISAS indicated that 94.1 per cent

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of all received cases were resolved within 6 weeks, in the second Quarter of 2015 (CISAS 2015).

The impact of this approach on the TIO's operation can be clearly seen from figures disclosed in the TIO's 2014-15 annual report. Indeed, 90 per cent of consumer contacts were dealt with within one business day, whilst the other 10 per cent included a total of 12,083 cases requiring conciliations and/or investigations, in which the TIO closed 80 per cent of conciliated complaints within 30 business days and 80 per cent of investigated complaints within 70 business days. Only five per cent of open complaints were unresolved for more than 120 days out of a total of 124,417 complaints in the year ending July 2015 (TIO 2015g).

So, what is the problem with early resolution? While early resolution does not necessarily bring undesirable impacts on its own, there are strong arguments in support of alternative dispute resolution methods that require longer negotiation periods, such as mediation and conciliation (Morris & James 2002). For instance, the TIO does not record outcomes of early resolutions achieved at the referral stage (TIO 2015g) which can possibly lead to either undiscovered serious one-off problems or serious systemic weaknesses. At the same time, it would not be advisable that the TIO place too much significance solely on mediation and conciliation as this may also alter the ultimate advantage of the TIO, which as an alternative to the Court, the TIO is able to visualise the broader picture and identify broad problems as opposed to only resolving individual cases. Therefore, industry specific ombudsmen like the TIO should have mechanisms in place to monitor what happens to complainants sent back to service providers at the referral stage in order to check whether conciliation is tending to operate in favor of one party; to consider whether there is potential for serious one-off problems, or indeed, serious systemic weaknesses "hidden" by the emphasis on informal processes. Here, the TIO must balance the priorities of their stakeholders by ensuring that individual complainants are provided with a speedy and fair resolution, that the TIO decision making processes are consistently monitored for bias and that the service providers are receiving informed recommendations to improve the quality of their services.

5. The misleading use of "ombudsman" as a term for private sector ombudsmen

Administrative law embodies the legal framework within which public administration is carried out. It derives from the need to create and develop a system of public administration under law, a concept that may be compared with the much older notion of justice under law. Since administration involves the exercise of power by the executive arm of government, administrative law is of constitutional and political, as well as juridical, importance. Although there is no universally accepted definition of administrative law, it may rationally

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be understood to cover the organisation, powers, duties, and functions of public authorities of all kinds engaged in administration, their relations with one another and with citizens and non-governmental bodies. Administrative law also constitutes legal methods of controlling public administration and the rights and liabilities of officials (Cane & McDonald 2013).

Constitutional law complements administrative law to a large extent, and the line between them can be difficult to draw. While the legislature, the courts, and the administration are regarded as constitutional matters, the substantive and procedural provisions concerning the administration as well as judicial review of the administration are regarded matters of administrative law. However, some matters, such as the responsibility of ministers, cannot be exclusively assigned to either administrative or constitutional law. Elsewhere, some French and American jurists regard administrative law as including parts of constitutional law. The law relating to public health, education, housing, and other public services could logically be regarded as administrative law (Robson 2013; 1951). By the same token, public ombudsman institutions, scrutinising the work of the executive within public administration, should also be regarded as part of administrative law.

Private sector ombudsmen are different. A typical private sector ombudsman institution, such as the TIO, has its main function and additional functions. As established in the key claim above in this paper, the main function of a private sector ombudsman is to provide redress and remedies, which are comparable to the courts. The additional functions normally include empowering consumers, facilitating industry regulators to develop consumer policies and providing feedback to the service sector as a whole. The additional functions are the functions that no court can perform. Nonetheless, neither the main function nor the additional functions can be regarded as administrative in nature given the fact that these functions have little relevance to the public administration (or the executive) arm of the constitutional arrangement.

While it is easy to justify the constitutional standing of the public ombudsman in the administrative law system, it is nearly impossible to position the private sector ombudsman in the existing constitutional arrangement according to the established separation of powers principle. Due to the divergent responsibilities of the public and private ombudsmen alongside the legitimacy that the public ombudsman receives as part of the administrative law system, the use of ‘ombudsman’ in the private sector deceptively capitalises on the legality of the public ombudsman in order to generate a public perception of authority and a tenuous connection with the roles in which the public ombudsman has performed for decades.

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In fact, the use of the term "ombudsman" has already created much confusion in recent years. As the Australian Commonwealth Ombudsman, Professor McMillan, describes: "

> … the proliferation of private sector complaints bodies have raised issues as to whether private bodies should be allowed to adopt the name "ombudsman" … the problem has more to do with unconstrained and unsystematic use of the term; this was followed by an elaboration of the problem of public deception and public confusion." (McMillan 2008).

The TIO, like many other private sector ombudsmen, does not differ from the description provided by Professor McMillan as it was set up and continually funded by the industry as a sectorial specific dispute resolution scheme. Therefore, it does not have any relevance to the contemporary understanding of administrative law and it is difficult to justify its use of the title "ombudsman".

The other important distinguishing feature of the TIO's practice from the very purpose of administrative law is its function regarding the balancing of powers. Public ombudsmen level the field by providing the complainant with an opportunity to cut through the red tape of government entities at no charge, whereas the situation in the telecommunications industry, where the TIO operates, can be very different. A Canadian Justice once stated, 'the Ombudsman can bring the lamp of scrutiny to otherwise dark places even over the resistance of those who would draw the blinds.' (Re Alberta Ombudsman Act 1970). So, who would draw the blinds? Parties in the position of being able to draw the blinds could include government officials in the public sector and large, powerful firms in the private sector.

The earlier telecommunications market comprised a small number of big firms and the TIO could effectively balance the bargaining power between the individual complainant and these big firms at that time. Although these big firms still remain as key players, the industry has already seen the growth of a number of smaller or small private firms as a result of introducing sectorial competition and deregulation. With the development of the current National Broadband Network (NBN) project, the industry is expected to welcome more small players into the retail telecommunications market and many of these small firms are expected to join the TIO scheme. With an increasing number of small firms joining in, the role of the TIO in balancing powers decreases as these small businesses may not be in the position of '*drawing the blinds*'. Again, this is another reason to differentiate the private sectorial dispute resolution scheme, such as the TIO, from the public ombudsman. To address this trend, the TIO may need to revise its operational guide and fee structure by considering the position of its smaller members.

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Conclusion

Public sector ombudsmen still hold a strong standing in the current provision of administrative justice while private sector ombudsmen do not offer the same effect, as they are no longer complimenting the administration scheme, but rather the judicial system. Private ombudsman institutions justify their existence by offering service functions in forming a desirable relationship between the citizen, government, lawmakers and the industry. There are, however, fundamental issues, which might hinder the development of the ombudsman institution and also compromise the rights of the individuals in seeking justice.

This paper accepts that private sector ombudsmen can be an effective industry self-regulation scheme. This however does not mean that they should not be subject to authoritative and standardised quality control assurance mechanisms to ensure that both consumer complainants and the participating firms are getting an efficient and fair deal. Unfortunately, such a mechanism is not yet being considered in the telecommunications industry

By using the TIO as a typical private sector ombudsman institution, this paper establishes the nature of the TIO as a substitute to the judicial system on matters arising from the service sector it operates within. Proceeding from this claim, this paper examines five separate issues and argues that the TIO may go beyond providing legal rights in a more accessible forum and actually provide different rights and remedies from those available in the courts and tribunals. The very fact that the TIO can expand its scope of operation requires further justification and immediate attention from relevant stakeholders. In addition, this paper highlights a challenge for the TIO to balance the extent to which it tolerates discretionary power being exercised by its delegated decision-makers, and to ensure that general decision-making principles are appropriately applied across the entire institution. To respond to this challenge, so as to gain public confidence and industry support, setting up special courses to train the ombudsmen staff is essential and a good way to start, but there is a lot more that needs to be done in this regard.

Finally, while it is easy to justify the constitutional standing of the public sector ombudsman institution in the administrative law system, it is certainly more difficult to place the private ombudsman institution in the constitutional arrangement, according to the established separation of powers principle. Private sector ombudsman institutions do not seem to have relevance to the contemporary understanding of administrative law. On this point, this paper argues that the use of the word “ombudsman” in settling sectorial consumer disputes can be

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a misleading concept, which may generate a false public perception by linking it to the various roles of public administration carried out by public ombudsmen for decades.

References

Abraham, A. (2008). The Future in International Perspective: The Ombudsman as Agent of Rights, Justice and Democracy. *Parliamentary Affairs*, 681.

Ackner, L. (1993). *Report on a New Unified Complaints Procedure for the Personal Investment Authority*. Dispute Resolution Report.

Australian Administrative Law Policy Guide. (2015). Retrieved from Attorney General's Department, Australian Government: https://www.ag.gov.au/LegalSystem/AdministrativeLaw/Documents/Australian%20Administrative%20Law%20Policy%20Guide.pdf

Australian Bureau of Statistics. (2015). *Population clock*. Retrieved from ABS: http://www.abs.gov.au/ausstats/abs@.nsf/0/1647509ef7e25faaca2568a900154b63?OpenDocument

Australian Communications and Media Authority. (2015). *Communications Report 2014 – 2015*. ACMA.

Bames, J. (1993). Is Administrative Law the Corporate Future? *Australian Business Law Review*, 66.

Birds, J., & Graham, C. (1988). Complaints Mechanisms in the Financial Services Industry. *Civil Justice Quarterly*, 317.

Cane, P., & McDonald, L. (2013). *Principles of Administrative Law*. Oxford University Press.

CISAS. (2015). *CISAS KPI Report for the second Quarter of 2015*. Retrieved from http://www.cedr.com/docslib/CISAS_KPI_Report_for_the_second_Quarter_of_2015.pdf

Coase, R. (1960). The Problem of Social Cost. *Journal of Law and Economics*, 1-44.

Commonwealth Ombudsman. (2015a). *About Commonwealth Ombudsman*. Retrieved from Commonwealth Ombudsman: http://www.ombudsman.gov.au/about/our-history

Commonwealth Ombudsman. (2015b). *Complaints the Ombudsman can investigate*. Retrieved from Commonwealth Ombudsman: http://www.ombudsman.gov.au/pages/making-a-complaint/complaints-the-ombudsman-can-investigate/

Financial Ombudsman Service. (2000). *Laying the Foundations: First Annual Report*.

http://doi.org/10.18080/ajtde.v3n1.57

Financial Ombudsman Service. (2002). *Annual Review and Report & Financial Statements*.

Flohr et al. (2010). *Wolfsberg principles against money-laundering in banks*. Hoffman.

Gill, C. (2014). The evolving role of the ombudsman: a conceptual and constitutional analysis of the "Scottish solution" to administrative justice. *Public Law*, 662.

Gilling, B. (1998). *The Ombudsman in New Zealand*. Palmerston North: Dunmore Press.

Gunningham, N., & Rees, J. (1997). Industry Self-Regulation: An Institutional Perspective. *Law and Policy*, 363.

Hilson, C. (2002). Judicial Review, Policies and the Fettering of Discretion. *Public Law*, 111.

Kagan, B. (1982). *Going By The Book: The Problem of Regulatory Unreasonableness*. Philadelphia: Temple University Press.

Kirkham, R., Thompson, B., & Buck, T. (2009). Putting the Ombudsman into Constitutional Context. *Parliamentary Affairs*, 602.

McMillan, J. (2008). What's in a name? Use of the term “Ombudsman". *Australian and New Zealand Ombudsman Association Conference*.

Merricks, W. (2001). Lessons from Merging the Financial Ombudsman Schemes. *British and Irish Ombudsman Association Conference*. London.

Morris, P. (1987). The Banking Ombudsman. *Journal of Banking Law*, 131.

Morris, P., & Hamilton, J. (1996). The Insurance Ombudsman and PIA Ombudsman: A Critical Comparison. *North Ireland Legal Quarterly*, 119.

Morris, P., & James, R. (2002). The Financial Ombudsman Service - A brave new world in ‘ombudsmanry'. *Public Law*, 640.

Nobles, R. (2001). Keeping ombudsmen in their place – the courts and the Pensions Ombudsman. *Public Law*, 308.

NSW Local Court Act. (2007). Section 29.

Paunio, R. (2009). The Ombudsman as Human Rights Defender. *The 9th World Conference of the International Ombudsman Institute*. Stockholm.

Re Alberta Ombudsman Act, 10 (1970). doi:Re Alberta Ombudsman Act (1970), 10 D.L.R. (3d) 47, per Milvain C.J.T.D.

Reif, L. (2004). *The Ombudsman, Good Governance and the International Human Rights System*. Leiden: Martinus Nijhoff Publishers.

http://doi.org/10.18080/ajtde.v3n1.57

Robson, W. (1951). *Justice and administrative law: a study of the British Constitution*. Greenwood Press.

Robson, W. (2013). *Administrative law: Judicial review of administration*. Retrieved from E Page and Encyclopaedia Britannica.

Sammeck, J. (2012). *A new institutional economics perspective on industry self-regulation*. Springer.

Seneviratne, M. (1994). *Ombudsmen in the Public Sector*. Open University Press.

Seneviratne, M. (2002). *Ombudsmen: Public Services and Administrative Justice*. Cambridge : Cambridge University Press.

Smith, S., & Wood, J. (2009). Industry Ombudsman Schemes Twenty Years On: World benchmark or industry captured? *Alternative Law Journal*, 3.

Telecommunications Industry Ombudsman. (2012). *Systemic Issues*. Retrieved from TIO: http://ar2012.tio.com.au/performance/systemic-issues

Telecommunications Industry Ombudsman. (2014a). *Annual Report*. Retrieved from TIO: https://www.tio.com.au/__data/assets/pdf_file/0005/162662/TIO-2014-Annual-Report-WEB.pdf

Telecommunications Industry Ombudsman. (2014b). *Complaints we handle*. Retrieved from TIO: https://www.tio.com.au/about-us/terms-of-reference-and-company-constitution/2.-complaints-we-handle

Telecommunications Industry Ombudsman. (2015a). *Benchmarks for Industry-Based Customer Dispute Resolution Schemes*. Retrieved from TIO: https://www.tio.com.au/__data/assets/pdf_file/0004/131764/Benchmarks_DIST1997.pdf

Telecommunications Industry Ombudsman. (2015b). *career*. Retrieved from Telecommunications Industry Ombudsman: https://www.tio.com.au/__data/assets/pdf_file/0019/155017/PD-Enquiry-Officer-May-2014.pdf

Telecommunications Industry Ombudsman. (2015c). *Complaint outcomes*. Retrieved from Telecommunications Industry Ombudsman: http://annualreport.tio.com.au/complaint-trends/outcomes

Telecommunications Industry Ombudsman. (2015d). *Evidence and Decision Making – 7.0 Fair and Reasonable*. Retrieved from: http://www.tio.com.au/about-us/policies-and-procedures/evidence-and-decision-making#70FairandReasonable

http://doi.org/10.18080/ajtde.v3n1.57

Telecommunications Industry Ombudsman. (2015e). *Funding*. Retrieved from TIO: https://www.tio.com.au/about-us/funding

Telecommunications Industry Ombudsman. (2015f). *Objectives and Principles*. Retrieved from TIO: https://www.tio.com.au/about-us/policies-and-procedures/objectives-and-principles

Telecommunications Industry Ombudsman. (2015g). *TIO annual report* . Melbourne: Telecommunications Industry Ombudsman.

Telecommunications Industry Ombudsman. (2015h). *TIO complaints: the year in review 2013 – 2014 Complaints Report*. Retrieved from TIO: https://www.tio.com.au/__data/assets/pdf_file/0006/158964/TIO-complaints-the-year-in-review-2013-14_WEB.pdf

Telecommunications Industry Ombudsman. (2015i). *About Us*. Reterieved from TIO: https://www.tio.com.au/about-us

Telecommunications Industry Ombudsman. (2015j). *2014-2015 Snapshot*. Retrieved from TIO: http://annualreport.tio.com.au/performance/2014-15-snapshot

Tyldesley, P. J. (2003). The Insurance Ombudsman Bureau - the early history. *Journal of Insurance*, 34.

Widdowson, L., & Li, G. (2013). Telecommunications industry self-regulation: assessing the Telecommunications Industry Ombudsman Scheme in Australia. *International Journal of Private Law*, 315.

Wyatt, J. (1961). *The Citizen and the Administration: The Redress of Grievances*. London: Stevens.

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Colour Television in Australia

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Summary:

A historic paper from the Journal in 1976 regarding the colour conversion of transmitters in the National Television Service by Telecom Australia (now Telstra).

Introduction

The National Television Systems Committee was formed in the United States in 1950 to research the problems associated with colour television. The Radio Corporation of America (RCA) played a large part in development of a compatible system adopted by the committee called the NTSC system. (Hutson 1971) The United States commenced regular colour television broadcasts in January 1954 and well before the introduction of monochrome television in Australia in 1956 and in time for the Olympic Games in Melbourne.

The new colour system was compatible in both directions, meaning an existing monochrome receiver was able to display a monochrome picture with a colour broadcast and a colour receiver was able to display a monochrome picture with a monochrome broadcast. The NTSC system however had some drawbacks such as phase distortion which caused hue or colour errors. This led to the NTSC system being referred to as “Never Twice the Same Colour” by broadcast engineers. In 1958, Graham Kennedy of Channel 9 fame, visited the United States and witnessed a number of colour television broadcasts. He was impressed but only saw the system on expertly-tuned studio monitor sets. Kennedy said of the NTSC system, "I believe however it can be a tricky business for the viewer with a clutch of knobs to twiddle on your set and if you are not too expert you get green cows, white grass and purple people eaters would probably come out tartan" (Blundell 2003)

Whilst Australia was far behind the United States in the race to introduce colour television, we eventually chose a variant to the NTSC system called PAL which was developed at the Telefunken Laboratories in the German Federal Republic. The system was designed to reduce the effects of phase distortion on the colour signal. (Hutson 1971) In 1967 the PAL system was adopted by the German Federal Republic and the United Kingdom.

The local broadcast industry had been lobbying the Australian Government since the 1960’s to introduce colour television. In 1966 Hansard records the Postmaster-General being asked

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which of the three colour television standards (NTSC, PAL & SECAM) would be used in Australia ? The answer given was "No decision has been made regarding the introduction of colour television in Australia. An essential pre-requisite for a colour television service in Australia is the determination of technical standards. Following recent failure to reach international agreement on a common colour television standard for Europe at a meeting of the International Radio Consultative Committee (C.C.I.R.) of the International Telecommunications Union, it is apparent that the most advantageous course for Australia will be to await further developments in the introduction of colour television services in Europe, particularly in Britain, so that the merits of competing technical systems may be assessed on the basis of the practical operation of comprehensive colour television services in those countries".

"The timing of the introduction of colour television into Australia is a matter for decision by the Government at the appropriate time. Consideration of all the factors relevant to the matter including the experience of overseas countries in colour television suggests the desirability of a cautious approach. The matter of colour television, having regard to its complexities, is unlikely to be considered and decided in a way which would not leave manufacturing interests ample time to prepare themselves before final Government decisions are made. The Australian Broadcasting Control Board recently obtained the views of industry in this country on the question of technical standards considered appropriate for Australia" (Hansard 1966).

On 15 February 1972, the Prime Minister William McMahon announced that colour television would be introduced on 1 March 1975, allowing the local broadcast industry three years to convert to the PAL standard that had been adopted by the Australian Broadcasting Control Board (PM Transcripts 1972). The National Television Service would be updated to colour on a phased basis due to financial constraints brought about by Australia's continued participation in the Vietnam War (Gyngell 1998).

The historic paper (Lees & Hodgson 1976) details the significant challenges and solutions employed to convert the National Television Service transmitters to colour operation. Telecom Australia's approach was to modify the existing transmitter equipment wherever possible to minimise the capital expenditure. This presented unique challenges given the equipment had to be operational during the day for monochrome transmissions, then modified and tested during the night with colour and rolled-back by morning when monochrome transmissions resumed. Luckily there were no 24 hour, 7 day transmissions in those days.

Naturally the conversion to colour triggered a number of changes elsewhere in the Telecom's network such as transmission, not to mention the significant changes at the studio end

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managed by the Australian Broadcasting Commission and the respective commercial broadcasters.

Additional information on the effects of colour television on Telecom's network can be found in (Hatfield 1974) and the extensive modifications to the Melbourne Television Operating Centre in (Humberstone & Lock 1976).

References

Blundell G. 2003. "King: The Life and Comedy of Graham Kennedy 2003, page 156, Macmillan.

Gyngell B. 1998. Bruce Gyngell interviewed by Brendan Horgan (1998), Oral History, National Film and Sound Archive.

Hansard. 1966. 15 September 1966 at http://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;adv=yes;orderBy=_fragment_number,doc_date-rev;page=13;query=Dataset%3Ahansardr,hansardr80%20Decade%3A%221960s%22;rec=1;resCount=Default

Hatfield G. E. 1974. "Colour Television – Some Effects on Australian Post Office Plant", *Telecommunication Journal of Australia*, Vol. 24 No. 2 1974, pages 107-120.

Humberstone D. L; Lock K. R. 1976. "The Melbourne Television Operating Centre", *Telecommunication Journal of Australia*, Vol. 24 No. 2 1974, pages 200-207.

Hutson G. H. 1971. "Colour Television Theory PAL-System Principles and Receiver Circuitry Preface Historical Notes

Lees R. P; Hodgson J. D. 1976. "Colour Conversion of National Television Transmitting Stations". *Telecommunication Journal of Australia*, Vol. 26 No. 1 1976, pages 18-31.

NFSA title: 382977 at http://nfsa.gov.au/blog/2015/02/26/colour-tv-part-1/

PM Transcripts. 1972. "Colour Television - Statement by the Prime Minister, Mr. William McMahon CH, MP. at https://pmtranscripts.dpmc.gov.au/release/transcript-2536

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The historical paper

Colour Conversion of National Television Transmitting Stations

R. P. LEES, B.E.E., and J. D. HODGSON, B.S.C. (ENG.)

Telecom Australia is responsible for the installation and operation of the television transmitting stations providing the National Television Service. This paper describes the approach adopted by the then Post Office in converting these stations for colour, including the performance investigations undertaken and the equipment modifications required to allow the introduction of a colour television service on 1st March, 1975. The paper also describes the configuration of facilities adopted at the converted stations and concludes with a discussion of the problems of converting the Hobart station while maintaining service.

Editorial Note: This article was presented at the Annual Engineering Conference of the Institute of Engineers, Australia held in Hobart in February 1975, and published by the Institute in the Annual Engineering Conference Papers. Their approval to republish it is gratefully acknowledged.

INTRODUCTION

Monochrome television broadcasting began in the National Television Service in 1956 with the establishment of stations to serve Melbourne and Sydney. Over the period 1959-1967 a further 37 high power transmitters were established by the then Post Office which extended the National Service to the remaining capital city stations and to all except the more remote regional areas. Further extension and improvement in the coverage of the National Service has since been achieved by the installation of low power transmitting and translator stations; at 30th June, 1975, there were 99 such station with a further 26 in the process of construction. This development is shown in Fig. 1. All Australian television services are transmitted in the VHF band.

Telecom Australia is also responsible for the provision and operation of the programme relay facilities which interconnect the transmitting stations with the studios of the Australian Broadcasting Commission where the programmes are produced. With the exception of direct studio-transmitter links established for several capital city stations, the programme relay facilities are provided on the National Broadband Bearer Network. The colour conversion of this network is not discussed in this paper, nor are the colour conversion works required at the studios of the ABC.

In 1969 the recommendation of the Australian Broadcasting Control Board that Australia should adopt the PAL system of colour transmission was accepted by the Government of the day. The previous years of monochrome television had resulted in the development in the industry of considerable expertise and to draw upon this, Industry Working Parties were established involving representatives from television companies, equipment manufacturers and both commercial and national broadcasting organisations. These working parties developed basic system standards for Australia and these were duly embodied in the ABCB publication (Ref. 1) and APO specification (Ref. 2).

COLOUR TELEVISION SIGNALS

Colour television signals have waveform and spectral characteristics which differ from those of monochrome television signals. These differences are such that colour signals impose additional demands upon equipment designed originally for monochrome services. Some of these demands are fundamental to colour signals and must be met before colour services can take place while other demands affect the faithfulness with which the picture is transmitted.

The waveform characteristics of Australian colour and monochrome television signals are shown in Fig. 2, and it can be seen that the proportion of the signal which can be occupied by visible picture information has increased from 100 units to approximately 170 units. As a result, the colour

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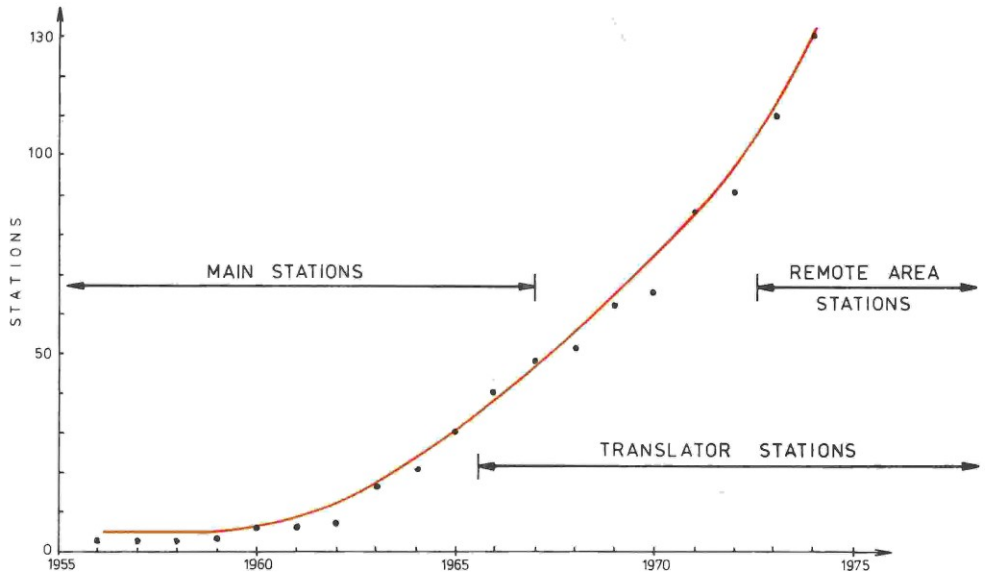

Fig. 1 — National Television Development.

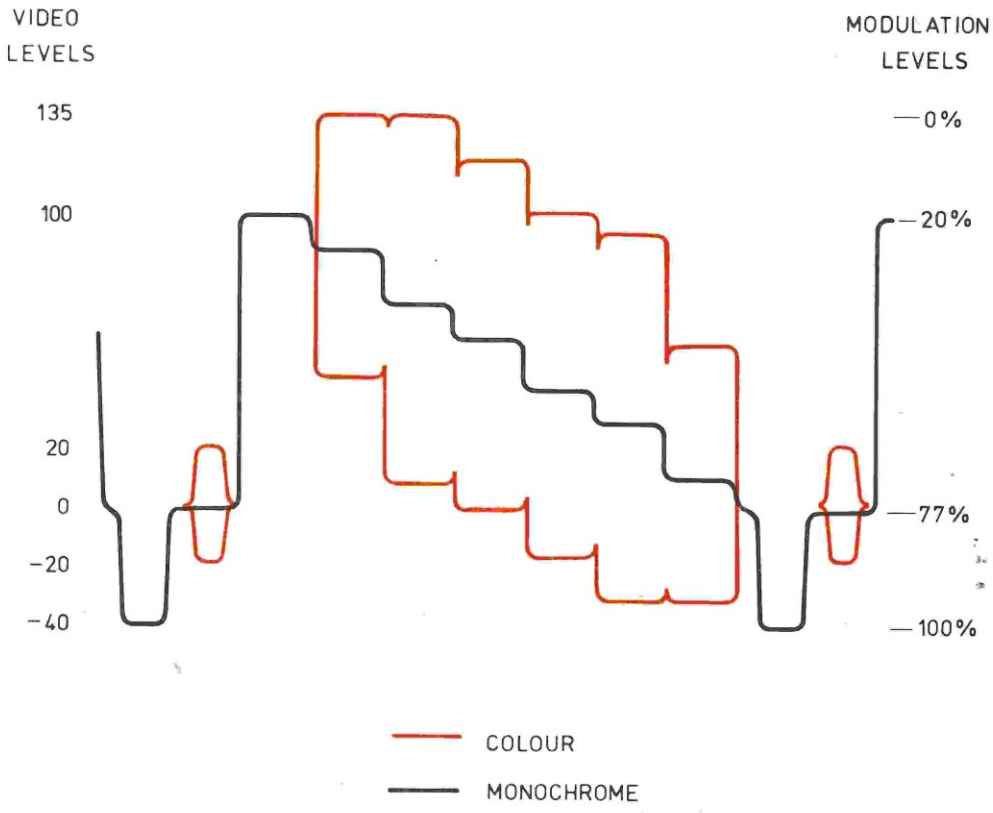

Fig. 2 — Television Line Waveforms.

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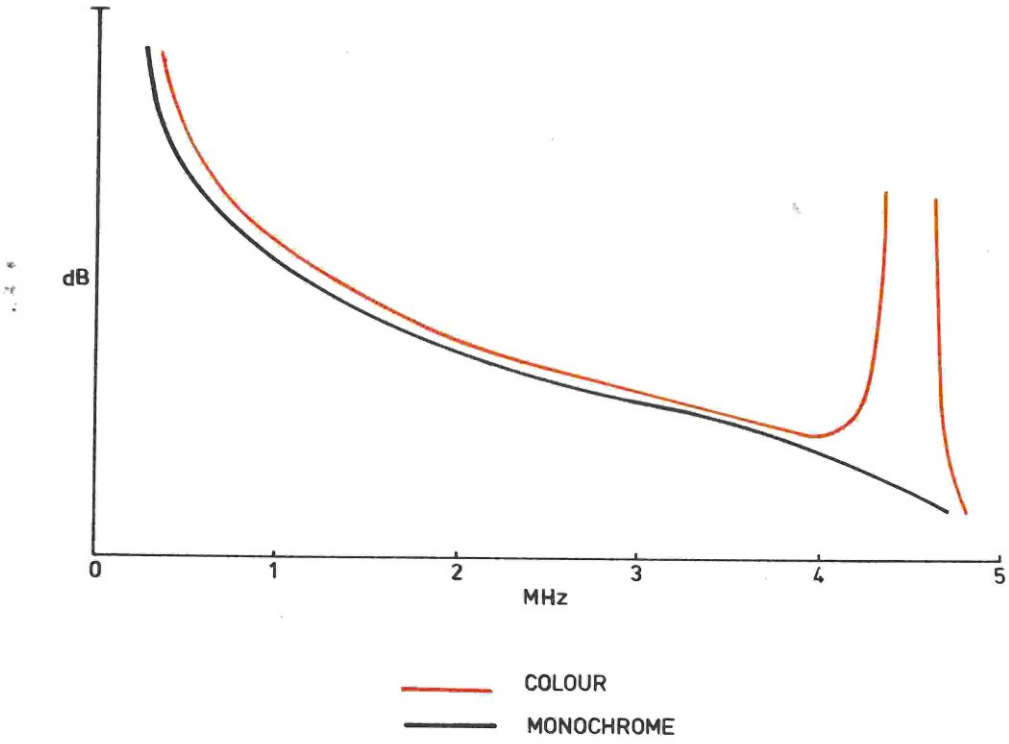

Fig. 3 — Frequency Spectra of Typical Signals.

signal has increased susceptibility to level dependent or non-linear distortions, which affect the accuracy of the picture reproduction.

The excursion of picture information into the portion of the signal occupied only by synchronising information in a monochrome signal affects synchronising signal processing circuits normally used in monochrome equipment. It should be noted that the modulation levels apply to an ideal double sideband signal. In practice this is modified to a vestigial sideband signal in the transmitter prior to transmission, with the result that the amplitude of the high frequency colour or chrominance information is reduced to one half. In addition the synchronising portion of the colour signal includes the "colour burst" which is essential for decoding the colour information in the transmitted signal.

The distribution of spectral energy in colour and monochrome signals is represented in Fig. 3.

The increased level of high frequency energy is due to the inclusion of the colour information, in the form of a colour sub-carrier of approximately 4.43 Mhz on to which the hue or colour itself is phase modulated and the saturation or strength of the colour is amplitude modulated. As a result the colour signal makes increased demands upon the frequency dependent performance characteristics of the transmitting equipment and also increases the frequency range over which level dependent distortions are significant. Deficiencies in these performance characteristics affect the accuracy of picture reproduction. In particular, the different time delays of the frequencies associated with colour information and the picture or luminance information affect the "registration" of the colour with the the picture. The addition of the colour sub-carrier to the vision and sound carriers increases the likelihood of intermodulation and spurious radiation problems.

With the recognition of these characteristic differences between monochrome and colour television signals, the more important basic tests appropriate

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to explore and quantify the colour performance of monochrome equipment are listed below:

- Differential gain and phase — this test measures the non-linear distortion arising in the chrominance information with level variations in the luminance signal.
- Chrominance non-linearity — This test measures the non-linear distortion arising in the chrominance information with level variations in the chrominance signal.
- Luminance Shift — this test measures the luminance changes arising with level variations in the chrominance signal.
- Luminance-chrominance inequality — this test measures the difference between the gains and the time delays of the luminance and chrominance information, respectively.

A description of these and other tests which can be used to explore the adequacy of monochrome equipment for colour operation is given by Bartlett (Ref. 3). These tests were used in an initial assessment of monochrome equipment in the National Service undertaken in the development of the conversion programme as described in the next Section.

DEVELOPMENT OF CONVERSION PROGRAMME

The basic equipment at National Television transmitting stations falls within five groups:

- Transmitters
- Translators
- Antenna systems
- Studio-transmitter direct links
- Ancilliary Equipment comprising
  Programme Input Equipment
  Local/emergency programme source
  Test and monitoring facilities.

In each of these categories the equipment has been supplied by a wide range of overseas and local manufacturers during the period extending from 1956, when television commenced in Australia, to the present time. The equipment shows the changes in design practice with solid state component availability over the years and different installation reflect developments of station equipment configuration philosophies.

Following the announcement that colour television would be introduced, an assessment was made of the colour transmission performance of this wide range of monochrome transmitting equipment. The assessment was based upon previous experience and knowledge of the equipment and included performance measurements, using the previously discussed tests, on selected representative items. The assessment also included consideration of operating and maintenance aspects of the existing equipment, such as reliability, long term stability of adjustment and current maintenance costs, to determine if any deficiencies developing in these areas would become unacceptable with the increased performance demands of colour operation. Recognition was also given to the desirability of standardising station equipment.

This assessment enabled the development of two interacting programmes; firstly an engineering works programme covering the ordering, installation and funding of replacement items of equipment and secondly, a detailed equipment investigation programme covering the colour evaluation of specific items of existing equipment to enable a decision to be taken between retention, re-design or complete replacement.

The results of this assessment and the subsequent investigations and conversion works that followed are discussed for each group of equipment listed above.

TRANSMITTERS

Table 1 shows the range of high power vision transmitters employed at main 100 kW ERP National Stations and summarises the basic conversion work required. The majority of these transmitters including that at Canberra has been supplied by one Australian manufacturer. This manufacturer was the only supplier able to provide a colour conversion modification kit for their transmitters. Accordingly, the transmitter at Canberra was converted to colour operation by this manufacturer as a model exercise, to enable a full assessment to be made of the colour conversion equipment and the conversion procedures adopted in relation to the cost and final performance achieved. From this work, guidelines were developed for the evaluation and conversion of other transmitters, particularly those provided by this manufacturer.

The transmitters at Melbourne, Sydney and Hobart were supplied by overseas manufacturers who were not in a position to assist with conversion components. These stations were among the first National Stations to commence operation and the transmitters were not capable of conversion to colour operation without extensive and un-economic modifications. They were therefore replaced. Details of the colour evaluation tests conducted on the original Hobart transmitter are discussed later. The other high power transmitters of overseas origin are of more recent design and were assessed as being capable of successful conversion to colour operation, although, in the case of the transmitters at Brisbane, Adelaide and Perth it was necessary to replace major components associated with the band shaping and combining of the vision and sound transmitter outputs.

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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TABLE 1 — CONVERSION OF HIGH POWER VISION TRANSMITTERS

Group	Country of Manufacture	Station Configuration, Frequencies and Location	Opening Date	Conversion Work
1A	Australia	Parallel 10 kW Ch 3—Canberra	1962	Manufacturer to convert as model exercise
1B	Australia	Parallel 10 kW Ch 2, 3, 4, 16 locations	1963-1967	APO to convert based on: (a) Experience from Canberra (b) Investigation of detailed requirements (c) Modification kit from manufacturer
1C	Australia	Parallel 10 kW Ch 5. 2 locations	1965	APO to convert as for Group 1B pending change of Channel allocation requiring new transmitters
1D	Australia	Parallel 5 kW Ch 6-9. 4 locations	1965-1966	APO to convert as for Group 1B
2A	U.K.	Main 18 kW-4kW standby Ch 2 Melbourne and Sydney	1956	Complete replacement
2B	U.K.	Parallel 10 kW Ch 2 Brisbane Adelaide and Perth	1959-1960	APO to convert based on: (a) Investigation of detailed requirements (b) Replacement of major components (c) Redesign of major circuitry
2C	U.K.	Parallel 10 kW Ch 0, 1 5 locations	1963-1965	APO to convert based on: (a) Investigation of detailed requirements (b) Redesign of major circuitry
2D	U.K.	Parallel 5 kW Ch 6 1 location	1964	APO to convert as for group 2B
3A	Japan	Parallel 10 kW Ch 4, 5 2 locations	1963	APO to convert based on: (a) Investigation of detailed requirements (b) Redesign of major circuitry
3B	Japan	Parallel 6 kW Ch 5A 1 location	1963	APO to convert as for group 3A
4	Holland	Main 22 kW -5 kW standby Ch 2 Hobart	1960	Complete replacement
5	Australia	Parallel 10 kW Ch 7 1 location	1966	APO to convert based on: (a) Investigation of detailed requirements (b) Redesign of major circuitry

The high power sound transmitters were not influential in determining the conversion work required but where the vision transmitters were to be replaced then the associated sound transmitters were also replaced as the two are closely integrated in modern equipment.

The transmitters at low and medium power stations have been installed during the last three years, with few exceptions. The equipment is consequently modern in design and was provided with an awareness that the introduction of colour services was imminent. An assessment of the colour performance of these transmitters showed that satisfactory colour operation could be achieved with minor equipment additions and modifications. These low power stations are not normally staffed and the long term stability of adjustment and performance of the equipment is an important maintenance consideration. In some cases a lack of stability has proved to be a limitation in monochrome operation and with the additional performance demands imposed by colour operation equipment replacement is necessary.

Replacement Transmitters

The replacement transmitters employ low level intermediate frequency modulation techniques in

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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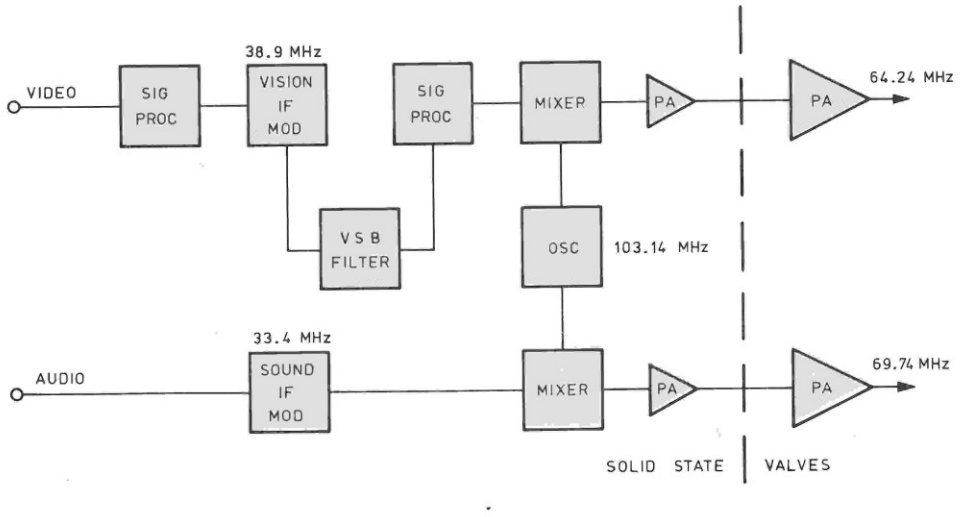

Fig. 4 — Block Diagram of Intermediate Frequency Modulated Transmitter.

accordance with the latest transmitter design philosophy. The principal advantage of IF modulation is that signal processing can be done at low level both before and after modulation. This enables increased use to be made of physically small and highly reliable components and solid state devices, with the result that complex circuitry of improved performance and stability can be designed without sacrificing overall transmitter reliability. A typical modern IF modulated vision transmitter with associated sound transmitter, such as shown in block diagram form in Fig. 4, employs only three electron tubes. Detail of such transmitters is described by Bartlett (Ref. 4) and by Ohshima, Sakai and Higashi (Ref. 5).

The new transmitters are arranged in parallel pairs of both vision and sound transmitters, with all units in operation simultaneously. This configuration avoids interruption to the service in the event of failure of one transmitter and is now standard at all high power National transmitting stations.

Converted Transmitters

From Table 1 it can be seen that the majority of high power transmitters in the National Service were capable of conversion to colour operation, but considerable detailed investigation and redesign of circuitry would be necessary. Although the monochrome transmitters to be converted have been supplied by various manufacturers, it is found that there are common limitations and problems experienced in converting these to colour operation. The components of transmitters in which problems occur and the solutions adopted are as follows:

Modulator

The monochrome modulators used in the medium and high level modulated transmitters in the National Service were unable to satisfactorily handle colour signals without considerable modification. The deficiencies were inter-related and were evident to differing degrees depending upon the transmitter design. They occur in four main areas.

Firstly, the modulators were unable to produce a sufficient output voltage to modulate the transmitter to the lower carrier levels required in colour operation.

Secondly, the requirement in colour operation for modulation by high amplitude high frequency chrominance signals causes modulator output stages and their power supplies to suffer overloading and excessive heat dissipation in their attempts to produce sufficient reactive current to drive the capacitive load presented by the modulated amplifier stage. The modulator in the transmitters supplied by the main Australian manufacturer was a well integrated design for monochrome signals and all the above problems were evident on colour signals. The modification proposals prepared by the manufacturer overcame these by increasing the supply voltage to the final modulator stages and replacing the output stage valves with types of increased dissipation rating, supported by power supplies of higher capacity. The overseas transmitters were found to have a greater margin in their design with the result that a small increase in the gain of an early amplifier stage overcame the modulation depth limitation and only in the case of the Japanese

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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transmitter was it necessary to overcome an output stage overheating problem by means of a replacement valve with increased dissipation rating. Achievement of modulation depths below 5% of the carrier level at the peak of synchronising pulses is dependent on the condition of modulator valves and on careful setting up to prevent grid current caused by any excessive amplifier input voltages from introducing counter-acting black level shifts. The performance defects arising from being unable to modulate below 5% are not frequent or serious enough to justify the more extensive modulator changes that would be required to ensure this could always be achieved, particularly in the case of the overseas transmitters.

The third deficiency in all the monochrome modulators used in the National Service was that the back porch clamping circuits caused interference to the colour synchronising burst which is located on the back porch of the colour signal. The most common method of avoiding this interference, and the method adopted by the main Australian supplier in their modulator modification, is the insertion of a rejection filter at colour sub-carrier frequency to isolate the effects of the clamp circuits at colour frequencies. This method does not entirely eliminate disturbance to the burst information and two alternative methods are bing tested for use on other modulators. The first alternative method is the insertion of a resistor rather than a tuned filter in the clamp line. This removal of reactive elements minimises disturbance to the burst information by only at the expense of clamp efficiency. The second alternative method is the timing of the clamp pulse on the small portion of the back porch not occupied by the burst. In concept this is the superior method as complete independence is obtained between clamp operation and the burst, but complex circuitry is required to ensure that the clamp pulse is correctly positioned, particularly during the field blanking interval, and to ensure continued correct operation of blanking level feedback systems.

The fourth deficiency requiring alteration in monochrome modulators was in the operation of signal processing circuits designed to compensate for non-linearity of the modulation characteristic and limiting circuits designed to prevent excessive signal amplitudes. Synchronising pulse stretching circuits operating on a "stretch and clip" basis interfere with chrominance information extending beyond the black level and they were modified so as to operate only at luminance frequencies. Peak white clipping circuits were similarly modified to avoid interference with chrominance information extending beyond white level. Other linearity correction circuits found in monochrome modulators do not provide adequate correction at chrominance frequencies over the increased range of picture information found in a colour signal, and they make no provision for differential phase correction which is necessary with colour operation. Therefore they were supplemented at the modulator input by a colour correction unit providing a full range of signal processing facilities. There is evidence that in some monochrome modulators the existing correction circuits introduce differential phase errors or are difficult to set up in conjunction with the colour correction unit. If this is confirmed all signal processing circuits will be removed from operation and all correction performed by the colour correction unit.

This process of off-setting errors in one part of the equipment by introducing compensatory errors in another part directly affects the long term stability of the overall equipment performance and has implications for the operation and maintenance of the station. This aspect will be carefully watched as experience is gained with converted stations.

Filterplexer and Other Coaxial Components

All medium and high level modulated monochrome transmitters are equipped with filterplexers to provide vestigal sideband shaping and to combine the output of the vision transmitter with the associated sound transmitter. The outputs of each of the vision/sound transmitters are further combined and connected to the aerial system by various coaxial components such as diplexers and switching frames. The filterplexers supplied with the monochrome transmitters do not offer the same level and stability of performance of parameters such as in-band insertion loss and return loss as do more recently available filterplexers. In addition the design does not reflect such colour requirements as the suppression of the colour sub-carrier image frequency to avoid spurious out-of-band radiation, and adequate cross-insertion loss between the sound and vision input ports which guards against the production of a visible 1.07 Mhz component in the transmitted signal from inter-modulation between the sound and colour sub-carrier. An evaluation program involving measurement of individual filterplexer characteristics was commenced which included measurements on the transmitter-filterplexer combination in those cases where the filterplexer characteristics varied from those obtainable from a replacement unit. The aim was to determine those transmitters where the filterplexer represented the limiting factor in achieving satisfactory stable colour performance. These measurements showed that the in-band insertion loss of the monochrome filterplexers does not vary outside 0.5 dB across the band and does not jeopardise the power-bandwidth performance of the transmitter-filterplexer combination. The out-of-

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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band insertion loss was generally satisfactory but in some cases an additional coaxial notch filter is required to suppress the colour sub-carrier image frequency to better than 60 dB below peak carrier. The filterplexer cross insertion loss was found to be of the order of 30 dB and measurements with both vision and sound transmitters in operation showed that the 1.07 Mhz product is over 60 dB below peak vision power which is satisfactory. The return loss of the existing filterplexers was found to be worse in some part of the band than the 40 dB to be expected in filterplexers of the new design, with deteriorations in some cases of down to 25 dB at the high end of the band. In this situation the overall transmitter-filterplexer frequency response was examined to assess the presence and position of variations caused by changes in the filterplexer input impedance. In some cases these variations improve the overall response by providing a lift at the high end of the band which can compensate for the minor insertion loss deficiencies in the filterplexer. In other cases the variations act the opposite way and degrade the response at the high end of the band or introduce mid-band disturbances. These variations are usually rapid in terms of frequency and cannot be off-set by normal transmitter tuning adjustment without seriously affecting the power-bandwidth performance. When this occurs the only scope for improvement lies in the addition of matching elements between the filterplexer and the transmitter.

If the overall frequency response of the transmitter filterplexer combination could be made satisfactory, notwithstanding the filterplexer return loss, then the existing filterplexer was not replaced, as the influence of the return loss upon other parameters is marginal as argued by Blair (Ref. 6).

It was found that fewer than 10% of the filterplexers in the National Service monochrome transmitters needed to be replaced as an essential part of the colour conversion work. Where this was done the associated coaxial components were also replaced.

TRANSLATORS

The key factor in the performance of translators with colour signals is the linearity of the common amplifiers which handle vision signals including colour sub-carrier and sound signals. The most critical measure of this linearity is the level of the 1.07 MHz intermodulation product for which a level of 50 dB below peak vision carrier level is required.

An evaluation programme was commenced to assess the level of this intermodulation product for each type of translator used in the National Service. Most translators proved satisfactory for colour operations although in some cases it was necessary to improve the performance by a minor adjustment of the amplifier operating conditions.

ANTENNA SYSTEMS

The antenna systems installed in the National Service seek to achieve a reflection coefficient of the antenna input of 1.5% at vision carrier tapering to approximately 3.0% and 5.0% at the lower and upper band limits respectively. This requirement was developed from original work by the BBC and includes a consideration of colour signals. Installed antenna systems meet this requirement with only a few marginal exceptions and it is not expected to replace any antenna systems solely for colour performance reasons. An investigation programme was undertaken to ensure that the antenna systems had not deteriorated in performance since installation.

STUDIO-TRANSMITTER DIRECT LINK

Direct studio-transmitter links using microwave radio systems are installed at the capital city stations in Melbourne, Brisbane, Adelaide, Perth and Hobart. These systems were installed in the period 1956-1960 and the equipment is obsolete in design with unsatisfactory colour performance and presents an excessive maintenance requirement. All links were therefore replaced with modern equipment.

ANCILLIARY EQUIPMENT

The majority of the ancilliary vision equipment at the main National Stations was replaced with modern solid state units designed for colour operation. Equipment replaced includes video distribution and clamping amplifiers, stabilising amplifiers, video switches, waveform and picture monitors, monitoring receivers, synchronising pulse generators and test signal generators. Specialised colour television equipment being supplied includes a test pattern generator and encoder.

COSTS

The costs associated with the colour conversion of the National Television Service transmitter stations are summarised in Table 2.

TABLE 2 — ESTIMATED TRANSMITTING STATION CONVERSION COSTS

Conversion Work	Estimated Final Cost $M
Complete replacement of transmitters and translators	1.2
Modification and partial replacement of transmitters and translators	1.7
Replacement of aerial systems	—
Replacement of studio transmitter direct links	0.3
Replacement of ancilliary equipment	2.5
Total	5.7

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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STATION EQUIPMENT CONFIGURATION

The increased availability of solid state equipment of high reliability has enabled the configuration of station facilities, particularly in the programme input equipment area, to be progressively simplified over a period of time from that adopted when the major stations were established. A simplified block diagram of the configuration now adopted at a typical converted station is shown in Fig. 5.

PROGRESS AT 1 MARCH, 1975

By 7 October, 1974, progress with conversion work had reached the stage where colour test transmissions were introduced from capital city stations. These test transmissions were subsequently extended to all National television stations and associated translators. These test transmissions which involved test patterns and programme material, proved most effective in enabling available resources to be directed towards the conversion of those aspects of each item of equipment causing the most visible performance deficiencies. By this means it was possible for all National stations to commence regular colour services at a subjectively acceptable level on the official 'C-Day' of 1 March, 1975.

Following this date, the conversion work as planned continued at the majority of regional stations. Completion of this work ensures that the

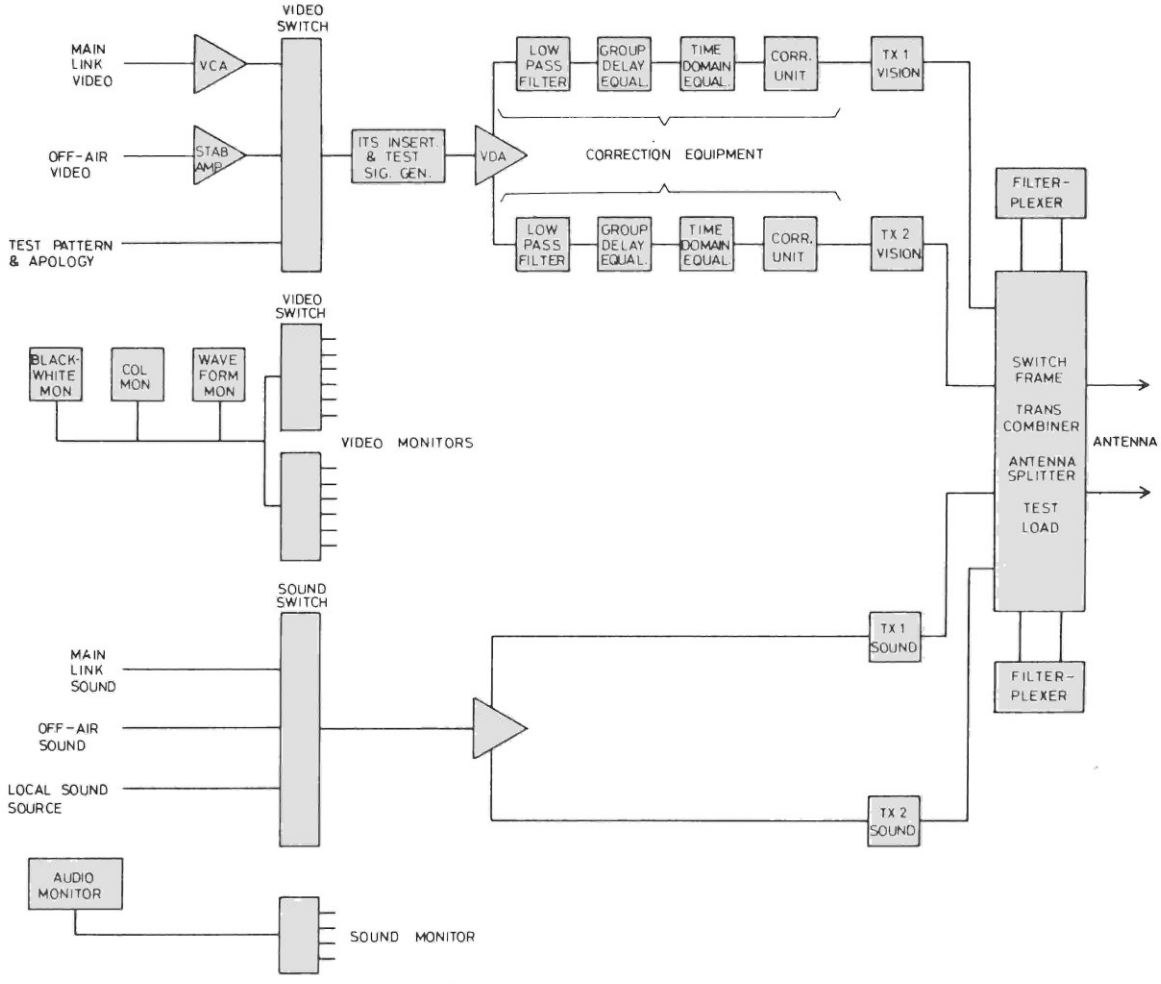

Fig. 5 — Simplified Diagram of Facilities at Typical Converted Station.

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stations fully comply with transmission standards and are adequately equipped with the operating testing and monitoring facilities for reliable long term colour operation. Over 75% of stations were fully converted by the end of 1975.

EVALUATION TESTS ON ORIGINAL HOBART TRANSMITTER

The original transmitter at ABT2 Hobart comprised a 5 kW modulated amplifier stage driving a 22 kW linear amplifier stage. In the event of the failure of the 22 kW final stage, the output of the 5 kW modulated stage could be connected to the antenna system directly. This allowed programme to be maintained on low power.

The effect of this arrangement on evaluation work was that testing had to be carried out after close down each night and yet the transmitter had to be ready for operation by the following morning. Also, any work involving existing circuitry was lengthened because any unsuccessful modifications had to be removed before the morning. Overall tests were carried out from the input of the transmitter through all the stages in their normal configuration through the filterplexer into a precision dummy load. It was found that high amplitude high frequency signals suffered serious crushing to less than one half correct amplitude. Work was then undertaken to determine which particular sections of the transmitter were causing the distortion and to see if the performance could be improved. This was done by examining the performance at the output of the 5 kW modulated stage with the stage terminated in a precision load. It was found that serious signal degradations occurred, with the response to high amplitude, high frequency signals being 4 dB down to 5 MHz above vision carrier. This could not be improved by transmitter retuning.

The performance at the output of that stage is shown in Table 3.

TABLE 3 — COLOUR PERFORMANCE OF ORIGINAL HOBART TRANSMITTER

Test	5kW Mod. Stage	22kW Lin. Stage	Overall	Spec.
Chrominance/ Luminance Inequalities				
Gain	—5dB	—4dB	—8dB	—0.8dB
Phase	—100nS	—70nS	—	—30nS
Differential Gain	28%	35%	—	5%
Differential Phase	4°	4°	—	5°
Chrominance Non-Linearity	42%	60%	—	7%

With the 5 kW modulated stage driving the 22 kW linear stage terminated in a precision load, it was found that the high frequency performance of the 5kW modulated stage was further degraded. This was due to the loading from the 22 kW stage input and arose from poor matching of impedances between the output of the first stage and input of the next. No tuning adjustments were provided for interstage matching. The only way to set-up the two stages was to tune them as a pair. This was done and a further set of measurements were made and the results are also shown in Table 3. The performance although improved slightly at the high frequency end of the band was still not satisfactory. The differential gain had further deteriorated. With the output of the linear stage connected through the filterplexer the response was further degraded at high frequencies as shown in Table 3.

The inadequate power capability at high frequency is a basic characteristic of the original transmitter and could not be overcome without extensive modification.

INSTALLATION WORK AT HOBART

The paramount problem at all stages of the installation work was the essential requirement to keep the existing equipment operational so as to maintain service. This problem effected both the decision as to where to locate the new transmitter equipment and the sequence in which the new equipment installation was to take place.

Location

The transmitter hall at Hobart has a floor area of 300 square metres. However, location of the new equipment was restricted to a relatively small portion of the floor area for the following reasons:

- It was preferable to maintan a similar equipment/ building configuration to that existing.
- The switching frame of the new transmitter had to be near to the existing antenna feeder entry point.
- The new equipment could not be located so close to the existing transmitter as to prevent maintenance access.
- It was necessary to have suitable accommodation directly under the transmitter for forced air cooling equipment.
- Any holes that were required in the floor had to avoid the lattice of floor supporting beams.
- Any new rigid coaxial feeders, air ducting or cables had to avoid existing feeders, ducting or cables.

Fig. 6 shows the arrangement adopted. The new transmitter suite is located parallel to and behind the original transmitter. They were spaced apart

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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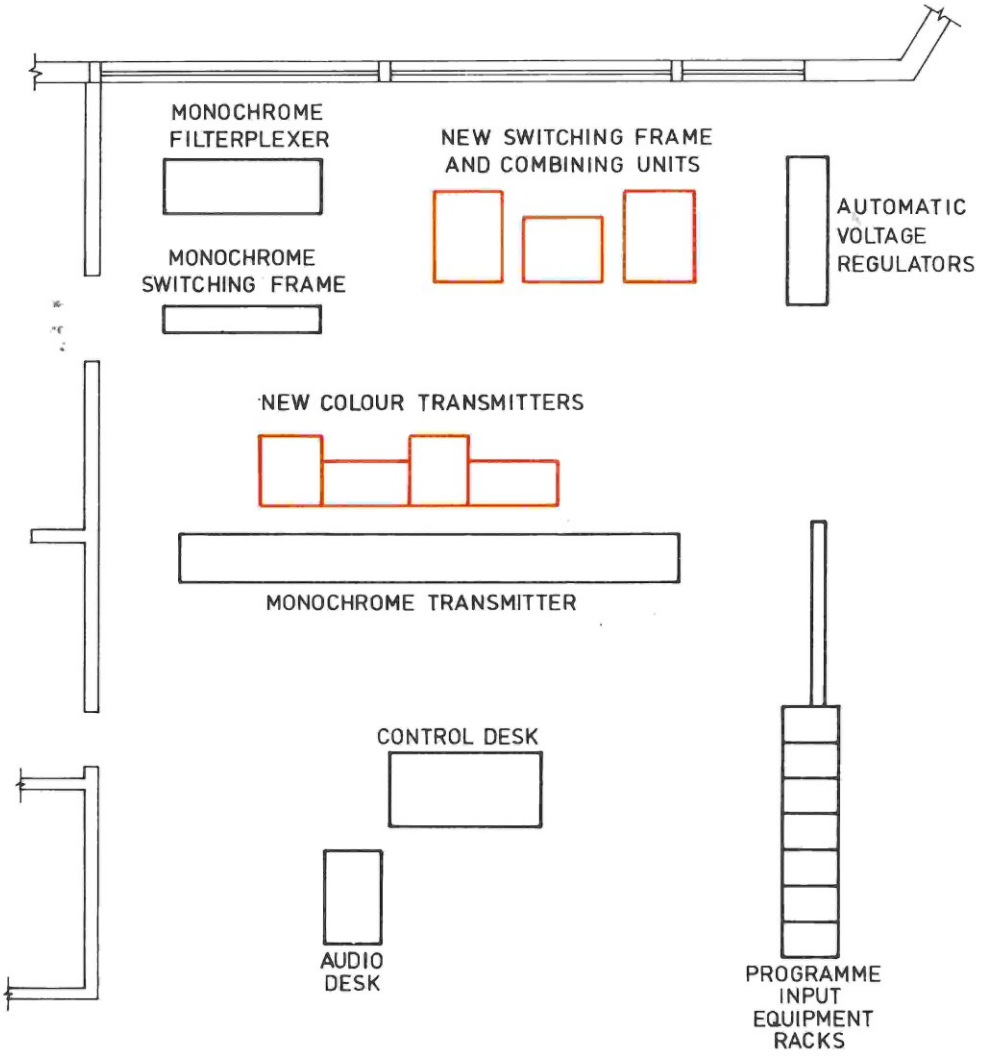

Fig. 6 — Layout of ABT-2 Hobart.

in such a way that the rear doors on the original transmitter could be opened for maintenance access and the front doors and panels on the new transmitter could be opened or removed for installation access. Fig. 6 also gives an appreciation of the reduction in size of the new transmitter units in comparision with the original 15 year old transmitter.

Fig. 7 shows the arrangement at the rear of the original transmitters. The temporary repositioning of the transformers seen to the right of Fig. 7 provided space at the rear of the new transmitters for the new combining units and switching frame. This satisfied the requirement of having the new switching frame close to the area of the old one in order to gain access to the main antenna feeders.

The basment area under the new transmitter was clear of any other air ducting or equipment and no problems were met in locating air blowers directly under the power amplifier cabinets. Fortunately the new positioning allowed for holes to be cut for air ducting and cables without fouling the floor beams. The only spatial problem to arise was that an original set of rigid coaxial feeders passed over the new transmitters and would foul the air cooling ducts above one unit. The location of the feed-

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
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Fig. 7 — Arrangement of Rear of Original Transmitter.

ers can be seen in Figure 7. On closer inspection, it was found that only the bottom pair of feeders would foul the air duct. The bottom two feeders are only used for testing either the sound or vision transmitters into dummy load, without the filterplexer. Consequently removal of the bottom pair, during the final stages of installation, would only reduce the test facilities of the original transmitter for a short period.

Sequence

It was first necessary to clear the area that the new transmitters and associated equipment would finally occupy. A large portion was already clear as can be seen from Figure 7. However it was necessary to relocate the original power supply components away from the area to be occupied by new frames. It was fortunate that most of the original power supply leads were too long and had been folded back in the cable trunking under the floor. This allowed transformers and chokes to be moved without extensive recabling. The rearrangement was carried out after programme hours and the power requirements were checked and tested before programme the following morning.

Holes were cut in the floor prior to the delivery of the transmitter equipment. The floor thickness is 152 mm (6 inches) and diamond drills were employed. The inevitable hidden conduit was hit by the drilling, successfully extinguishing the whole of the basement lighting system.

It was decided that the new transmitter furthest from the original feeders would be installed first. The second one would then be put in position and when the time was reached for air to be supplied to the second unit the two lower feeders would be removed. This sequence provided a margin of safety in that if a failure in the original monochrome transmitter required it to be tested into dummy load, there would be one of the new transmitters that could be put to air with programme while the two test feeders were being replaced.

Transmission

At the correct stage in the installation, it was necessary to connect the new transmitters to the antenna system. The final arrangement was to connect the main external antenna feeders via suitable reducers to the $2\frac{1}{8}$ in. rigid coaxial feeder used from the new switching frame. The mono-

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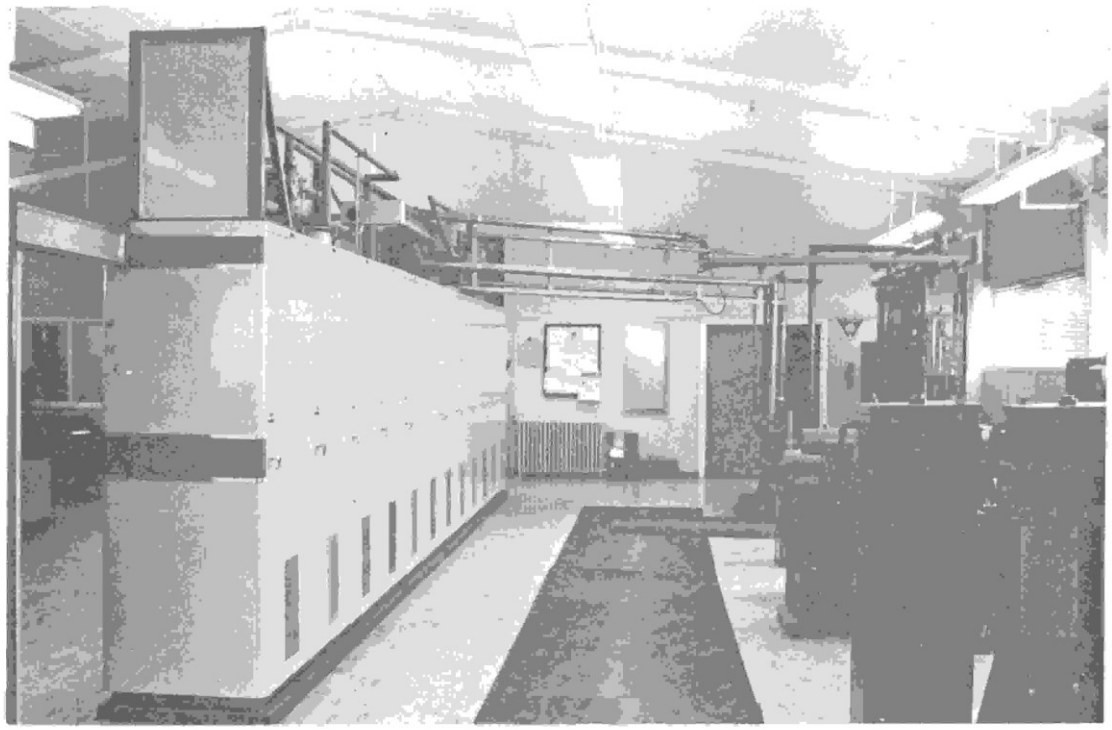

Fig. 8 — New Colour Transmitter at Hobart.

chrome transmitter was connected by $3\frac{1}{8}$ in. rigid feeder to the main external feeder via a switching frame, which contained several electrically operated coaxial switches. This arrangement enabled the output from the monochrome filterplexer to be connected to:

- Dummy Load
- Both halves of the antenna via a power divider.
- Upper antenna only
- Lower antenna only

The new switching frame provides the same facilities but was not brought into full use until the two transmitters had been completely tested and the main antenna feeders connected to the $2\frac{1}{8}$ in. feeder. It was however, advantageous to retain the antenna splitting facilities, in case of a fault. An electrically driven coaxial switch was located in series with the feed from the monochrome filterplexer, for use as a 'change over' switch between the monochrome and colour installations, whilst maintaining full antenna switching flexibility. The main purpose of the changeover facility was to enable the new colour installation, 10kW at first, to be put to air for trade test transmissions of colour test pattern. Normal monochrome programmes were then broadcast using the monochrome transmitter whilst work continued on the new colour transmitters. Finally when the colour installation was complete and the permanent connections made to the antenna feeders, the monochrome installation was removed completely, leaving the final arrangement as shown in Fig. 8.

CONCLUSIONS

The National Television Transmitting Stations have been converted to colour operation by the modification of those items of equipment unable to handle the increased transmission demands of colour signals. If the necessary modifications were expensive or the item was becoming a maintenance liability then the item was replaced. This engineering approach was aimed at providing a colour service in compliance with Australian Standards, at minimum cost. Experience with colour operations is expected to show the areas in which there is an opportunity to improve further the standard of the service in both quality and reliability and to reduce the maintenance costs.

Australian Journal of Telecommunications and the Digital Economy Volume 4 Number 3, September 2016
ISSN 2203-1693. http://doi.org/10.7790/ajtde.v4n3.65

REFERENCES

1. Australian Broadcasting Control Board: 'Technical Standards for the Australian Television Service'; April 1970.
2. Australian Post Office: 'Television Transmitter and Translator Equipment'; Specification 871, Issue 5, January 1972.
3. Bartlett, H. F.: 'The Preparation of Television Transmitting Stations for Colour'; Proc. I.R.E.E. Aust., Vol. 31, No. 9, September 1970.
4. Bartlett, H. F.: 'Design Trends in Television Transmitters'; Proc. I.R.E.E. Aust., Vol. 34, No. 9, October 1973.
5. Ohshima, T., Sakai, T. and Higashi, S.: 'New Series VHF Television Broadcasting Transmitter'; NEC Research and Development No. 20, January 1971.
6. Blair, R. H.: 'Colour Conversion of National Television Plan'; Symposium 'Broadcasting — The New Era', University of Adelaide, August 1974.

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The Transformation of Telecom's "Ugly Duckling"

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Abstract: Telecom's directory publishing business produced the White and Yellow Pages directories from 1975 to 1991. Prior to 1980, directory publishing was regarded within Telecom as a side show to the mainstream business – telecommunications. In 1976 the directory publishing business was in a crisis; it ranked in the top three of Telecom's public relations problems, was operating at a loss which would rapidly increase, and was becoming untenable. Over the next 15 years the publishing business was transformed to become the most profitable and innovative business in Telecom. This is the story of that transformation, which also illustrates the difficulty in innovating in a public service business at that time. A remarkable improvement in performance in the first five years failed to establish credibility within Telecom. What might have taken less than ten years to achieve in the private sector took more than 20 years in Telecom and Telstra.

Keywords: Telecommunications, Directory, Publishing.

Directory Publishing

Telecom, and its predecessor the Postmaster General's Department (PMG), published telephone and other directories to assist customers to make calls on the network. In 1976 Telecom published the White and Yellow Pages in 63 telephone directories, a telex directory (28,000 copies) and a Telegraphic Code Address Directory (35,000 copies).

Disclosure

This is not an academic paper; a more accurate description would be a reflective historical paper.

The paper is supported by a number of records from the period, including business plans, business cases, and trading statements, as listed under "References". The records are incomplete but sufficient to support the points made. A number of these records no longer exist or are not easily accessible, such as those in the archives of Telstra and its predecessors.

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Opinions and judgments are mine unless otherwise stated. Those of Telstra and its predecessors are expressed using standard private sector criteria including growth, market share, customer service and profit, rather than using public service criteria.

Telecom in 1976

This section draws on material in the following references:

- Study of the Organisation of the Postmaster-General's Department (CMP 1973);
- Vernon Royal Commission of Inquiry (Vernon 1974);
- Evaluation of (the APO's) Financial Management (Price Waterhouse 1974);
- Report of the Committee of Inquiry into Telecommunications Services in Australia (The Davidson Report) (Davidson 1982).

The report of the Vernon Royal Commission of Inquiry with its contributory studies into the Postmaster General's Department (PMG) recommended in 1974 to the Whitlam Government that the PMG be split into two businesses, the Australian Telecommunications Commission (Telecom Australia) and the Australian Postal Commission (Australia Post). The two businesses were to each have a board of management, be operated on "commercial business principles", with personnel and other employment policies, including industrial relations, suited to the new businesses and independent of the Public Service Board. Two of the key consultants to the Commission of Inquiry into the Australian Post Office were Cresap McCormack & Paget (CMP) and Price Waterhouse. [1] [2] [3]

The new Telecom was designed and implemented in 1975 by senior managers transferring from the PMG. Key recommendations of the Vernon Report were not implemented: for example, the new district organisation was based on state boundaries rather than on commercial principles; the one senior manager appointed from the private sector had little commercial experience; and the personnel and other employment policies, processes, and culture of the public service were retained.

The resulting business was minimally commercial in organisation, skills, focus, priorities and processes. From 1975 until 1989, except for a brief period, there was only one senior manager in Telecom who had a significant commercial, private sector training and experience.

This background is crucial to understanding Telecom's resistance to the transformational change needed and proposed for directory publishing. Vastly different from the private sector driven by markets, Telecom, with its monopolies, union constraints and public sector legacy, preferred change on its own terms with minimal risk; it was familiar with managed technical change but not commercial change.

The Fraser government elected in late 1975 made no significant attempt to influence change in Telecom until 1981. AUSSAT Pty Ltd, another government carrier, was established in 1981

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to operate domestic satellite telecommunication and broadcasting services, and the Davidson Inquiry (Davidson 1982) was launched in 1982 to assess private sector involvement in the delivery of existing and proposed telecommunications services, including "value added" services. Davidson recommended radical change in Australia's telecommunications market; widespread competition in customer premises equipment, resale of telecommunications capacity, the installation and operation of private networks and the interconnection of private networks with the public network. These were rejected by the incoming Hawke Labour government in March, 1983.

Attempts to implement change in directory publishing from 1976 proceeded with minimal internal support, and sometimes obstruction, until the mid 1980's. By the end of the 1980's, with more radical change possible, directory publishing had become a cash flow powerhouse impossible to ignore.

Telecom's Directory Publishing Business in 1976

This section draws on material in the following references:

- Directory 81 – an initial business strategy for the Directory Function – 1976/81 (Telecom 1976a);
- Telecom Australia National Product Costing Results for the year ending June, 1976 (Telecom 1976c);
- Telecom Australia Annual Reports for the years 1975/76 to 1988/89 (ATC 1975-1989)

In June, 1976, there were 3.7 million telephone services in operation in Australia. Over that year there were over one million changes in the telephone directories; 335,000 new services connected and 449,000 cancellations (of which 280,000 services were re-connected for the next customer in a home or business). This “churn” of listings - approaching 25% and climbing - justified producing a new edition of the White Pages for each telephone area each year. Over 10 million books were printed each year and the printing task was one of the largest in Australia.

At that time the Sydney and Melbourne directories were so large that the White and Yellow Pages were split into separate volumes and the Yellow Pages into two volumes - commercial and industrial. All telephone directories for other areas in Australia were White and Yellow Pages combined into one volume.

The Sydney and Melbourne Yellow Pages format – “commercial" and "industrial”, each in a separate volume – was so unpopular with users and advertisers that this ranked in the top three of Telecom’s public relations problems.

Usage, the reason for the existence of the White and Yellow Pages, was not known. The sharp rise in directory assistance costs over the previous five years by more than 40% - from

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$4.3 million in 1971 to $17.7 million in 1976 – suggested that usage of the White Pages was declining.

The mainstream paper-based and computer systems and related databases and production processes were fragmented across Australia, unable to handle the growing transaction volumes, and the computer systems were approaching a state of chaos.

Table 1 attempts to show the contractors involved in each process and the locations of the processes. About 30% of the White Pages database was converted to computer format, with the rest still on paper records. There were four different and incompatible White Pages computer systems maintaining the listings databases and compiling and paginating the directories; each system with its own database, one operated by Telecom and three by the contractors at five locations. The situation was similar for the Yellow Pages.

Table 1: 1976 - Directory Publishing Processes and Contractors

	% of Work Converted to Computer	Brisbane	Sydney	Melbourne	Adelaide	Perth
Production						
White Pages databases	30%	A	T	B	B	D
Yellow Pages databases	50%	A	A	E	B	D
Pre-press	n/a	A	A	E	C	D
Printing	n/a	A	A	E	C	D
Sales						
Yellow Pages database	100%		F	G		

T = Telecom A, B, C, D, E, F, G = Contractors

There were three reasons for this mess.

For example, Telecom used three production contractors (A, B and D) to maintain the White Pages databases which were used for pre-press (composing into pages and plate making for printing), and for printing directories. Contractor A maintained the White Pages database in Brisbane, Contractor B in Melbourne and Adelaide, and Contractor D in Perth.

Firstly, at that time the Australian printing industry was converting as fast as possible from the old manual pre-press processes to the new screen-based computer systems to input listings and artwork, manage the databases, and compile and paginate the pages for printing. The benefits that these new computer systems offered to the industry were massive: much more sophisticated printing capabilities, higher printing quality, far faster processing times, far lower error rates and much lower operating costs.

Secondly, because Telecom was slow in developing mainstream computer processing systems, including directory publishing systems, the contractors developed their own

http://doi.org/10.18080/ajtde.v4n3.61

systems to obtain the obvious benefits until Telecom "caught up". Worse, as Telecom had no White Pages or Yellow Pages computer systems strategy, the four contractors were advancing their computer systems independently without any guidance from Telecom.

Finally, Telecom's internally developed directory computer system, with about 30% of the listings converted, appeared to be well behind the most advanced comparable systems in the USA and Canada. Telecom's system was intended to replace the contractors' systems as the future national, standard White Pages system in about two years. By this time the system would be obsolete.

The four contractors used for pre-press and printing operated centres for data processing, pre-press and printing plants in five states. These operations complicated directory production and provided no benefits of scale. The printing capability and related equipment was approaching obsolescence; the colour printing capability was minimal, production rates were far too slow, and the printing quality was generally unsatisfactory.

The marketing of advertising in the Yellow Pages was passive with two contractors used to sell the service and minimal advertising and promotion. The computer systems used by the sales contractors were different and were operated on the contractors' premises. The level of complaints by customers and advertisers was unacceptably high as was the revenue forgone by the passive approach and outsourcing.

Apart from the inefficiencies and cost of the large number of incompatible computer systems, the fact that the White and Yellow Pages databases were maintained on the production and sales contractors' premises with the contractors' systems was strategically unacceptable. It meant that Telecom's ownership of the data was tenuous at best.

Directory publishing was regarded within Telecom as a necessary but separate and "non-core" activity compared to the mainstream business of telecommunications – building and operating the network. Directory management and staff, many of them long serving, were considered as “less than equal” to the elite mainstream; the thinking was that a job in directory publishing reduced career prospects in the parent business.

Almost all of the directory publishing businesses in advanced countries were highly profitable; the White Pages operated at a marginal loss but the Yellow Pages usually had a gross margin of over 40% on sales. The little financial information available indicated that Telecom's directory business was unique; in 1976 it would operate at a loss and the loss would increase rapidly.

There was no business plan and no credible plan to address any of the main problems. The business was sinking.

http://doi.org/10.18080/ajtde.v4n3.61

The Initial Directory Publishing Strategy - "Directory 81"

A “first order” business plan was proposed in late 1976 – named “Directory 81” (Telecom 1976a) – which defined a vastly improved business to aim for in 1981, five years away.

"Directory 81" was a standard business planning approach; it nominated three options to better understand the business issues, the related opportunities and consequences of each option, and to prepare the ground for agreeing the proposed way ahead.

- Option A: "Business as usual – band aid to keep the business operational";
- Option B: "Fix the Sydney and Melbourne Yellow Pages problem and drive for a high sales growth while attempting to reduce costs within the restrictive public service framework";
- Option C: "The private sector approach; transform the business".

Capital expenditure over the five-year period for options B and C, mainly for computer systems and equipment, was expected to be less than $10 million, less than 3% of Telecom's capital investment program.

Option "C" over the five years would dramatically improve the business. The Yellow Pages directories in Sydney and Melbourne would be re-formatted to market demand with the next issue. Processes would be re-engineered, standardised and automated nationally. Production contractors would make a major investment in the emerging pre-press and computer technologies to increase prepress and printing capabilities and capacity, to improve product quality, and to sharply reduce production and distribution costs and times.

Management and staff would be recruited, trained and motivated for the task. Outsourcing contracts for advertising sales, listings management, compilation, pagination, prepress, printing and distribution would be made more demanding and accountable to improve quality and operational and financial performance, and consolidated to provide scale benefits.

Looking back, it is interesting to note that in late 1976 inflation was running at about 13%, making any financial projections beyond one year somewhat heroic.

"Directory 81" attracted little interest among Telecom's senior management beyond fixing the Yellow Pages problem in Sydney and Melbourne, and there was no encouragement for implementation. Implementation proceeded in areas where it was possible – such as sales – which did not require significant internal support. To achieve faster progress, overseas experience, technology and systems were sought and adopted where useful, using the contractors as conduits to overseas sources of information. Internal development such as in

http://doi.org/10.18080/ajtde.v4n3.61

systems would be minimal. To motivate the contractors their contracts would be reconstructed to meet the plan.

The outcome would be a directory business which still outsourced Yellow Pages sales, pre-press, printing and distribution and was approaching world benchmark performance within five years.

The main elements of the strategy are outlined in a later section.

The Performance against "Directory 81" Option "C" - Transforming the Business

This section draws on material in the following references:

- Directory 81 – An initial business strategy for the Directory Function – 1976/81 (Telecom 1976a);
- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81 (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory 1981-1986)

Table 2 shows the outcome five years later against the three forecast options; the financial results substantiated the practicality of Option "C".

Table 2: Directory Publishing – Financial Performance against Directory 81 Projections – 1976/81

	Option "A" est. 1980/81	Option "B" est. 1980/81	Option "C" est. 1980/81	Actual 1980/81	Variance from Option "C"
Revenue $m	55	68	81	120	+39
Publishing Costs $m	66	66	68	83	-15
Net Profit $m (before Interest & Tax)	-11	2	13	37	+24

Source: (Telecom 1976a; Telecom 1976b; Directory 1981-1986)

The business, which made a loss in the first year, 1976/77, made a profit in year five of $37 million, exceeding the "Directory 81" Option C by $24 million.

This "non-core" publishing business now contributed 4.6% of Telecom's revenue and almost 15% of Telecom's profit at a gross margin on sales of over 30%, an extraordinary recovery.

The main reason operating costs in year five exceeded Option "C" by $15 million was that higher sales, particularly of Yellow Pages advertising, caused higher printing and paper costs. Another reason was that the operating costs of the mainstream processes could not be reduced to the potential due to substandard computer systems.

http://doi.org/10.18080/ajtde.v4n3.61

The directory business had become far more market oriented. Users were generally satisfied with book formats around the country. Usage was being measured and used as a guide to make the books more attractive and to refine promotion.

Telecom's contractual frameworks for sales, pre-press, and printing and for purchasing paper were all revised as applicable to those models provided by the world leaders in directory publishing in the USA and Canada – AT&T, GTE, Reuben H Donnelly and Bell Canada.

The production and distribution quality had improved markedly, costs and times for all directories had fallen considerably, and delivery was usually on schedule.

While directory services were still only a relatively small part of Telecom's business in terms of sales value, it appeared to rank around 150th by revenue in the businesses listed on the in Australian stock exchange.

The main failure in the first five years was slow progress towards nationwide standard systems at world class parity. The strong performance in the first five years made no difference to the lack of support from Telecom to fast track key areas of the business, including systems and contracts; the next ten years were to be a constant grind.

The Main Strategic Actions

This section draws on material in the following references:

- Directory Services Program 1976-1981 (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981-86 (Directory Services 1981-1986);
- Telecom Australia Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988).

The main strategic actions taken from 1976 were textbook, unremarkable in the private sector.

The priorities were to drive book usage and revenue growth, strip out costs to "lowest cost" in the industry – standard nationwide systems at world parity, one pre-press and printing plant, and escape from public service employment policies – secure the data bases and prepare for an electronic future.

To achieve faster progress, the business would adapt overseas experience, technology and systems, using the contractors as the major source of information.

The outcome would hopefully be a directory business which was operating at world benchmark performance within five years.

http://doi.org/10.18080/ajtde.v4n3.61

The Main Strategic Actions - 1. Quickly reformat the Sydney and Melbourne Yellow Pages from "commercial/ industrial" to the familiar "classifications A-Z".

This section draws on material in the following references:

- Directory Services Program 1976/77 - 1980/81 (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory 1981-1986);
- Enterprises Division Strategic Review 1988. (Telecom Enterprises 1988)

This would resume the format popular with users and be a sound basis for the next Yellow Pages sales campaign. It would also greatly reduce the number of complaints from advertisers and users.

The popular new format was announced in early 1977 so that it was the basis for the Yellow Pages sales campaign in Sydney and Melbourne beginning in February, 1977, and for the new format books to be distributed in late 1977. This move was crucial, not only to fix the public relations problem, but because the Sydney and Melbourne Yellow Pages contributed almost 50% of the national Yellow Pages revenue. With an increase in binding capacity installed for the following year, the Sydney and Melbourne Yellow Pages were each issued as a single volume.

The Main Strategic Actions - 2. Rapidly increase Usage of both the White and Yellow Pages.

This section draws on material in the following references:

- Directory Services Program 1976/77 to 1980/81 (Telecom 1976b);
- Directory Services Review of Activities 1981/82 to 1985/86 (Directory Services 1981-1986.);
- Enterprises Division Strategic Review (Telecom Enterprises 1988)

Usage was the prime purpose of telephone directories – to increase the number of calls made on the network. It was also the foundation for ramping up sales of White and Yellow Pages entries and, hopefully, containing the growth of directory assistance operating costs.

The pursuit of usage was problematic and challenging. Could usage be increased and if so by how much?

White Pages usage in the early years appeared low and calls to directory assistance were soaring; the costs of the directory assistance service were $4.3 million in1971; $17.7 million in 1976 and $31.6 million in 1981. The Australian people appeared to increasingly prefer to call directory assistance rather than use the "unattractive, clumsy" paper directories. Over 60% of calls to directory assistance requested a number that was listed correctly in the White Pages. A more attractive White Pages in every household and business reduced the need for a

http://doi.org/10.18080/ajtde.v4n3.61

customer to call directory assistance. It also strengthened the case for a charge for a call requesting a number which was correct in the current book.

For the White Pages the dominating drive was to increase usage by making the books more useful, more attractive and easier to use, and on that foundation promote higher usage. The White Pages were made more attractive by a range of enhancements. For example:

- from 1977 the emergency services pages and the various levels of government information pages were progressively made easier to access and read. In the same year ethnic sections appeared in the front of metropolitan directories providing information in a number of languages other than English and rolled out to other directories in the following years.
- beginning with the 1979 issue of the Perth directory, a four-colour indexed information pages section was introduced to make the information pages easier to understand and use; this was extended across all White Pages directories over the following year.
- in 1980, maps of the area covered by the directory were provided on the back cover of country directories showing the area covered and the adjacent STD (long distance calling) area codes.
- in 1981 a Community Information section (Blue Pages) was launched on the Gold Coast.

The front covers of the White Pages promoted various prominent activities and events to lift brand recognition. In 1979 the front covers were designed by primary school children living in the area of the directory. Children across Australia submitted well over 100,000 entries in a contest for the design of the covers of the 1980 telephone directories to mark the "International Year of the Child" and the 1980 centenary of the first telephone directory in Australia. The subject of the drawings was "a child's view of our heritage". The 1981 covers promoted "The International Year of the Disabled".

A national tracking study was launched in 1979 to measure directory usage nationally and observe any changes in usage. The first results in 1979 revealed that over 60% of people over the age of 14 years used the White Pages in the last seven days. The average usage was 5.5 times a week and a total usage of 39 million times per week. About 80% of people who used the White Pages did so to find a telephone number and call it right away, and about 30% used the Yellow Pages on the same basis.

It was disappointing, but probably inevitable, that the usage of the White Pages remained roughly steady for the next few years; even though the directories were being progressively improved people increasingly called directory assistance.

http://doi.org/10.18080/ajtde.v4n3.61

From 1981 the White Pages was the only directory of its type in developed countries to make a profit.

For the Yellow Pages boosting usage not only assisted to increase calls on the network, it increased the value of the product as an advertising medium to advertisers and the sales of Yellow Pages advertisements.

As with the White Pages, to increase usage of the Yellow Pages the product was made more attractive and easier to use. A major difference was that the Yellow Pages was very heavily promoted and sold as an advertising medium.

The format problem for the Sydney and Melbourne directories was fixed in 1977. In 1981 the Adelaide and Perth directories were split into separate White and Yellow Pages.

Apart from restructuring a steady range of improvements and features were introduced. For example:

- covers were standardised on the Yellow Pages logo to strengthen brand recognition,
- in 1980 colour coded information pages were introduced, and the range of advertisements was expanded. Locality indexes – for example, dentists in Melbourne listed by suburb – were made more comprehensive. A number of new types of advertisements were developed to improve the convenience to users and offer more affordable advertisements to smaller and new advertisers.
- red, a second colour to black, was introduced to the advertisements range in 1984 as a trial, and then rolled out during the following year.

The Main Strategic Actions - 3. Drive Revenue Growth of Yellow Pages Advertising

This section draws on material in the following references:

- Directory Services Program 1976 – 1980/81 (Telecom 1976b);
- Directory Services Review of Activities (Directory Services 1981-1986);
- Enterprises Division Strategic Review (Telecom Enterprises 1988).

Revenue growth targets for sales of advertising in the Yellow Pages were ambitious and were based on usage and the value as an advertising medium to advertisers.

With the formats, appearance and utility of the Yellow Pages progressively improving, in 1978 spending on advertising and promotion was almost tripled over the previous year; in the following years the increase was about 15%pa. This rise in spending was validated by the sales increases achieved, but was controversial in Telecom as many believed spending on advertising was "wasted money".

http://doi.org/10.18080/ajtde.v4n3.61

Table 3: Usage of Yellow Pages and Advertising Recall through Interviews - 1979/81

Last Time used Yellow Pages	Wave 1 %	Wave 2 %	Wave 3 %	Wave 4 %	Wave 5 %	Standard 6 %	Error %
- in the last 7 days	28	27	28	29	34	30	+/-2
- in the last 14 days	40	41	43	42	48	45	+/-2
- in the last 28 days	51	50	53	52	58	55	+/-2
- in the last 6 months	70	72	74	74	77	77	+/-2
- in the last 12 months	75	77	78	79	81	81	+/-2
- at some stage		86	88	89	89	90	+/-2
- never used Yellow Pages	14	12	11	11	7	10	+/-1
Recall of Yellow Pages Advertising	42	49	51	54	56	58	+/-2
Refer to Yellow Pages as a Buying Guide	39	41	42	45	45	43	+/-2

Population is people over the age of 14. Source: Australian Sales Research Bureau Pty Ltd through Roy Morgan Research Centre Pty Ltd

As with White Pages, Yellow Pages usage and advertising effectiveness were tracked by market research. The surveys for the Yellow Pages were more extensive and were more focussed on driving sales. Table 3 provides an example of the methodology and shows that usage increased modestly in the first two years. Advertisers considered these early results sufficiently convincing to support a large increase in sales over the next decade and beyond.

Table 4: Usage of Yellow Pages and Sources of Buying Information - 1981/84

Year ending June	1981	1982	1983	1984
- used at least once in the last 7 days	30%	38%	53%	55%
Sources of information when buying a product or service (a person could name one or more sources).				
Yellow Pages	43%	64%	70%	72%
Daily Newspapers	42%	50%	47%	47%
Local Newspapers	37%	39%	39%	40%
Television	20%	27%	19%	20%
Weekly Newspapers	11%	17%	18%	15%
Radio	10%	9%	7%	8%
Magazines	10%	10%	9%	9%

Population is people over the age of 14. Source: Australian Sales Research Bureau Pty Ltd through Roy Morgan Research Centre Pty Ltd

National promotions included the Australian Open Tennis Championship, the Australian Open Golf Championship, the Little America's Cup (for small catamarans) and the Australian Small Business Awards. Advertising campaigns supported the sales campaigns

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and were aimed at usage after distribution of a book. Advertising themes included: “If you need a little help (in buying a product or service consult the Yellow Pages)”; “Run around Sue” who saved money, time and effort by using the Yellow Pages; and "(Yellow Pages advertising) working 365 days a year”.

The use of "survey" phones was increased to demonstrate the effectiveness of Yellow Pages advertising to an advertiser. A "survey" phone was installed in an advertiser's premises with a number that only appeared in that advertiser's Yellow Pages advertisement; the number of calls to that phone number indicated the effectiveness of the advertisement and the Yellow Pages as an advertising medium.

The marketing program – the combination of product improvement, a more professional and more highly motivated sales force, more rigorous quality controls preventing dubious sales practices, improvements in customer service and much stronger and focussed promotion and advertising – clearly worked. The White Pages brand was already strong. The Yellow Pages brand became one of the most recognised in Australia, as did the "Walking Fingers" logo. Sales of Yellow Pages advertising increased by over 350% in five years.

Table 4 shows that from 1981 the Yellow Pages dominated other advertising media as source of buying information; when people thought about buying a product or service.

The Main Strategic Actions - 4. Diversify the Directory Product Range and Revenue Base and establish a strong position in Emerging Markets, particularly in Electronic Services.

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81 (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory Services 1981-1986);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988)

A more diverse product base would accelerate revenue growth and strengthen Telecom's market position and market share ahead of the competition in the traditional directory markets.

Diversification was pursued in three broad areas: traditional directory printed products, mass-market electronic directories and specific-market electronic services.

Although the standard White and Yellow Pages continued to be the basic directory products, changes in the market and the emergence of competition spurred the introduction of new printed products.

http://doi.org/10.18080/ajtde.v4n3.61

For example, Community Phone books were introduced in 1983 in several trial suburbs in Sydney and Melbourne, and then rolled out to other suitable suburbs and in other cities.

Both the Sydney and Melbourne Yellow Pages covered very large areas. Melbourne extended from Frankston in the east to suburbs more than 40 kilometres away in the west. Many advertisers in the Melbourne Yellow Pages such as tradespeople only wanted coverage in their nearest suburbs, and the Community Directory provided this option. In addition, users in a suburb sought a range of local services such as from plumbers and dentists in the immediate area, and appreciated a more convenient directory for these services in addition to the comprehensive standard White and Yellow Pages.

In 1985 the Australian Business Communications Directory was launched which combined the existing Telex and Telegraphic Code Address directories, and in 1990 was re-launched as a “National Business Directory”.

Even in 1976 it was clear that electronic directory and related services were a crucial part of the directory future. Computer terminal access to remote electronic directory databases, other databases and electronic services was certain to happen, but the speed and nature of the transition was speculation.

In 1978 the France PTT launched "Minitel" – a Videotex online service accessible through telephone lines – in Brittany, and extended it throughout France in 1982. Millions of terminals were placed free with telephone subscribers instead of providing the traditional White Pages. Customers could access White Pages listings free but were charged for access to Yellow Pages listings and advertisements. Users could make online purchases, make train reservations, check stock prices, search the telephone directory, have a mail box, and chat in a similar way to that now provided by the Internet.

Minitel was one of several "nation building" projects launched and heavily subsidised and supported by the French government during the 1980's. Other projects included deployment of digital information services, accelerated digitisation of the telecommunications network and high speed trains.

In late 1979 the UK Post Office introduced a far less ambitious (and less funded) inter-active videotex type of service called Prestel.

The French PTT released very little information about Minitel such as the Minitel price – said to be $US100-200 per terminal – the take-up rate, usage, investment, operating costs, and savings achieved from any reduced distribution of White Pages. Around 1980 the price of similar terminals in Australia was estimated at over $A1000. Modelling indicated that an Australian Minitel service would accelerate customers’ electronic access to directory and other databases, as in France, but the service would produce a very large negative cash flow

http://doi.org/10.18080/ajtde.v4n3.61

during the 1980's, beyond Telecom's capability to resource. During the 1980's there appeared to be no political support from the Australian government to heavily subsidise an Australian Minitel-type of service. Telecom monitored developments in France during the 1980's, but over that period the cost structure continued to be prohibitive, political interest in Australia remained low and the service viability was essentially unchanged.

Meanwhile, Telecom developed prototype electronic White and Yellow Pages in the early 1980's but these were not available as a public service until 1985 when Telecom launched Viatel, a videotex type of service. The stand-alone Electronic White Pages (EWP) directory product as a public service was launched in 1988 with a data base of 6.7 million listings. The Service attracted over 35,000 customers in the first year. A similar public Electronic Yellow Pages (EYP) service was launched in 1990.

During the 1980's computer terminals and data modems became more capable, affordable and more widely deployed in the homes and businesses of Australia. Noting the progress of Minitel, it was apparent that a huge market would develop for "electronic services" – **directory services** (electronic White and Yellow Pages), **electronic trading** (transactions), **electronic services** (airline bookings), and information services (weather) – perhaps in the early 1990's. After the Davidson Inquiry in 1982 it was also apparent that there would be strong network and services competition emerging in the same timeframe.

From 1985 the challenge for Telecom was to establish a strong and proprietary position in this new, massive, yet to be fully understood “electronic services” market by (say) 1990. The strategy adopted was to develop independently the four service areas – directory, trading, services and information – and package them in ways that might accelerate demand and deployment to achieve that proprietary position. New services were easy to identify, but without an Internet-type of infrastructure and a higher penetration of terminals in homes and businesses, the services were expensive to explore and deploy. Over $50 million was invested over the period 1985-1991 preparing for the (internet-type) market. Telecom’s retention of market share from 1993, the success of BigPond a little later, and the escalating profits from the directories business from 1991 indicates that there was some success.

The platform used was the Telecom Viatel service which offered both an EWP and an EYP with a range of electronic services, initially with over 100 service providers, for the home and office. For example, an on-line information service primarily aimed at small businesses combined a public messaging service with access to a range of information services which included the electronic directories, investment advice and travel information. A tele-banking service operated by the Commonwealth Bank allowed customers to conduct transactions from the home or office. Directory publishing, together with Viatel, explored advertising

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opportunities in electronic media and information services beyond the EYP classified advertising market alongside investigating the potential of other electronic services. Electronic services projects covered a range of sectors including the automotive industry, shipping, finance and banking, mining and telecommunications.

The EWP system was the winner of the 1990 Australian Design Award. It was so well regarded that in 1991, DirectoryNet Inc, a wholly owned subsidiary of Telecom, was established in Atlanta in the USA, to offer an EWP service in North America.

The Main Strategic Actions - 5. Convert the remaining paper records to computer as quickly as possible and Purchase and Install a "state-of the art" Computer System for both White and Yellow Pages as the standard national system owned and operated by Telecom on Telecom premises.

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81. (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory Services 1981-1986);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988)

In 1976 about one half of the listings transactions and prepress activity for the White and Yellow Pages was still performed "off-computer". Conversion to computer systems was completed within two years.

Computer processing improved product quality and reduced processing times, error rates, and production costs, but there were still huge potential improvements to be gained by standardising the various White and Yellow Pages systems to one single nationwide system.

In 1976 Telecom was developing a national White Pages system in-house which already appeared to be obsolete.

In 1977 GTE, the second largest telephone company in the USA and the second largest directory publisher in the world, agreed to sell at a nominal cost their most advanced computer systems for listings processing, compilation, pagination, and distribution for both the White and Yellow Pages. This offered a "world class" standardised nationwide publishing system and database, and an earlier, automated feed of data to a computer-based directory assistance within one year. Telecom's decision to continue the deployment of the in-house Telecom White Pages system, rather than to transfer resources to adapt and implement the GTE system, was a huge setback for directory publishing.

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The progressive implementation of the less capable Telecom system still achieved a major improvement in productivity over the five years 1976/81, but far less than was possible; staff increased to 497 (17%) to handle increases in the number of telephone services to 5.07 million (37%), in the number of directory listings to 4.92 million (45%), and in directory transactions to 2.21 million (91%).

By 1985 the four different and incompatible White Pages computer systems operating in 1976 for maintaining the databases were reduced to one system owned and operated by Telecom. This gave Telecom ownership and control of the White Pages database. The four pre-press contractors operating four incompatible computer systems at five locations were reduced to two contractors using two systems at two locations – Sydney and Melbourne.

A world class system – supplied and facilities operated by AMDOCS of the USA – was deployed nationally for White Pages from 1987. This greatly improved the speed and accuracy of listings processing at a substantially lower cost. A world class Yellow Pages sales system operating on one database controlled by Telecom was achieved in 1992 with the formation of Pacific Access, Telstra's new Yellow Pages sales subsidiary.

The decision not to purchase the "state-of-the-art" GTE system in 1977 had enormous consequences for directory publishing; a world class White Pages system only began operation some 10 years later, from 1987, and a Yellow Pages system 15 years later, from 1992.

The Main Strategic Actions - 6. Bring all Computer Systems and Databases In-house

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81 (Telecom 1976b)
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory Services 1981-1986);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988)

This would secure Telecom's ownership and control of the brands, processing systems and databases, particularly against any attack on branding, and listings ownership and copyright.

The White Pages database was owned by Telecom and operated on Telecom premises from 1980.

The Yellow Pages database was effectively owned and controlled by Telecom from 1992 with the establishment of Pacific Access. The database was not operated on Telecom premises until 1999 with the formation of Sensis.

http://doi.org/10.18080/ajtde.v4n3.61

The purchase the GTE system in 1977 would have provided ownership and control of the systems and databases on Telecom premises before 1982.

The Main Strategic Actions - 7. Consolidate all Production - Pre-press and Printing - at One Printing Plant

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81 (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory Services 1981-1986);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988);
- Enterprises Benchmarking Project (Booz Allen & Hamilton 1988)

This would provide scale and "lowest cost" production. If this was impractical in the short term, compromise on two plants, one in Sydney and the other in Melbourne.

The "churn" – additions, alterations or deletions – in the listings in White Pages was already high in 1977 – about one million, approaching 25% and climbing. Together with the growth in listings the number of changes was expected to exceed 2.0 million in five years. Any book that took (say) 90 days to print would contain listings that had more than 25% errors or omissions on the first day of distribution.

In 1977 the typical elapsed times between closing and distributing a directory were abysmally long, particularly for the largest directories: Sydney was about 50 days, Melbourne and Perth 90 –100 days, and Brisbane and Adelaide 90 days. As the number of listings and volume of advertisements increased the books would become larger and production times longer.

Clearly production needed to be transformed to produce more attractive books, and a range of new directories, up to four colours, higher quality, higher utilisation, and far faster and more flexible production at "lowest cost" for the small Australian market. A reasonable expectation was that within five years there would be one plant in Sydney and another in Melbourne and within ten years one plant serving Australia.

From 1977 production contracts were modelled on those used by the leading publishers in the world – AT&T, GTED, Rueben H Donnelly and R. R. Donnelly in the USA. The contracts foreshadowed fully computerised White and Yellow Pages compilation, pagination, improved printing quality, much high production volumes and faster production times, progression to four colour printing, and more comprehensive and rigorous processes for planning and programming production and managing quality, throughput and paper utilisation.

After nine years, in 1985, the five printing contractors operating in five locations in 1976 were reduced to two contractors in two plants at two locations – Sydney and Melbourne. The

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Sydney printing plant was already dedicated to directory production. In 1988 a second dedicated plant opened in Melbourne. As an indication, the new Melbourne plant increased output dramatically from 3,000 books per hour to 7,000.

The slow progress to two dedicated production centres was caused by a combination of factors including political considerations in shutting down printing plants, the application of the public tender process in Telecom and the capability of the printing industry to fund the required level of investments.

In 1988 a benchmarking study by Booz-Allen Hamilton (Booz 1988) reported that the printing costs of the two dedicated plants were about 30% higher by US standards, with the lower local volumes being a factor, but most of the gap could be closed by moving to one supplier operating one factory. This option was explored for the next production contract period in the early 1990's and "one factory" production began at Chullora, Sydney in 1995.

The Main Strategic Actions - 8. If necessary, accept slightly higher paper prices from local producers, if the quality is acceptable, to obtain security of supply.

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81 (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory Services 1981-1986);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988);
- Enterprises Benchmarking Project (Booz 1988)

In 1976 all directory paper was imported, contributed 28% of production and distribution costs, and was already the highest cost in producing and distributing directories. Paper costs exceeded the costs of prepress, printing and distribution, and was rapidly approaching the level of the sales commission. All the signs were that it would exceed 45% in five years.

The market and financial consequences of delaying or missing a directory due to a shortage of paper were unacceptable. The cost of stockholding of imported paper sufficient to minimise the supply risk was excessive, and the cost of a stock-out of paper was intolerable. Paper prices were close to parity with the USA.

Telephone directories use a special type of thin paper. The international standard yield was 36 grams per square metre, lighter than newsprint. Directory paper is a balance between strength, opacity and the cost of production; a low thickness (and lower strength) reduces the bulk and weight of a directory, and opacity or density avoids show-through of the print on the reverse side. Directory paper is thin but must be strong enough to avoid web breaks at

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high web speeds during the printing process which cause delays in the production and delivery schedules.

Telecom had purchased paper on behalf of the printers since 1974. In that year, a worldwide paper shortage increased prices beyond the capacity of the printers to finance the purchase. Most of the paper was imported from the USA, Canada and Scandinavia. A local supplier, Australian Pulp & Paper Manufacturers (APPM), had supplied a limited amount of paper, but could not reliably produce to specification.

Usage in 1976 was 15,000 tons and was estimated to exceed 25,000 tons in five years. The world market for directory paper was cyclical with rapid movements from glut to shortage and with prices moving even more erratically. A shortage of paper could mean cancelling, delaying or a reducing a print run of a directory. This would unacceptably damage the market position and revenue. Stockholdings of paper were costly; stock in 1976 was of the order of 50% of purchases, about 8,000 tons valued at about $4 million.

Variability of worldwide supply and prices and the risk of stock outs made a strong case for local paper manufacture provided suppliers could produce reliably to specification at a competitive price.

The two paper manufacturers in Australia – APPM and Australian Newsprint Mills (ANM) -- were approached and trials were held. In 1979 APPM still had not achieved the standard. As the Wesley Vale mill was not fully loaded, APPM unilaterally claimed that their quality was satisfactory and persuaded the Fraser Government to impose a tariff on directory paper of 20% and instruct Telecom to purchase 6,000 tonnes. The result was that the cost of paper consumption rose by about 20% and production slowed while the marginal quality APPM paper was used.

Over the following years the quality of locally manufactured paper improved so that in 1987 Telecom purchased all its requirements from local suppliers at a quality and price competitive with imports. Paper quality continued to be satisfactory making the supply of paper secure.

The benchmarking study by Booz Allen Hamilton in 1988 (Booz 1988) reported that paper costs were close to parity with the US with local manufacturers unable to close the remaining gap.

The Main Strategic Actions - 9. Recycling

This section draws on material in the following references:

- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988);
- Enterprises Division Business Review - 1990/96 (Telecom Enterprises 1990a).

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By 1990 paper usage had reached 48,000 tons producing some 22 million books. A recycling strategy was developed with the ambitious target of collecting and recycling 80% of old books nationally by 1997.

Several approaches were trialled for collecting old directories: local scouting groups, drop-offs at supermarkets, swapping an old directory for a new one, and collection by municipal councils. Large plastic bins in the shape of a "Book Muncher" almost two metres high were placed in supermarkets and other high traffic areas convenient for customers to dispose of their books.

Approaches for recycling the old directories were made with the Australian Conservation Foundation to produce a safe low-cost building insulation material branded “All Seasons”. A wide variety of alternative uses were also being explored ranging from seedling pots to kitty litter.

Directory materials such as inks, glues and cover boards had already been modified to facilitate recycling.

The Main Strategic Actions - 10. Establish rigorous National Standard Accounting, Budgeting, Control and Reporting Systems, including performance parameters for every activity of the business.

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81. (Telecom 1976b);
- Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86 (Directory Services 1981-1986);
- Enterprises Division Strategic Review. 1988 (Telecom Enterprises 1988).

This was a standard activity in the private sector and would provide tight management and operating control of the business and a framework for driving improved quality, reduced production and distribution times, improved process productivity and lower costs.

Comprehensive systems with related management accountabilities were operating within two years including new production contracts based on the contractual frameworks used by the US publishers.

The Main Strategic Actions - 11. Spin off Directory Services as a Separately Incorporated Arm’s Length Subsidiary of Telecom.

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, - 1980/81 (Telecom 1976b);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988);
- Enterprises Division – Arm’s Length Proposal (Telecom Enterprises 1990b)

http://doi.org/10.18080/ajtde.v4n3.61

Over time, this action would reduce, if not remove, the public service influence and culture, reduce the higher cost of public sector employment, reduce the influence of the public service unions and allow faster and more focussed improvement.

Several proposals were made over the years to 1991 and all failed. The main benefits of separation were superior service quality, faster expansion of the service range and higher profits. The main argument against was that a separated business would be more vulnerable to a political instruction that Telecom sell the business. In fact, it would have been just as easy to sell the business whether it was within or separated from Telecom. A more profitable separated business would attract a higher price.

In the mid-1980's directory publishing was located at Box Hill some 20 kilometres from Telecom's headquarters, which moderated the public service culture but little else.

In the late 1980's there were several approaches from the private sector to purchase the publishing business. None were accepted.

The Main Strategic Actions - 12. Bring the Yellow Pages sales operation in-house.

This section draws on material in the following references:

- Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81 (Telecom 1976b);
- Enterprises Division Strategic Review 1988 (Telecom Enterprises 1988);
- Pacific Access Negotiations. Notes for negotiating the Joint Venture (Telecom 1990);
- Pacific Access Business Case. Presentation to the Board of the Australian Telecommunications Commission (Pacific Access 1990).

This would provide far stronger control of the sales function, savings exceeding 2% of sales, “lowest cost” operation and full security of the databases, branding and data copyright.

Telecom outsourced the selling of the Yellow Pages to two sales contractors with the contractors operating the Yellow Pages sales databases on their premises. The strategic intention in 1976 was to take over the selling function and to directly own and manage the data bases on Telecom premises. This action was unthinkable while directory publishing was operating within Telecom and subject to public sector policies and processes.

The establishment of the Australian & Overseas Telecommunications Corporation (AOTC) through the merger of Telecom and OTC in 1992 finally made this practical as the public service ethos was expected to decline in the new business.

The takeover of the sales function was achieved in two stages: Stage 1 was a joint venture with the current contractors, and Stage 2 was, in say another five years, the exercise of pre-emptive rights to buy the partners out.

http://doi.org/10.18080/ajtde.v4n3.61

Stage 1 negotiations with the two sales contractors over 1989 and 1990 resulted in "Pacific Access", a joint venture between Telecom, the majority owner, and the owners of the two sales contractors. The scope of the business was published directories, electronic directories and other business areas largely based on the directory databases both within and beyond Australia.

Pacific Access was one of the largest – if not the largest – and most favourable deals structured in Telecom's lifetime; the Net Present Value (NPV) to Telecom of the joint venture over 10 years approached $800 million ($350 million NPV @ 17%) and required minimal capital.

Pacific Access Pty Ltd, a Telecom Yellow Pages sales subsidiary, began operation on 1 July, 1991. All of the Yellow Pages functions were consolidated into the new business; research and development, sales, marketing and compilation services, both for the traditional and electronic directories. Apart from the financial benefit, combining the two sales contractors in this way improved the quality of the finished product, improved customer service and encouraged faster development of new products and services.

A crucial strategic benefit arising from the Pacific Access structure was that, for the first time, after 14 years, Telecom had uncontested ownership and complete control of the Yellow Pages data bases, branding and data copyright.

Benchmarking against North America

Continuous contact had been maintained with the leading directory publishers in the USA and Canada since 1977 and developments suited to the Australian market were quickly applied.

In September, 1988, Booz-Allan Hamilton, an international consultant, benchmarked Telecom's directory publishing business against the US directory publishing industry (Booz 1988). It reported that Telecom's business was at benchmark performance in almost all parameters except for systems development costs, paper prices, and printing and distribution costs.

Yellow Pages revenue performance in terms of account penetration – the proportion of business accounts who were advertisers in the Yellow Pages (at about 30%), and share of total advertising media (at 10%), were both close to parity with the US performance. Pricing for Yellow Pages advertisements in the large metropolitan directories was at the low end compared to the US, and White Pages revenue performance was significantly better than the US ($34 per line of business compared with $15-25).

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Telecom's Yellow Pages sales productivity compared with the US at significantly lower cost, and further productivity gains were possible by increased telemarketing and direct mail.

Paper costs were close to parity with the US, but in aiming for the security of local manufacture of paper there was little possibility of closing the remaining "local price premium" gap.

White Pages and Yellow Pages production costs were higher than in the US. The gap for White Pages could be partly closed by reducing the error rate of listings provided by the Telecom District customer service offices and reducing the costs of directory computer systems development. Yellow Pages production could be moved towards parity by consolidating the Telecom and Yellow Pages sales contractor systems.

Computer systems development costs were high by US standards – 5.3% of revenue compared to 2.6% – mainly due to in-house systems development.

Printing costs were about 30% higher by US standards with the lower local volumes being a factor, but most of the gap could be closed by moving to one printing supplier. Almost all of the US publishers used one printer for a market far larger than Australia.

Distribution costs were higher than in the US. Service levels were comparable for the initial delivery, but the US achieved a superior service for on-going deliveries through the year. The US out-sourcing of distribution for on-going deliveries allowed costs to be 30-50% lower than Telecom.

In summary, Directory Services had potential cost savings of perhaps $25 million per year from directory delivery ($4.5-$6m), production ($5-$8m) and printing ($4-$11m).

Telstra's Directory Publishing Business in 1991.

This section draws on material in the following references:

- Australian Telecommunications Commission Annual Reports for the years 1975/76 to 1988/89 (ATC 1975-1989);
- Annual Reports for the years 1989/90 & 1990/1991 (ATC 1989-1991);
- Enterprises Division Business Review – 1990/96 (Telecom Enterprises 1990a);
- Enterprises Division Strategic Review – 1992/97 (AOTC 1992).

Telecom's directory publishing business in 1991 was a cash flow powerhouse and a highly practised innovator which was positioned as a dominant platform for publishing and electronic services for the future.

The trading performance over 15 years (shown in Table 5) was remarkable. Revenue rose from $33 million in 1976 to almost $600 million in 15 years (1991) achieved by market

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growth alone. More significantly, contribution rose from an expected loss of $1 million to $264 million over the same 15 year period.

Over the 15 year period from 1976, for a capital investment of less than $150 million Telecom gained a contribution of about $1.5 billion.

Table 5: Telecom's Directory Publishing Trading Performance - 1976-1991

Year ending 30th June	1976	1981	1986	1991
Gross Revenue ($m)	33	120	336	593
Less Publishing Costs ($m)	32	83	207	329
Publishing Contribution ($m)	1	37	129	264

Source: National Directory Services, 31 March, 1994.

Table 6 shows that directory publishing revenue and profit growth exceeded Telecom's growth. Directory publishing revenue was 2.3% of Telecom's revenue in 1975/6 growing to 6.2% fifteen years later. The profit contribution was even more spectacular: 0.7% in 1975/6 and 27.4% in 1990/91.

Table 6: Directory Publishing & Telecom's Performance - Revenue & Profit Growth - 1976/91

Year ending 30th June	1976	1981	1986	1991
Directory Services Revenue ($m)	33	120	336	593
Profit ($m)	1	37	129	264
Telecom Revenue ($m)	1,424	2,609	5,472	9,531
Profit ($m)	152	234	465	963
Directory Services/Telecom Revenue (%)	2.3	4.6	6.1	6.2
Profit (%)	0.7	15.8	27.7	27.4

Table 7: Directory Services - Some Measures of Actual Performance - 1980/1

Year ending 30th June	1976	1981	1986	1991
Sales Telecom ($000's per person)	19.2	29.0	60.0	113.6
Sales Directory Publishing ($000's per person)	99.5	241.0	511.4	916.8*
Operating Costs Telecom ($000's per person)	17.3	26.4	53.0	94.2
Operating Costs Directory Publishing ($000's per person)	89.4	167.6	315.7	500.8*

Note: *. Indicates only an order of scale due to Telecom's accounting treatment of the sales commission.

Table 7 shows sales and operating costs per person for Telecom and directory publishing. The directory publishing figures are high due to the outsourcing of a range of functions including pre-press, production, distribution and sales of Yellow Pages. Telecom's sales and operating costs per person should have been much higher as a range of functions should

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have been outsourced from 1975; for example, food services, property services, the limousine fleet, and a high proportion of transport and information systems development.

For directory publishing over the 15 year period sales per person grew ninefold while Telecom's growth factor was sixfold. Comparing growth in profit is not useful due to directory publishing's low base and the high degree of outsourcing.

Directory publishing handled all of the considerable development activity and an 83% increase in listings processed with a 17% increase in staff, a major improvement in productivity.

Some Directory Publishing Innovations

This section draws on material in the following references:

- Enterprises Division Strategic Review - 1992/97 (AOTC 1992)

Telecom did not grasp the opportunity to become commercially focussed in 1975 and only seriously began that journey in 1988. Directory publishing stood out as the most innovative area in the business through many innovations, most of which were standard practice in the private sector and illustrate how far Telecom was behind.

Some of the innovations included:

- Business strategic planning based on modelling and options.
- Rigorous budgeting, control and accountability based on the trading statement with monthly reviews against budget, mandatory practices in the private sector. Until 1985 directory publishing was the only product area within Telecom which operated in this way.
- Commercially focussed product management for each product and service in the directory range. Telecom did not introduce commercially focussed product management across the range of businesses until 1988.
- An operational computer systems strategy integrated with the business plan and trading statement. Again this was an essential practice in the private sector. Directory publishing completed conversion of White Pages customer records to computer in 1980. Yellow Pages records were operating on computers from 1975.

  Telecom's conversion of telephone customer records to a computer system (DCRIS) was completed in 1985. At that time there were at least three customer data bases (CABS, DCRIS, directory publishing and LEOPARD) and there was no clear plan to rationalise this architecture. A fourth customer data base, mobiles, was launched in 1988. This proliferation of data bases continued into the 1990's.

http://doi.org/10.18080/ajtde.v4n3.61

- Market research tightly focussed on usage and the quality of customer service began in 1977. Telecom's TELCATS customer polling began in 1988.
- Benchmarking against industry leaders around the world began in 1977. The first significant benchmarking in Telecom was done informally by George Hams in 1985.
- Directory publishing engaged in a high degree of collaboration with contractors to accelerate benefits to mutual advantage.

  For example, the Yellow Pages Management Group comprising staff from directory publishing and the sales contractors began operation in 1977. This was the most successful marketing group in Telecom and drove sales far more strongly than would have been possible working at arm's length. The owners of the Yellow Pages contractors – Bell Canada International, GTE Directories, Southwestern Bell and Volt Information Sciences – all contributed marketing and production data, developments, ideas and knowhow free as part of the association.
- Directory publishing developed regular contact with a number of overseas telecommunications businesses including AT&T, GTE, GTE Mobile, Southwestern Bell, Pacific Bell, Bell Atlantic, British Telecom and Televerket (Sweden), and directory publishing businesses such as AT&T Directories, Ruben H Donnelly Corporation, R R Donnelly, Bell Canada Directories and NZ Telecom Directories.

  This resulted in sharing plans and developments in the directories business as well as in other telecommunications areas such as Mobile Services and Operator Services.

  The collaboration was less with some operators in the USA after the AT&T divestiture in 1984, but still continued.
- A sales incentive program was introduced in the Yellow Pages sales force in 1977, the first such program in Telecom until the sales incentive program for the new Telecom sales force in 1984.

The Directory Publishing Business transferred to Telstra in 1991

This section draws on material in the following references:

- Annual Reports for the years 1989/90 & 1990/1991 (ATC 1989-1991);
- Enterprises Division Strategic Review - 1992/97 (AOTC 1992).

The Australian & Overseas Telecommunications Corporation (AOTC, later Telstra) was established in 1992. The directory publishing business handed over to AOTC was a strategically strong and profitable platform for the future:

- The projected trading performance over the five years to 1997 was solid. Revenue including sales expense was expected to increase from about $790 million to over

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$1 billion in 1996, and it did. If the agreement with the Pacific Access partners was to be believed, gross sales in 1997 would be higher at almost $1.2 billion; this was probably optimistic but optimistic partners were an asset.

More significantly, projected contribution was planned to rise from $267 million to reach $480 billion in 1997 totalling $2 billion in the five years.

Capital investment for the five years would be less than $200 million.

- A nationwide standard and world parity mainstream computer system for published and electronic directories offered "lowest cost" operations for the Australian market, operating costs as a proportion of sales were expected to decline.
- Operating efficiencies were high with very low error rates and fast processing times.

  Although processing volumes were projected to markedly increase, staff would fall from 700 to about 680.
- Usage rates for both the White and Yellow Pages appeared durable - over 50% of people used the books in the last seven days - but it was uncertain how long this usage would hold against electronic directories and alternative advertising media (the "internet" was not so named until about 1992).
- In 1992 Yellow Pages was Australia's leading buying guide with over 1.2 million people using it every day. Again, the effect in the future of the internet was an unknown.

Table 8: Directory Publishing - Business Plan - 1992/97

Year ending 30th June	1992	1993	1994	1995	1996	1997
Gross Sales (Est $m future prices)	794	810	856	934	1043	1142
Revenue* (Est $m future prices)	632	630	681	742	832	913
Profit (PBIT) (Est $m future prices)	267	281	317	376	436	486
Capital (Est $m future prices)	15	38	19	25	33	57
RoS (%)	n/a	35	37	40	42	43
Staff	649	661	696	692	699	697

* Note that "Revenue" is "Gross Revenue" less "Sales Commission". This table reports that directory publishing was a $1 billion business based on Gross Sales by 1996.

In Table 9 the category, "Telephone Directories", included the other directory publisher, Business Marketing Australia (BMA) which published seven directories (compared with Telecom 72) with a circulation of 3.4 million (Telecom 13.5 million) and a revenue of $26 million (Telecom $697 million). Telecom's revenue of $681 million does not include White Pages, Electronic White and Yellow Pages and contractor sales commission, which adds to a total revenue of about $850 million.

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- An independent survey of the telephone directory market in 1994 reported that Telecom Directory Services held 12% of the advertising market in Australia – see Table 9.

  Telstra dominated the market for classified directories.
- The Telstra Electronic White Pages and Yellow Pages were in a strong position to expand to other forms of electronic services and Pacific Access was a supporting developer to assist with this.
- The related electronic services, although still exploratory, were a sound gateway to expand into other information services and advertising based on those services.

Table 9: Advertising Industry in Australia - 1993/4

	Revenue ($M)	Growth 1993/94 (%)	Market Share (%)
Newspapers	2,301	14.1	38.5
Television	1,870	6.2	31.3
Radio	477	4.6	8.0
Magazines	340	25.9	5.7
Outdoor / Cinema	269	- 22.0	4.5
Telephone Directories	723	9.2	12.1
Total	5,980	8.5	100

What could the Directory Publishing have achieved as a Private Sector Business?

Most professional managers with experience in both the public and private sectors would agree that it was more difficult to innovate in the public service.

Competition is a hard taskmaster in the private sector. It encourages and rewards innovation and punishes the slow, the static and the inefficient. In grim business situations open markets and shareholders demand radical change. Telecom, with its monopolies, union constraints and public sector legacy, preferred change on its own terms with minimal risk. It was familiar with managed technical change but not commercial change.

On the other hand, even with its monopoly advantages, Telecom faced a number of huge challenges, particularly in the early years from 1975. For example, a new national district organisation with some 83 districts was implemented throughout Australia in the first three years. A new computer-based telephone customer service order system was deployed in the districts converting over three million telephone paper-based customer service records to the new system by 1985. However, this achievement in 1985 was at least ten years after similar

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systems were deployed in the USA, and perhaps 15 years after similar systems were operating in the commercial world in Australia.

There were perhaps six main problems experienced over the 15 years of the directory publishing transformation period which hindered improving the service and driving profits:

- the lack of a strong commercial strategic planning framework in the 1970's to the mid 1980's within which business proposals such as "Directory 81" could have been structured, assessed, approved and implemented.
- the lack of an IT strategy with business priorities and a defined systems architecture within which all systems and data base development could be assessed, approved and implemented. For example, the new telephone service order system, while urgently needed, added another customer data base and another product data base to at least two existing similar data bases – billing and directory publishing. By 1990 there would be more such data bases.
- the rigidity in computer systems development which preferred in-house built systems rather than purchasing and adapting "state of the art" systems.

  The rejection of the GTE systems opportunity in 1977 was a major setback, delaying the availability of a leading directory system until 1989. The Booz Allen Hamilton benchmarking study in 1988 reported that internal development of directory publishing systems was roughly twice as costly as those in the USA.
- while the use of a public tender process in government business enterprises was essential for transparency and probity, the rigidity of the process hindered innovation in directory contracts.

  The reduction in the number of production centres from five to two was delayed by as much as three years.
- political considerations increased operating costs.

  Ending pre-press and printing operations in Western Australia raised a political issue of "lost jobs in WA" which delayed the result by at least four years. The Government policy to introduce tariffs for directory paper increased the price of paper by 20% adding costs of about $1 million each year. A Ministerial direction which forced the purchase of unsatisfactory paper from a local supplier also increased production costs.
- the public service policies, processes, employment conditions and unions inhibited innovation and increased operating costs. The amount of the increase was debatable but benchmarking studies over 1985 to 1988 indicate the penalty could have exceeded 20%.

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The speed and effectiveness of a transformation in a similar business in the private sector is, of course, speculative. However, a reasonable expectation would be that a world class, standard computer system for both White and Yellow Pages would have been achievable within three years instead of 12; two production contractors in say four years instead of eight; one production contractor in six years instead of nine; a "Pacific Access" subsidiary in eight years instead of 14; and lower paper prices without Government and ministerial direction.

The outcome would have included an even faster growth in sales and lower operating costs, perhaps generating higher profits of the order of $0.5 billion over 20 years.

1992 and Beyond

There appear to have been three major developments in Telstra's directory services after 1991 before the published directory product moved towards collapse in about 2010.

In 1994 directory production of all telephone directories in Australia was consolidated to one purpose-built factory in NSW. This occurred when McPhersons Limited won the production tender by proposing a “one plant” solution based on a factory at Chullora, some 15 kilometres west of Sydney.

In 1997 Telstra bought out two of the minority partners in Pacific Access, and in 1999 the other two. (Montgomery 1999)

In 2002 Pacific Access was rebranded to "Sensis". (Sensis 2002)

The March of the Internet

To an outside observer, after 2000 the rationale and financial viability of published directories began to weaken, and by about 2010 became a serious problem.

In the early 2000's a push began in several countries, including the USA, to reduce or prohibit the publishing of the White Pages, mainly on conservation grounds. The USA used about 600,000 tons of paper each year and this was regarded by some as a “waste”. In 2012, after some North American cities passed laws banning the distribution of telephone books, an industry group took legal action and obtained a court ruling permitting distribution to continue.

Mobile telephones eroded the utility of published directories. These phones provided a comprehensive internal directory for most of the numbers called and could obtain almost all of the other numbers needed on the Internet, including from Telstra's electronic directories. In 2004 Sensis' revenue was reported to be $1.3 billion, accounting for about 6.5 per cent of Telstra's total revenues, and around 10 per cent of its cash flows. (Koutsoukis 2005)

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Around 2007 the internet began to significantly affect Yellow Pages revenue and profits. Yellow Pages sales were reported to be falling. To reduce costs Telstra degraded the White Pages and Yellow Pages in a number of ways including a smaller typeface resulting in fewer pages and smaller, lighter books which used less paper. The effect on usage has not been made public, but usage would likely have fallen faster.

In 2012 Sensis reported that it had "been struggling with the move from phone books to online directories ". In the 2011 financial year "... income declined 5.9% ..." but "in the first half of the 2012 financial year sales fell 24.1%" to $528 million. At the same time earnings before interest, tax, depreciation and amortisation dropped by 54.9%. The company noted that "the advertising and directories market's shift to digital marketing is occurring faster than we expected" (Whalley 2012; Robin 2012).

In 2013 Telstra reported that Sensis revenue for 2012/13 was $1.33 billion, a decline of 11.7% from the previous year. Print revenue fell by 19.9% to $778 million, comprising a decline of 11.4% in White Pages and a 25.6% reduction in the Yellow Pages (Telstra 2013).

In 2014 Telstra announced the sale of the White and Yellow Pages directories part of Sensis, about 70% of Sensis' revenue, for $454 million to Platinum Equity, a US-based investment fund. At the announced price the entire business was valued at less than its print revenue for 2013. Telstra retained the Trading Post and the voice services business which included directory assistance. (Pond 2014; Bingemann 2014)

Most financial commentators expressed the opinion that the sale should have been made at least eight years earlier when the asset was at a peak value, said to be about $12 billion. One opinion was that "(the Sensis sale) will long be a symbol of one of Telstra's biggest failures to deliver shareholder value".

In Conclusion

The story of the Telecom's directory publishing business during Telecom's 16 years is of managers and staff in the directory area and among the contractors who accepted a challenge, even though the mainstream was unlikely to support them and might in some ways obstruct them. They succeeded.

These people included two managers of directories in the States: Rupert Brown in NSW and Ron Warnock in Queensland. In Headquarters it included people such as Jim Holmes, Martin Turner, Geoff Barkla, Andrea Polmear, Bob Copp, Wayne Jones and John Stanhope.

The managers of the contractors were also crucial to the success of the business. Strong supporters in the Yellow Pages sales contractors were Phil Watts of Edward H. O'Brien, the selling contractor in NSW; Tony Knight and Barry van Ry of Directories Australia, the selling

http://doi.org/10.18080/ajtde.v4n3.61

contractor for the other states until 1985; Stan Schmidt of Australian Directory Services; and Bob Johnson of Pacific Access. Among the production contractors, supporters included William Brooks of William Brooks Ltd; Bryan Price of Wilke Ltd; and George Gatehouse of Wilke and McPhersons Ltd. All were enthusiastic and dependable colleagues and innovators.

Telecom's directory publishing business was an "ugly duckling" in 1976; in 1991 perhaps it was a "swan", or even an "eagle"?

References

Australian & Overseas Telecommunications Corporation. 1992. Enterprises Division Strategic Review - 1992/1997.

Australian Telecommunications Commission. 1975-1989. Annual Reports for the years 1975/76 to 1988/89.

Australian Telecommunications Corporation. 1989-1991. Annual Reports for the years 1989/90 & 1990/1991

Bingemann, Mitchell. 2014. "Telstra to sell 70pc of Sensis to Platinum Equity." *The Australian*, January, 2014.

Booz Allen & Hamilton. 1988. Enterprises Benchmarking Project.

Cresap, McCormack & Paget.1973. Study of the Organisation of the Postmaster-General's Department. Volume 2, Para 11.25

Davidson, JA. (Chairman). 1982. Report of the Committee of Inquiry into Telecommunications Services in Australia (The Davidson Report). Recommendations in Vol. 1 pp 28-39

Directory Services Branch, Telecom Australia. 1977. Directory Business Plan 1977/78. March, 1977.

Directory Services Branch, Telecom Australia. 1981-1986. Directory Services Review of Activities (for the years) 1981/82, 1982/83, 1983/84, 1984/85 & 1985/86.

Koutsoukis, Jason. 2005. "Telstra Paves the Way for Big Sale." *The Age*, February, 2005.

Montgomery, Paul. 1999. "Telstra Flexes Muscle in Australian Net Industry." Retrieved from http://www.internetnews.com

Pacific Access. 1990. Pacific Access Business Case. Presentation to the Board of the Australian Telecommunications Commission.

http://doi.org/10.18080/ajtde.v4n3.61

Pond, Nicholas. 2014. "Sensis sale threatens print directories." *The Australian*, January, 2014.

Price Waterhouse & Co. 1974. Evaluation of (the APO's) Financial Management.

Robin, Miriam. 2012. The Three Big Challenges for the New Boss of Sensis. *The Australian*

Sensis. 2002. Retrieved from http://ww.sensis.com.au

Telecom Australia. 1988. Enterprises Division Strategic Review. 1988. Telecom Australia, Enterprises Division.

Telecom Australia. 1990a. Enterprises Division Business Review - 1990/96. Telecom Australia, Enterprises Division.

Telecom Australia. 1990b. Enterprises Division - Arm's Length Proposal. Telecom Australia, Enterprises Division

Telecom Australia. 1976a. Directory 81 – an initial business strategy for the Directory Function - 1976/81

Telecom Australia. 1976b. Directory Services Program (for the years) 1976/77, 1977/78, 1978/79, 1979/80, 1980/81. Telecom Australia, Directory Services Branch

Telecom Australia. 1976c. National Product Costing Results for the year ending June, 1976. Accounting & Supply Department, Headquarters.[4]

Telecom Australia. 1990. Pacific Access Negotiations. Notes for negotiating the Joint Venture between Telecom Australia, Edward H O'Brien Pty Ltd and Australian Directory Services Pty Ltd dated February, 1990

Telstra. 2013. Annual Report.

Vernon, J. 1974. Report of the Commission of Inquiry into the Australian Post Office.

Whalley, Geoff. 2012. "Bruce Akhurst departs Sensis as profits tumble." *Herald Sun*, March, 2012.

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[1] CMP recommended *inter alia*:

> "Fundamental to the proposed Customer Services unit is adequate staffing in terms of both numbers and quality of personnel. Achieving such adequacy will, without question, require heavy augmentation of the present Telecommunications Division staff; experienced and talented marketing personnel should be sought from outside the APO to the extent required.

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[2] Price Waterhouse commented, *inter alia*:

> (regarding regional organisation)
>
> "The reasons for States based regions are historical . . . . (it is) illogical to arrange regional organisation with Tasmania matched with NSW."
>
> "State Directors have a high level of delegation of responsibility. States operate with considerable independence and effective co-ordination by senior management (in National Headquarters) is difficult."

[3] The relevant recommendations of the Vernon Report were:

> **Recommendation**: (regarding regional organisation) Pages 248 & 249
>
> "(a) new regional organisation, as outlined, should be established for the administration of the telecommunications service; the boundaries of these administrative areas should be determined by the business characteristics of the telecommunications network rather than by State boundaries."
>
> **Recommendation**: (regarding Customer Services) Chapter 11.20, Page 247.
>
> "To take responsibility for marketing and customer related programs, an operational unit is proposed under a Director Customer Service". This unit represents a markedly upgraded and re-organised version of the existing Telecommunications Division within the APO Central Office. Its purpose is to improve co-ordination between marketing and engineering by bringing a marketing viewpoint into technical decisions. Product marketing analysis would be strengthened to provide better sources of marketing data, including tariff analysis. The consultants make the point that adequate staffing in terms of numbers and quality of personnel is fundamental to the proposed Customer Services unit and that experienced marketing personnel should be sought from outside the APO.

[4] Product Costing Report: Directory Publications Revenue = $26.4 m; Expenses = $28.2 m; Surplus/ (Deficit) = ($1.8 m); Investment in Fixed Assets = $0.5 m.

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Fifth Generation Cellular Networks

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Abstract:

In this article the emerging requirements that are driving the fifth generation of mobile cellular networks are discussed and the technologies that will most likely be used to satisfy those requirements are identified. Proposals for 5G are at an early stage, but there is an expectation that the early 2020s will see the first deployments.

The requirements for 5G are increased download speeds, the need to deal with increased cell density, increased bandwidth efficiency and availability of new bandwidth. It is likely that 5G will play a role in the emerging Internet of Things, potentially resulting in enormous increase in the number of attached devices.

To meet the expected requirements 5G is likely to make use of spectrum in the millimetre range, beam-forming antenna arrays, massive Multi-Input Multi-Output, and fundamental changes to base station design. In this paper the key drivers for 5G are discussed including the very large numbers of devices in cells, the need to make available new spectrum, energy efficient ways of implementing base station capabilities, standards developments so far and 5G related issues for Australia.

Keywords: Fifth generation Cellular networks, 5G

Introduction

The fifth generation cellular network (5G) is starting to gain attention from standards bodies, carriers, manufacturers and researchers. There is an increasing need on the part of carriers to support much larger numbers of end devices than in the past and at much greater bit rates. Within less than a decade the Internet of Things is expected to more than double the number of devices attached to the Internet, a substantial number of which will likely be attached via cellular networks. At the same time there is a need to make more efficient use of existing spectrum allocated to cellular systems and if possible open up new spectrum. Fortunately, there have been developments in wireless communications technologies that

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should be able to meet these challenges, but the changes are sufficiently substantial as to constitute a new generation of cellular systems; a fifth generation or 5G.

In this paper we look at the factors leading to these increased demands and the technologies of 5G that are likely to be used to meet them. We also consider the impact 5G might have on the Australian communications environment.

Developments in cellular systems have been classified as generational when there has been a dramatic change in what the system can do and in how it does it. Although generational change typically results in higher data rates for customers and improved bandwidth efficiency for carriers, it has also usually meant a substantial change in the way the technology works, in what the technology can do for consumers, and how it is implemented and managed by operators. Each generation has delivered significant changes to the cellular environment compared with its predecessor, benefiting both customers and operators. Looking at the key changes each generation brought, 1G introduced mobile telephony. 2G introduced digital voice communication, some data services, improved security and SMS messaging. 3G introduced multimedia communications and native Internet access. 4G enabled seamless handover between different access networks and allowed carriers to rationalise their networks to all use a common Internet Protocol (IP) based core (Pereira & Sousa 2004).

Each new generation has seen new spectrum become available, improvements in the efficiency with which spectrum is used and hence the ability to support more customers, as well as efficiencies in how the network is constructed and managed enabling reductions in operational expenditure (ACMA 2016b).

The most successful first generation cellular technology in Australia was the AMPS system. AMPS was introduced into Australia in 1987. It was an analogue system making use of frequency division modulation (FDM). Handsets were bulky and heavy, communications were insecure and the cost of subscribing to a service was high. Nevertheless, the demand for the mobile voice service it provided made it a success (The Economist 2016).

A number of 2G technologies were introduced into Australia including CDMA and GSM, the most successful of which was GSM. GSM was introduced to Australia in 1993. It is still very widely used throughout the world and is only now (1st December 2016) being shut down in Australia by Telstra. GSM is a digital system, provides very good security but the main service it provides is still voice. It does offer some limited data capabilities but at quite low bit rates (Pereira & Sousa 2004).

The most widely used third generation cellular technology currently available within Australia is the Universal Mobile Terrestrial System (UMTS). UMTS was developed to

http://doi.org/10.18080/ajtde.v4n3.63

support Internet services as well as voice. It incorporated capabilities and technologies from intermediate generations, notably the General Packet Radio Service (GPRS) which is sometimes referred to as 2.5 G.

In 2015 the Long Term Evolution (LTE) system was released in Australia. Telstra, Optus and Vodafone all run LTE in Australia. A 4G technology should be able to achieve download speeds of up to 1 Gbps. Early releases of LTE increased the speed possible for cellular users, but rarely achieved that rate. However, LTE has evolved and releases since are able to achieve that rat (Rost et al 2016). Although the download speed requirement of 4G took some time to be met by LTE it was nevertheless regarded as 4G because it achieves the other goals that define a 4G network: namely wider spectrum and an IP based core network, making possible rationalisation of networks supported by a carrier and seamless handover between radio access networks (Pereira & Sousa 2004).

So what might we expect of 5G? The GSM Association (GSMA Intelligence 2014) have identified seven characteristics that they believe are needed for the next generation of cellular systems. These are

- data rates of between 1 to 10 Gbps,
- extremely low latency,
- 1000 times more bandwidth per unit area than is currently available with 4G,
- 10 to 100 times as many connected devices,
- very high levels of availability and coverage,
- 90% reduction in network energy usage, and
- for low power devices, up to 10 year battery life.

5G is likely to meet these requirements by making use of previously lightly-used spectrum, increasing the efficiency in the way spectrum is used and by providing more flexible infrastructure for the development of new services (Agiwan et al *in press*). It is likely to have download speeds of up to several Gbps. Most operators believe 5G will play a significant role in the Internet of Things (Ericsson 2016). Depending on the extent to which IoT relies on cellular networks it may well result in an enormous increase in the number of new devices attached to cellular networks, with quite different requirements from those of the current user population.

In the next section we consider how these factors may combine to create the next generation of cellular networks.

http://doi.org/10.18080/ajtde.v4n3.63

The need for a new Cellular Generation

The need for cellular systems to support an increased number of attached devices and increased speeds for those devices continues its seemingly inexorable progress (The Economist 2016). The ubiquity of the smart-phone has increased the number of end users, the amount of data they consume and the rate at which they consume data.

This trend is unlikely to change. However, it is the arrival of the Internet of Things (IoT) that may well contribute to a dramatic increase in the number of attached devices (Press 2014). The IoT is the bringing together of sensor and actuator networks that are monitored and controlled by cloud based processes. The IoT encompasses many applications: from stationary sensor networks, smart cities where sensor and actuator networks are used to monitor and control the flow of people, traffic and utilities, smart buildings where networks are used to minimise energy consumption, through to vehicle-to-vehicle communications, and ad hoc emergency management.

The speed with which the Internet of Things is expected to be deployed and the sheer scale of it is extraordinary. There are currently approximately 14 billion devices connected to the Internet, most of which are used for conventional communication such as telephony, messaging, social media, email or web browsing. However, according to IDC (Kennellos 2016) by 2025 there will be approximately 80 billion devices connected to the Internet, most of which will be communicating with other devices or cloud-based services.

Although IoT home based services have attracted most attention, it is industrial and infrastructure services such as transport, agriculture and 'smart city' applications that are likely to account for most of the growth in the number of devices (Condon 2016).

There is an expectation that 5G will be the main communications technology supporting the IoT. If true, then the increase in the number of devices within urban areas is likely to be dramatic.

However, it is worth noting that this belief is not shared by everyone (ACMA 2016a). There are other competitor technologies to 5G as an IoT communications technology, such as LoraWan (Lora Alliance 2016), Weightless (Webb 2012) and WLAN (Aust et al 2012). Nevertheless, cellular has advantages over potential competitors in that it is well understood, geographically widely deployed and is the dominant communications technology in the Machine-to-Machine space which is one of the forerunners of the IoT.

Regardless of the future impact of IoT on 5G we will still see a great increase in the number of attached devices per cell, usually referred to as "densification". Densification is managed within a cellular network by making cells smaller. In densely populated urban areas such as

http://doi.org/10.18080/ajtde.v4n3.63

central Tokyo and New York cell sizes are already frequently measured in 100s of metres rather than the tens of kilometres of earlier cellular generations. This densification is likely to continue.

Managing networks consisting of very large numbers of densely packed small cells creates many management challenges, but it also creates opportunities. In particular, small cells make possible the use of previously unused spectrum (Rappaport et al 2014). Other technological developments that might be included in 5G include advances in massive-input, massive-output (MIMO) antenna systems, beam forming antenna arrays and changes to technologies for provisioning services (Andrews et al. 2014).

The purpose of this paper is to provide readers with a wide overview of the requirements leading to the need for 5G and the technologies being developed and incorporated in standards that will comprise it. In the next section we look at each of the technology areas in more detail. We then discuss the state of standards development and conclude with some comments on the Australian perspective of 5G.

Enabling Technologies for 5G

Requirements of 5G

As noted, the GSM Association have identified the following characteristics that they believe are needed for the next generation of cellular systems. These are: data rates of between 1 to 10 Gbps; extremely low latency; 1000 times more bandwidth per unit area than is currently available with 4G; 10 to 100 times as many connected devices; very high levels of availability and coverage; 90% reduction in network energy usage; and for low power devices, up to 10 year battery life.

Some of these requirements are a result of 5G's expected role in IoT and related areas such a public safety, smart cities and smart buildings. Other requirements, such as very low latency, are needed for online games, but also to enable quick reaction times for emerging applications such as haptic feedback where a sense of touch is included in the user interface. Such capabilities make possible applications such as remote surgery and other forms of remote robotics where a rapid response is needed.

As well as new applications 5G will need to support familiar applications such as media streaming. Media companies are likely to want high bandwidth so that they can stream video at high resolutions. Consequently, mobile broadband is expected to be an important user of 5G (Wang et al 2014).

http://doi.org/10.18080/ajtde.v4n3.63

There is an expectation that 5G will contribute to infrastructure sharing, where the owners of the infrastructure and its operators are not necessarily the same. There are a number of scenarios possible: from passive sharing where the physical sites are shared, through active sharing where antennae, Base Stations, Radio Access Networks and possibly even Core networks are shared, through to the Mobile Virtual Network Operator where operators do not own any infrastructure of their own but enter into agreements with carriers to support their clients. In particular there has been standards development for a 5G network slice broker defining signalling protocols necessary to enable dynamic leasing of resources (Samdanis et al. 2016).

There is some discussion as to whether 5G is likely to be driven primarily by consumer or business needs (ACMA 2016a). Certainly media content delivery is more likely to be consumer oriented but some of the novel applications proposed for 5G such as smart cities and smart buildings are more likely to be business rather than consumer oriented.

In the next section we discuss the technologies that are expected to be used to meet the requirements of 5G.

Millimetre Spectrum Technologies

Previous generations of cellular networks have usually enabled additional spectrum to be used. Mostly this has been in a limited range of frequencies around 1 GHz which has been regarded as the ideal frequency for cellular communications. Communications at this frequency has good coverage characteristics and handsets require only a small antenna. Unfortunately, frequencies in this range are mostly occupied, so options for 5G to make use of additional frequency might seem limited. However, the increased density of cells, and developments in wireless communications technology mean that frequencies that were once regarded as unsuitable now appear to hold quite a lot of promise. In particular the millimetre band with frequencies in the 10 to 60 GHz range are likely to be used in 5G (Rappaport et al. 2014).

Propagation of a wireless signal can be through direct line of sight, diffraction, reflection or scattering. Diffraction is where a wavefront bends around an obstacle, reflection is where it bounces off smooth surfaces, and scattering is where it bounces off rough surfaces. As frequency increases diffraction becomes a much less suitable mechanism for propagation of the signal. Also, as frequencies become higher, the ability of the signal to penetrate materials such as concrete decreases. Consequently, frequencies much more than two or three GHz have long been regarded as unsuitable for cellular networks.

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However, the process of cell densification, where cell size decreases in urban areas as the number of devices increase, while causing problems in other ways, that will be discussed later, also opens up the possibility of using higher frequency spectrum in the millimetre range.

The potential range of millimetre spectrum is much less than that of lower frequency spectrum. In earlier generations cell sizes were originally up to about thirty kilometres whereas millimetre spectrum has a typical range of less than a kilometre. Also, diffraction is a much less effective propagation mechanism at this frequency. However, where cell densification has emerged as an issue, diffraction and range are much less important. In a densely populated urban environment cell sizes can be as small as a few hundred metres. Also, reflection off buildings is a more significant propagation mechanism than diffraction. With small urban cells the possibility of line of sight as the main propagation mechanism also becomes feasible. For all these reasons, attention has turned to the feasibility of using short wavelength spectrum in the millimetre range.

This spectrum has been largely unused for the reasons noted above. There are also physical factors that can affect the strength of signals at this frequency, notably absorption by water vapour and oxygen. However, these are only significant for distances of a kilometre or more in only a few frequency ranges. Oxygen absorption occurs at 57 to 64 GHz and water vapour at greater than 164 GHz. There is a great deal of unused or lightly used spectrum in the millimetre range.

Millimetre waves also have advantages in that the optimal antenna size is approximately half the wavelength. For millimetre length waves, this means it is possible for a handset to have a large number of antennas and still remain a reasonable size. Another advantage is in the area of space division multiplexing where most signal strength is directed in a tight beam to an individual user. It is possible to direct a small wavelength signal far more accurately than signals with longer wavelengths (Rappaport et al. 2014).

Using millimetre waves might be suitable for devices that are fixed within a densely packed cell, such as might occur in the IoT or when the handset owner is outdoors in an urban area, but when the device moves inside or to a less densely packed area the problems of millimetre waves become apparent. Either additional infrastructure will need to be deployed in remotely populated areas, lower frequencies used or a different radio access network will be needed. The issue of seamless handover from one radio access network to another was dealt within LTE but may be of greater significance within 5G.

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Beam Forming Antennae

One of the key challenges of cellular networks is extracting the most use from the available spectrum. Spectrum is a scarce, expensive resource. It needs to be used in such a way as to maximise the number of users that can be supported or provide very high data rates to individual users who need them. The key way in which efficient use of spectrum is achieved is through reuse. The same spectrum is used in multiple cells across the network. Reusing spectrum introduces "co-channel interference" where two or more users, using the same spectrum, interfere with each other. In the past this has been dealt with by allocating spectrum across cells in such a way as to maximise the distance between co-channels, and through sectoring, where transmission and reception of a signal is towards only a particular sector of the cell.

One technology likely to be implemented within 5G that dramatically reduces co-channel interference is space division multiplexing (SDM). This approach makes use of highly-directional antennae where the main beam of the transmission signal is directed at the intended device or where interfering devices are placed within a null of the reception pattern (Agiwan et al. *in press*).

Early experiments with SDM involved electro-mechanical devices where horn-antenna were physically directed towards the mobile device. However, the approach now is to make use of an array of antennae and adjust the amplitude and the frequency of individual antennae in order to create a highly directional beam towards the attached device.

Small wavelengths lend themselves well to this approach. First the antennae can be small, since optimal antenna size is approximately half the wave-length, meaning that arrays with large numbers of antennae can be constructed relatively easily. Second, the size of the beam depends on the wavelength, with small wavelengths able to create more focussed beams than larger wavelengths.

To this end it is likely that 5G will include ways of making use of beam-forming antennae.

Base station antennae are likely to be quite different from what we have seen in the past. Because frequencies will be higher and cells will be smaller, antennae can be smaller. Also, antennae are likely to be less conspicuous and distributed, again a consequence of cell densification and smaller distances involved. Distributed antennae have been a feature of cellular since 2G but 5G is likely to take it to an extreme. A cell may have a number of transmit and receive antennae within it at different locations.

Arrays of antennae can also be used in other, related ways, which we discuss in the next section.

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Multi-Input Multi-Output (MIMO)

In the previous section we discussed how antenna arrays can be used to construct tightly focussed beams in order to reduce co-channel interference. Antenna arrays can also be used to increase the amount of information transmitted using the same frequency band through a technology known as Multi-Input Multi-Output (MIMO).

With MIMO both the transmitter and receiver have an array of antennae. In MIMO antennae are separated by a distance comparable to the wavelength of the signal. Depending on implementation, each antenna transmits a different data stream. The aggregate signal is received by each receive antenna. However, because there is a separation between each of the transmit antennae and between each of the receive antennae, the receiver can determine the original signal on each transmit antenna. Essentially, MIMO takes advantage of the different path lengths between the multiple transmit and receive antennae and carries out computation to determine what was originally transmitted on each antenna.

MIMO has been used successfully in the WLAN technology IEEE 802.11n to obtain much higher bit rates using the same spectrum as 802.11a and 802.11g. Typically, two or three antennae are used since the size of the array is constrained to be comparable to the wavelength of the transmitted signal.

However, once again, the small wavelengths proposed for 5G become an advantage, since the small antenna size and separation needed for millimetre waves makes it feasible to include multiple antennae not just in the base station but also in the mobile device. Samsung have experimented with attached devices with 32 antennae (Rappaport et al. 2014).

Given its ability to increase the bit rates achievable it is likely that 5G will include “massive MIMO” where there are a large number of transmit and receive antennae.

Network Management

The use of millimetre waves has great advantages for beam-forming, MIMO and cell densification but the factors that prevented its use in the past will need to be addressed in any 5G network. In particular, communications indoors and in more sparsely populated areas where larger cells are desirable are challenges. There is quite a lot of discussion as to how this is likely to be done. One suggestion is that antenna would be placed indoors and become as ubiquitous as WLAN access is. However, given that most smartphones support WLAN it may be that it becomes the standardised mode of access in those situations. For wider areas there is the choice of deploying many more antenna to cope with the much smaller cell size, using lower frequencies than is currently proposed, or having handover to another network (most likely LTE) for use in more conventional spectra. LTE addressed the

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issue of seamless handover between Radio Access Networks and it is expected that 5G will continue with developing this approach further.

Achieving all the goals of 5G will require complex coordinated management of resources. To this end another approach to network design denoted as "Cloud Radio Access Network" (C-RAN) is likely to be included within 5G (Checko et al. 2015). C-RAN involves the centralisation of much of the functionality previously allocated to individual base stations. MIMO and SDM require huge amounts of processing power to convert the baseband signal from the backhaul network into an RF signal. Usually this processing has been co-located within individual base stations. With C-RAN this computational power is shared among many base stations with savings in terms of equipment deployment and in obtaining greater utilisation of the equipment responsible for the computation. Base stations of necessity are usually designed for the busiest time of the day. Unfortunately, a consequence is that much of the installed capacity lies idle outside those busy times. C-RAN enables multiple cells to share the same infrastructure with consequent increased utilisation.

Other Potential Technologies for 5G

The consensus seems to be that 5G will adopt millimetre wave spectrum, massive MIMO, space division multiplexing and cloud based RAN. However, a number of other technologies have been identified that may have an impact.

Cognitive Radio (CR) involves the constant monitoring by receivers and transmitters for free bands within licensed spectrum, which can be used on a temporary basis while the licensee is not using it. It has been proposed as a way of improving the utilisation of congested RF spectrum. Visible Light Communication (VLC) has also been proposed as another way of dealing with congested RF spectrum.

Given the relative abundance of spectrum in the millimetre range it may be unnecessary to make use of these technologies. However, if 5G does include use of spectrum in the congested RF bands they may well play a useful role.

Standards Development

Standards development for 5G is still in the early stages. However, a recent notable development is that the FCC have designated blocks of spectrum for 5G. These are 28 GHz (27.5–28.35 GHz), 37 GHz (37–38.6 GHz) and 39 GHz (38.6–40 GHz) bands, and a new unlicensed band at 64-71 GHz. The hope is that this will encourage research and development along with technology trials (FCC 2015).

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The ITU have also established a number of working groups to investigate options for 5G under IMT2000. These are groups for determining the requirements of 5G, the wireless technology to be used, the network technology, spectrum considerations and issues related to Intellectual Property Rights (Agiwan et al. *in press*).

Most commentary seems to agree that the technological changes planned for 5G will result in a new generational change in a similar manner to past generational changes, but there has been some discussion as to whether the use of the technologies proposed for 5G might be more evolutionary than revolutionary. In particular, the changes might be implemented as a development of LTE. The problem of dealing with sparsely populated cells or communications within buildings is likely to guarantee that LTE remains a widely used technology even after 5G is deployed in more densely populated areas. An alternative scenario is that 5G functionality might evolve as a development of IEEE 802.11 WLAN technology. In many ways the proposals for 5G, particularly small cells and MIMO, have more in common with WLAN than with traditional cellular technology. Most likely though is that there will be a cellular network generational change. It is worth noting that a summit sponsored by the European Telecommunications Standards Institute (ETSI) concluded that to make use of the emerging wireless technologies and to meet the requirements envisaged for cellular, evolution through LTE is unlikely to be effective and a new generation will be necessary.

Within Australia, the major carriers have all made commitments to providing 5G services when the technology becomes available. Most expect this to be around 2020.

The Australian Communications Media Authority (ACMA) have sponsored a consultation process on emerging issues for 5G which attracted considerable attention from carriers, manufacturers and other interested parties. The consultation process was based on the GSMA's characteristics of 5G (ACMA 2016b).

Telstra, in their submission noted that the emphasis on using high frequency bands meant that the issue of providing a service to regional and rural communities had been inadvertently overlooked. This is a significant issue for Australia with its very large but sparsely populated geographical area. Telstra would like to see lower frequencies included in any 5G standards. Lower frequencies are needed in order to provide coverage in a cost effective manner to larger, more sparsely populated areas.

Perhaps the key message is that there is still much to be resolved regarding 5G standards.

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Conclusion

In this paper we have discussed the requirements driving the development of 5G and the technologies that will most likely be used to meet those requirements.

The fifth generation of cellular networks is being driven by increasingly dense populations of attached devices, demand for increased bandwidth, and an expected rapid increase in the number of devices attached to the Internet. The key developments that will enable this are the use of higher frequencies, beam forming antennae, massive MIMO and new radio access network approaches.

Most likely this will be achieved through a new cellular generation, but there are still many technical and standards related issues to be resolved.

References

ACMA. (2016a). "5G: Known unknowns; A global investor perspective on the 5G roadmap", 21 June 2016, available at http://www.acma.gov.au/theACMA/About/Events/Spectrum-tune-ups/the-acma-and-iic-5g-seminar

ACMA. (2016b). "5G and mobile network developments – emerging issues occasional paper", February 2016, available at http://www.acma.gov.au/theACMA/5g-and-mobile-network-developments accessed 26 August 2016

Agiwan, M; Roy, A; Saxena, N. (in press). "Next Generation 5G Wireless Networks: A Comprehensive Survey", *IEEE Communications Surveys and Tutorials*

Andrews, J. G; Buzzi, S; Choi, W; Hanly, S. V; Lozano, A; Soong, A. C. K; Zhang, J. C. (2014). "What will 5G be?" *IEEE Journal on Selected Areas in Communications, 32(6),* 1065-1082

Aust, S; Prasad, R. V; Niemegeers, I.G.M.M (2012). "IEEE 802.11ah: Advantages in standards and further challenges for sub 1 GHz Wi-Fi" *IEEE International Conference on Communications*, 10-15 June 2012, available at http://ieeexplore.ieee.org/document/6364903/, accessed 26 August 2016

Checko, A; Christiansen, H. L; Yan, Y; Scolari, L; Kardaras, G; Berger, M. S; Dittmann, L. (2015). "Cloud RAN for Mobile Networks – A Technology Overview", *IEEE Communications Surveys and Tutorials*, 17(1), 405-426

Condon, S. (2016). "IoT will account for nearly half of connected devices by 2020, Cisco says", ZDNet, available at http://www.zdnet.com/article/iot-will-account-for-nearly-half-of-connected-devices-by-2020-cisco-says/ accessed 26 August 2016

http://doi.org/10.18080/ajtde.v4n3.63

The Economist. (2016). "Wireless: the next generation", The Economist, available at http://www.economist.com/news/business/21693197-new-wave-mobile-technology-its-way-and-will-bring-drastic-change-wireless-next

Ericsson (2016). "Number theories: what 100 operators really think about 5G", *Ericsson Business Review,* Issue 1, 2016

FCC (2015), "FCC Promotes Higher Frequency Spectrum for Future Wireless Technology" available at https://www.fcc.gov/document/fcc-promotes-higher-frequency-spectrum-future-wireless-technology accessed 26 August 2016

GSMA Intelligence (2014), "Understanding 5G: Perspectives on future technological advancements in mobile" December 2014, available at https://www.gsmaintelligence.com/research/?file=141208-5g.pdf&download accessed 26 August 2016

Kennellos (2016). "152,000 Smart Devices Every Minute In 2025: IDC Outlines the Future of Smart Things", Forbes, available at http://www.forbes.com/sites/michaelkanellos/2016/03/03/152000-smart-devices-every-minute-in-2025-idc-outlines-the-future-of-smart-things/#640ef80d69a7, accessed 26 August 2016

Lora Alliance. (2016). "Lora Alliance: Wide Area Networks for IoT", available at http://www.lora-alliance.org, accessed 26 August 2016

Pereira, V; Sousa, T. (2004). "Evolution of Mobile Communications: from 1G to 4G", Department of Informatics Engineering of the University of Coimbra, April 2004, available at https://eden.dei.uc.pt/~vasco/Papers_files/Mobile_evolution_v1.5.1.pdf, accessed 26 August 2016

Press, G. (2014). "Internet of Things By the Numbers: Market Estimates and Forecasts", Forbes, available at http://www.forbes.com/sites/gilpress/2014/08/22/internet-of-things-by-the-numbers-market-estimates-and-forecasts/#3ad2f2932dc9

Rappaport, T; Roh, W; Cheun, K. (2014). "Mobile's Millimeter-Wave Makeover", *IEEE Spectrum,* September 2014, 35-58

Rost, P., Bachs, A., Breitback, M., Doll, M., Droste, H., Mannweiler, C., Puente, M., Samdaris, K., Sayadi, B. (2016). "Mobile Network Architecture Evolution toward 5G", *IEEE Communications,* May 2016, 85-91

Samdanis, K; Costa-Perez, X; Siancalepore, V. (2016). "From Network Sharing to Multi-Tenancy: The 5G Network Slice Broker", *IEEE Communications Magazine – Communications Standards Supplement, July 2016,* 32-39

http://doi.org/10.18080/ajtde.v4n3.63

Wang, C.-X; Haider, F; Gao, X; You, X.-H; Yang, Y; Yuan, D; Aggoune, H.M; Haas, H; Fletcher, S; Hepsaydir, E. (2014), "Cellular Architecture and Key Technologeis for 5G Communication Networks", *IEEE Communications Magazine, February 2014,* 122-130 accessed 26 August 2016

Webb, W. (2012). "Understanding Weightless: Technology, Equipment, and Network Deployment for M2M Communications in White Space", Cambridge University Press, ISBN 9781107027077

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Social Practices of 3D Printing:

Decentralising Control and Reconfiguring Regulation

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Abstract: This paper considers the social practices of 3D printing by comparing consumer perspectives and practices with legal scholarship on intellectual property regimes. The paper draws on data gained through a mixed-methods approach involving participant observation, focus groups, and social network analysis of 3D printing file-sharing practices. It finds that while consumers display a level of naivety about their 3D printing rights and responsibilities as individuals, they possess a latent understanding about broader digital economies that guide their practices. We suggest that the social practices associated with 3D printing function through communication networks to decentralise manufacture and reconfigure legal capacities for regulation. The paper concludes by introducing nascent paths forward for policy frames across industry, government and consumer concern to address the opportunities and challenges of 3D printing's evolving interface with society.

Keywords: 3D Printing, Design, Copyright, Intellectual Property, Patents, Mixed-Methods, Social Network Analysis, Trademarks, Peer-Production

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Introduction

3D printing has existed for a number of decades as specialist and experimental projects in manufacturing research. Originally designed as a rapid prototyping technology, it has come to develop other unique qualities that make it relevant outside of a manufacturing environment. The technology is scalable, distributed, and innovative, and many models easily connect to networked computer services to access printable files. These attributes mean that educational institutions and everyday citizens are finding it possible – if still somewhat difficult – to own and operate 3D printers in domestic or educational settings. A wealth of corporate and user-generated online and offline resources that individuals consult to operate their printers means that 3D printing is emerging as a broad set of social practices that build on the technologies of additive manufacturing. Examples include various types of tinkering, small business, personal craft, DIY, and hobbyist activities.

These 3D printing cultures are enabled by extensive online sharing of files and information that situate consumer knowledge about 3D printing in the context of the current online discourses involved in the evolutions of rights, responsibilities, and regulations. In other words, the fact that these technologies are able to produce and distribute designs around the world means that 3D printing technologies are implicated in the complexities of global intellectual property regimes (IPR), and, importantly, many end users only seem to be marginally aware of what impact the relevant laws, treaties, and policies might have. This, understandably, opens the space for both naïve breaches of intellectual property law; but also there is the possibility of a chilling effect in users who are wary of engaging with 3D printing due to a perception of potential legal issues.

Citizens are aware of 3D printing as cutting-edge technology. Current developments in 3D printing exists within widespread rhetoric around a coming 3D printing "revolution" that promises social transformation, and which has been attested to by even relatively conservative publications such as The Economist ("A Third Industrial Revolution", 2012). This rhetoric is being spouted without providing evidence towards how the revolution is being enacted, and as a result, citizens have a higher degree of expectation about the capacity for 3D printing to solve problems in their own lives. Questions about how users are applying the technology in their social lives (and vice versa), or how different intellectual property regimes are responding to these social practices, and how these intersections will shape trajectories of digital cultures, economies, and citizenship in a networked society are often left unanswered. Citizens themselves are not necessarily sure about what it is they 'know' or 'don't know'.

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This research paper begins to provide detail on this gap in citizen knowledge by drawing on empirical data gathered from participant observation in open educational workshops on 3D printing, focus groups of Australian consumers, and a Social Network Analysis (SNA) wherein we mapped what is currently the largest online 3D printing file repository: 'Thingiverse'. From this, we identified the various uses of 3D printed files shared online among extant 3D printing communities. From this data, we suggest that the social practices associated with 3D printing function through communication networks to decentralise manufacture and reconfigure socio-political power and legal capacities for regulation.

The paper locates our empirical data on consumer perspectives and practices within relevant regulations. Specifically, those regulations relevant to 3D printing based on 'law in context' approach of recent legal scholarship grappling with how 3D printing intersects with copyright, trademark, design, and liability law. Although the study of law is necessary, it is not sufficient to understand evolving user experience. Internet intermediaries that mediate file sharing and modification, industry application of current IPR via automated measures, and the cultures that surround the designing, sharing and printing of goods all affect the future trajectories of 3D printing's place in society. The paper concludes by introducing paths forward for policy frames across industry, government and consumer concern.

Additively Manufacturing the Social Context of 3D Printing

A key analytical move which we make in order to address 3D printing and its cultures is to separate out the technology (additive manufacturing) from the culture (3D printing) to better describe and explain cultural and social uses of the technology. Our claim is that 3D printing is the social practice that sits on top of additive manufacturing technology which we can address through a brief history of the techno-societal interface. We observe three phases of 3D printing culture emerging, developing centralised, decentralised, and distributed behaviours over time. Each new phase *adds to*, rather than replaces, the sum total of 3D printing culture, such that the phase that is currently emerging – the distributed practice – is operating in parallel with centralised and decentralised modes. Note that these phases inform and bleed into each other, with peer-to-peer practices being taken up by institutions, while at the same time practices created through R&D are being used in community hobbyist workshops.

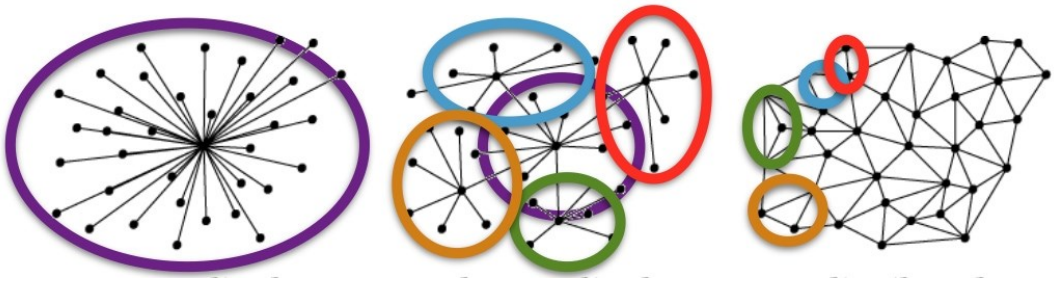
From a technical perspective, the patented inventions of Charles Hall (1986) and Scott Crump (1992) – who respectively went on to found the 3D Systems and Stratasys – are often credited for kick-starting 3D printing practices. We suggest that these inventions, along with the continuing stream of technical innovations in 3D printing, interface with and evolve within social contexts that can be categorised in three phases. The first phase involved 3D

http://doi.org/10.18080/ajtde.v4n3.64

printing becoming "available", reflecting economies of pre-production including rapid prototyping of one-off models as well as functional analysis and testing (Kellock 1989, Pham and Gault 1998, Wood 1990).

The second phase of "utility" decentralised manufacture from in-house pre-production to production houses that shifted supply chain logics and provided new utility for industry (Birtchnell, Böhme, & Gorkin, 2016; Krogmann, 2012). This phase also included material and process advances that enabled additively manufactured objects to withstand stress and strain or be designed with unique geometries or aesthetics that added value for products where customisation and complex geometries trumped economies of scale (Bak 2003; Hopkinson, Hague, and Dickens 2006). Examples of the decentralised production include aerospace and military applications that reduce weight through 3D printed designed parts and customised medical fittings, such as hearing aids.

Figure 1: Social phases of 3D printing, coloured borders denote organisations



Phases	Availability	Utility	Practicality
model	centralised	decentralised	distributed
economy	Pre-production	production	Peer-production

The third phase we identify is still emerging but already speaks to a wider "practicality" of 3D printing practices. It is defined through a more fully distributed network of 3D printers that rely on aspects of peer-production. This phase specifically addresses independent users coming together outside of the industry to share, learn and act upon 3D printing. Industry consultants Wohlers and Associates, for example, suggest that while 86% of 3D printing revenues came from industrial applications, 92% of the printers sold were for consumer purposes (2015). This shift to consumer adoption shows how the uses of 3D printing are distributing beyond industrial use cases and capitalist economies. Moilanen and Vadén (2013) explain this trend through the increasingly inexpensive open source and mass-market 3D printers targeted towards hobbyists and enthusiasts under the general label of 'makers'. Chris Anderson (2012) explains the cultural and economic cache of 'makers' through the

http://doi.org/10.18080/ajtde.v4n3.64

ability to use digital networks for practices of open design that combine with novel small scale manufacture technologies. From this frame, new forms of entrepreneurialism and innovation extend economic growth online in highly distributed niches. Apart from economics, such practices are important in the cultivation of self-identity and culture, both locally and worldwide (Luckman, 2015). Schrock (2014) describes the physical spaces where these practices blossom as hacker-maker spaces (HMS) that are made up of community-maintained workshops that allow individual tinkering, social learning, and collaboration on creative-technical projects. According to work by Kostakis et al. (2014) HMS spaces are growing at an exceptional rate, from 40 globally in 2007 to around 1000 by 2013. The forms of sharing and production enabled by 3D printing within HMS clearly diverge from the organisational hierarchies seen in the first phase and the price markets that enabled the second.

Specifically, much of the digital maker economy relates to and in many aspects relies upon what Benkler (2002; 2006) describes as commons-based peer-production. This involves the re-use of others' contributions with minimal restrictions on that use. From the perspective of a commons-based sharing economy and culture, IPR raise the cost of interaction or restrict re-using information, while also limiting the creative uses of the technology, and consequentially decreasing innovation in the field. Benkler's work draws from observation of open source software communities and a context of ubiquitous low-cost processing, storage, and networked connectivity that connects individuals to create and exchange information and culture in patterns of sharing and reciprocity (Benkler 2006:463). 3D printing as a distributed social practice also relies on low barriers to networked connectivity and exchange for both design and cultural content. Thus one of the policy challenges of 3D printing is how to facilitate education, innovation, and governance systems that make use of the large-scale, widely distributed creativity in online settings within incumbent IPRs that apply the logic of (product) scarcity instead of (information) abundance. How innovation and governance concerns are perceived by everyday 'consumers' interested in 3D printing is where this article now shifts.

Research Design

To explore 3D printing as a social practice, we engaged context appropriate methods across multiple sites (Yin, 2008, 2011), in order to build a collective case study (Stake, 2000, p. 437). This included expert interviews, participant observation at 3D printing workshops and trade shows, focus groups of individuals interested in but novices to 3D printing, and a social network analysis of data scraped from the largest online 3D printing file-sharing

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intermediary, the Thingiverse website. The full methodological outline of our project has been detailed previously.

Our focus group participants were recruited from clusters of city libraries and businesses with 3D printing facilities, services, or classes in Melbourne, Australia. The cohort of participants was stratified according to self-reported 3D printing experience to ensure some level of homogeneity within each group. Focus groups allowed us to consider how normative beliefs of 3D printing as a social practice are communally produced (Smithson, 2000). Our limited sample does not represent the Australian public at large, but the knowledge gained is indicative of demographically diverse consumers that wish to embark on 3D printing use.

The web-scrape and SNA enabled us to determine empirical patterns and cultural trends via hundreds of thousands of objects that people have uploaded to print. Through Python scripts run on the Australian National eResearch Collaboration Tools and Resources (NeCTAR) cloud servers, we obtained individualised metadata from all publicly accessible items (355,867) on the Thingiverse website. We then were able to employ descriptive statistical and social network analyses on the scraped dataset to obtain insights from real-world data about what users are actually printing and how they're managing the visibility and dissemination of their work (for detail on these methods see Author(s)). We leveraged the user created 'tags' associated with objects to discern meaning and relations in ways that allowed us to map the relevance of certain tags to others and aggregate themes and their links in different types of 3D printing practice. This method allowed insight to a number of limited categories of use that were not apparent during our qualitative phase and allowed novel, data-based perspectives on the use of 3D printing independent but complementary to other research approaches. By addressing socially-sorted data related to 3D printing, we were able to develop an understanding of different types of practice, and different categories of interest for users of 3D printing, which are indicative of likely uses in the future for Australian 3D printer users.

Consumer Perspectives & Realities of 3D Printing Practices

A significant portion of our project involved qualitative research methods; specifically, interviews, participant observation of workshops and trade shows, and focus groups. Data from these events brought to light a lack of centralised systems for managing accountability in terms of the rights and responsibilities that come with 3D printing for end users. In short, the networked structure of even fairly simple household 3D printer setups involve complex and hidden supply chains, and the technology natively lacks any structure of accountability for either legal or insurance purposes – a concern that is amplified in educational settings. We also found that consumers tended to approach 3D printing with an apparent naivety

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regarding their own rights and responsibilities for managing the sharing and printing of designs while possessing scepticism about protections to be found online. These themes are summarised below through elements that emerged most strongly and consistently across research sites and methods, and then by situating these insights in relation to practices of tagging files on the Thingiverse repository.

Decentralised Control

The data suggesting an inbuilt lack of centralised accountability for the rights and responsibilities that came with 3D printing presented a classic "wicked problem" (Rittel & Webber, 1973), defined through from complex distributed interdependencies across social and technological concerns. For instance, attempts to centrally regulate what is printed that are reliant on restrictive censorship regimes or other negative-use measures alternately work against the interests of users, hardware manufacturers, online intermediaries or the affordances of specific digital technologies themselves.

The manufacturers we spoke did not want to implement restrictions on their own hardware, as limitations regarding what content could or could not be printed (beyond the technical limitations of individual types of 3D printer) were seen to be undesirable restrictions on consumers. Meanwhile, online intermediaries are loathe to introduce new regimes that police content their users upload, pointing to the historically successful safe harbour laws that have allowed freedom of expression (and commerce) on the internet to flourish. Finally, if both manufacturers and intermediaries are not the choke points for restricting prints, deep packet inspection of users' uploading and downloading habits present an alternative, but presents a costly option both technically and politically. Deep packet inspection has the further limitation that it can be defeated by publicly-available encryption technologies such as the Tor Network or the BitTorrent protocols, which distribute the publication of files and efficiently obfuscate origins and recipients amongst other network traffic. While some expert respondents introduced the idea of individual licensing for the ability to print (like a fishing or driving licence), we could find no evidence of any governments, manufacturers, intermediaries, or consumers interested in this pathway, as it was seen to stifle capacities for innovation and freedom of expression without providing useful protections against nefarious uses of printers.

Potential alternatives to broad restrictive powers that were suggested to by respondents include increased transparency. In public and educational settings, recording who prints what may create a public forum for accountability that can reduce risk. Calls for transparency also find utility through using standards to reduce risk. Making standards

http://doi.org/10.18080/ajtde.v4n3.64

openly known, and encouraging them to be openly arrived at, can mediate some quality issues from an otherwise distributed printing practices that decentralise liability.

Sharing 3D designs

The qualitative data suggested an apparent naivety from those learning about 3D printing regarding their rights and responsibilities for managing the sharing and printing of designs. That being said there was wide consensus with regard to the normative and practical imperative to share designs with both friends and strangers across our respondents. However, the ethic of sharing designs was tempered by a caveat that as the complexity of designs increased, so too should intellectual property protections on them. Interestingly, the way that users approached specific IPR rules tended to be contradictory. Users largely believed that the value of 3D-printable objects came through the ability for people to collectively share designs, modify these designs, then re-share them to the community. Yet this was paralleled with a fatalist assumption that once something is put online, fully controlling its distribution is impossible, and that this was undesirable. Thus users both saw immense collective value in the networks and services that distributed printable content for negligible cost, but at the same time were highly reluctant to commit to sharing materials into this domain.

A second set of observations came through discussion on safety and liability. All focus groups and most interviewees tended to come to a consensus around users bearing the brunt of safety risks for sharing designs outside of market mechanisms. This was seen to be the case in almost every instance that research participants were questioned on, whether as a pessimistic expectation that 'big business always wins in court' or a 'responsibilisation' approach that end users need to take account of their own safety in these situations. The common metaphor used by participants to explain their thinking was to compare safety and liability to concerns for 3D printing to the responsible use of other power tools in DIY settings, such as bandsaws or drills. Experts commented that outside consumer protection regimes, which usually require business transactions to come into effect, negligence law would protect consumers of harms. However, consumer knowledge of the 'user beware' attitude was explained to researchers through both practical and normative assumptions. Practically, respondents thought the ability to enter into legal proceedings and see them through required access to large amounts of capital. Normatively, the respondents understood both the technology and the practices that surrounded it as experimental and explorative, and not aligned to market norms. Risk conceptualisation, assessment, and mitigation were topics that respondents conceptualised in terms outside of normal law-based social safety nets.

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Overall focus group data suggested respondents' naïve approach to the law did not cancel out their own subconscious knowledge of experience-based understandings of the limits of digital production practices. Our initial enquiries thus identified a need to inform both how the law in practice applies to 3D printing, and how practical user experiences online might differ from that law in practice template.

Interestingly, ownership was another concept that was tested by the discursive social interactions of the focus groups. For instance, many individuals present at the 3D printing workshop as well as focus group respondents were fearful of how large corporations would treat their intellectual property online, regardless of current IPR. One participant summed up their fear when stating,

> *you can print it, but it doesn't say anything about where you got it [...] that's something that's very easy to take advantage [of] by big companies [...] you can see people have a passion for printing, for 3D drawing, but that doesn't mean that companies are going to respect that...*

At the same time, respondents struggled with finding new meaning to ownership in economies of digital abundance. Overall, consumer-participants had a strong preference for sharing under a Creative Commons Share-Alike licensing structure (Creative Commons n.d.), where modifications are allowed as long as credit is given to previous contributors and the license is kept under the same terms. Interestingly, our web scraping dataset suggested this licensing type was most popular, with over 53% of publicly available objects being assigned a similar licence. However, this licence type showed no significant increase in use, measured in downloads, compared to other more restrictive license types (see chart 1). The only intellectual property 'license' that correlated with increased downloads was the abrogation of private intellectual property rights - objects rendered to the public domain.

The general use of Thingiverse objects showed a striking 'long tail' (Anderson, 2012) pattern that is common with economies of digital abundance, wherein a limited number of objects have a high degree of engagement, while the majority of the database has a vanishing small level of recorded engagement. That is to say that a minority of items on Thingiverse were viewed very frequently, while most were barely viewed at all (mean views: 6038, Std. Dev.: 3801). The 'long tail' was also pronounced for what was downloaded (mean downloads: 264, Std. Dev. 1179).

The SNA of the Thingiverse dataset also suggested the social utility of objects shared online are extremely varied. Our methods mapped social patterns within 3D printing on Thingiverse through how users tagged objects they uploaded, and how these tags related between objects. We found users employed 3D printing for purposes that seemed to include both purposive and aesthetic outputs. While these purposes often referenced the intellectual

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property of others (mostly through brand identifiers that signify form and fit or aesthetic properties), there were also prominent uses of non-branded (and thus non-infringing) uses for tags given to objects.

Tagging 3D files

Our SNA map of tags gave visual insight to how the relationship between different types of 3D printing practice clump together by identifying related themes through recording incidents of tags being used alongside other tags to label 3Dprinter files. This allows us to infer aggregate practices different to what individual users shared in interviews or focus groups. For instance, we detected a particularly wide array of braille-tagged objects that were not visible through other research methods. To show the largest trends and explicate what certain 'clumps' of tags signified in social practice, we used open coding to create summative categories of use from numerous reoccurring tag connections and suggest the themes users interact with as part of their 3D printing practices (see Table 2).

Table 2: Themes of use in 3D printing on Thingiverse via tag concurrence

Category	Example tags	Apparent common use
Geometric specificities	3D, 2D, cube, Z-Axis, 40mm	Item designed with specific ratios
Representational of subject content	Art, animal, moon, halo, knot, scan	Item's function is likely representational
Hardware in use	Makerbot replicator, RepRap	Item designed for specific printer
Software in use	Sketchup, blender, TinkerCAD	Item designed using specific software
Date/time	2013, 2014, July, Christmas	Item produced on that date, holiday-specific
Material specificities	ABS, PLA	Item intended to be printed in this material
Representational of use case	Holder, screwdriver, sensor, tensioner, food, wearable	Item is designed as a functional object.
Affective/emotional	Cool, awesome, love	Item evokes subjective evaluation
Brands and IP	Nike, Warhammer, Canon, GoPro, iPhone, Arduino, LEGO, Pokémon,	Item mirrors the aesthetics of these brands, or adds to or replaces proprietary parts
Subcultural	cookie, robot, baixar	Tag has context to a specific subcultural group that has origins outside 3D printing

Finally, we noted that patterns of re-mixing objects into new objects, which suggested low factors of sequential evolution. Most users remixed objects only once. This can partly be understood through the design of Thingiverse's interface, which affords a simple but restrictive 'customizer' tool to re-shape objects in specified ways. However, it can also be understood as a function of the use cases employed: from numerous spot checks on remixed items that did not employ the 'customizer' tool, users tended to remix in order to personalise objects rather than evolve their utility or form in a transformative manner. For instance, the

http://doi.org/10.18080/ajtde.v4n3.64

modification of mobile phone cases, which was one of the most common practices as measured by our SNA, often added names or personalised designs.

Rights & Responsibilities: Legal Frameworks & Beyond

This section locates the concerns we encountered from consumers and experts in reference to current IPR to express some common points of guidance to emerging wicked problems connected to 3D printing practices. Our findings are provided here mostly in summary and in a non-proscriptive framing, as the mosaic of law, business terms, geographical and jurisdictional issues that users interface with in their 3D printing practices are diverse and sometimes contradictory. Any guidelines must consider that comprehensive knowledge is untenable in this evolving field that must grapple with what decentralisation of responsibility and the individualisation of risk looks like for persons involved with 3D printing practices.

While our research relied on the necessary legal scholarship and case law to a certain extent (Daly, 2016; Engstrom, 2013; Holland, 2009; Lemley, 2015; Scardamaglia, 2015; Weinberg, 2016; Weinberg & Knowledge, 2010), these approaches are not sufficient to convey an accurate account of user experience online. Internet intermediaries, with their own policies that deflect responsibility on to use (Mendis & Secchi, 2015; Seng, 2014), consumer protection agencies that are coming to terms with shifting realities, and the evolving cultures and technologies of sharing objects online (Bogers, Hadar, & Bilberg, 2016; Moilanen, Daly, Lobato, & Allen, 2015; Moilanen & Vadén, 2013; Schrock, 2014; Söderberg, 2014), together create a complex and often contradictory reality that tests and sometime ignores codified policy and protection.

Weighing these factors, we found that across jurisdictions and services online, risk is often directed towards individual users of 3D printed goods. That is to say, the protections consumers might be used to through state protection regimes are less certain to apply, or be easily accessible as the complexity of ownership, jurisdiction, publisher, and enforceability of IPR create increased uncertainty of outcomes. For instance, user experience of governance in 3D printing cultures is often served through private threat of legal action, opaque website terms and conditions, or a conglomeration of such concerns as rendered through automated 'takedown' mechanisms tied to the America's Digital Millennium Copyright Act - regardless of the laws of the user faces in his or her host country. Thus, the below guidelines for 3D printing often take the 'worst case' scenarios of a specific jurisdiction or jurisprudence decision in forming a baseline for response to consumer concerns.

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Guiding responsible 3D printing practice

IPR factors into 3D printed goods through various copyright, patent, design, and trademark law. Copyright serves artistic works as they are expressed in some medium - not their ideas or functional objects that users might design and are granted immediately to the author/creator. Legal scholarship from the UK and the USA suggests 3D printing design files will probably be protected under copyright, but design ideas within the file (rather than its actual code) will probably fall outside copyright protection unless the object to be printed is artistic in nature (Copyright, Designs and Patents Act; Simons; Bradshaw et al. in Daly 2016: 26-27). Note that if artistic works are 'industrially' produced, copyright protections may no longer apply and the design should be registered under design law (see below). Showing how evolving socio-technological practices provide wicked problems for the law, Weinberg (2016) suggests that 3D scans of objects and people will struggle to meet copyright thresholds due to lack of originality and instead suggests that any governance regimes will require consideration of access. As our respondents intrinsically knew, controlling access to uploaded material is in itself problematic.

Patents also present an avenue for IPR to interface with 3D printing practices. Patents are not for artistic works but are instead meant to protect novel functional inventions that are not obvious. Users that 3D print objects to solve common household problems could technically infringe a patent; even if they are unaware the patent exists. Note that Australia and the US do not have exceptions for individual, personal, or unwitting use of patents, while the UK does have an exception for private, non-commercial purposes. Using others' patents for your own experimentation is allowed in Australia and the UK (Daly 2016: 30). Although technical infringement of patents in home use may occur, the legal avenues of proving this are at present quite slim. Patent law makes patented designs - by definition - public. The extent these designs are used in domestic inventions or household processes has never been a major prosecutorial concern of rights holders.

Design and trademark law is complex, but will be increasingly germane to 3D printing practices. Like patents, trademarks and (some) designs need to be registered and provide complex rights. Design and Trademarks concern IP that is separate from artistic and inventive function but speaks, respectively, to what makes a product look the way it does and to its origin. The current state of trademarks and design in 3D printing offers incentives for, as Scardamaglia (2015, p. 24) puts it, the "expansion of intellectual property laws to further … restrict the continued use of new and emerging technology". We believe that the attitude being identified by Scardmaglia is already apparent in the tone of public commentary from some legal firms, particularly in terms of how to protect designs from being copied for 3D

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printing, even when the practices being outlined in briefs widely found online, in some instances, manifest non-infringing uses.

As an important final consideration in terms of liability, most consumer protection laws are built around financial transactions or the business operations of the party to be held liable, which have the additional role of providing a chain of transitions of ownership. In contrast, it becomes quite onerous to sue for damages if a 3D printed object is defective due to a design that was shared freely rather than paid for. The terms and conditions of websites often make users wave rights concerning safety and liability, even if this touches on concerns of negligence from the designers of 3D printed objects. The extent that online intermediaries can evoke safe harbour for 3D printed goods here is untested.

In this short space, we analysed expert opinion towards relevant issues for 3D printing practices as they are playing out in law and practice. The above commentary is meant to reflect the weakest link for rights and responsibilities that users encounter online, and provide a starting point to understand the decentralisation of power and responsibility in 3D printing. What future practice looks like is dependent on a mosaic of intersecting claims of regulation, technology, jurisprudence, and changing social norms and cultural practices.

Conclusion

How 3D printing will reconfigure socio-political power and the capacity of regulation in terms of social communications practices that enable decentralised manufacturing is still complex and contradictory. If the general idea of promoting the progression of science and useful arts through granting exclusionary rights for a finite time to authors/inventors is to be upheld in a digitally networked age of mass self-manufacture, the tenets of its execution must adapt.

Balancing adaptations across industry, government and consumer concerns will require recognising the necessary precedents and pervasive expansion of IPR in digital communications. However, this frame is not sufficient to capture emerging 3D printing practices for the digital economies of the present and future. Evolving cultural practices, functioning business models and greater penetration of technologies will also play a role in determining pathways forward. One pathway suggests incumbent rights holders will hope to target nodes that spread their IP or enable its infringement, rather than the users who consume and reconfigure it (Holland, 2009). Focussing on such contributory infringement, or ‘secondary infringements’ will draw in many new stakeholders to the debate, and expose the various generative and non-infringing uses that 3D printing practices have in society. However, this will also make visible the limitations of intellectual property in the contexts of decentralised control.

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References

A Third Industrial Revolution. (2012 April 21). The Economist.

Anderson, C. (2012). Makers: the new industrial revolution: Random House.

Bak, D. (2003). Rapid prototyping or rapid production? 3D printing processes move industry towards the latter. Assembly Automation, 23(4), 340-345.

Benkler, Y. (2006). The wealth of networks: How social production transforms markets and freedom: Yale University Press.

Benkler, Y. (2011). The unselfish gene. Harvard business review, 89(7/8), 77-85.

Birtchnell, T., Böhme, T., & Gorkin, R. (2016). 3D printing and the third mission: The university in the materialization of intellectual capital. Technological Forecasting and Social Change.

Bogers, M., Hadar, R., & Bilberg, A. (2016). Additive manufacturing for consumer-centric business models: Implications for supply chains in consumer goods manufacturing. Technological Forecasting and Social Change, 102, 225-239.

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Crump, S. (1992). Apparatus and method for creating three-dimensional objects, US Patent No. 5121329. Google Patents.

Daly, A. (2016). Socio-Legal Aspects of the 3D Printing Revolution: Palgrave Macmillan UK.

Engstrom, N. F. (2013). 3-D printing and product liability: identifying the obstacles. University of Pennsylvania Law Review Online, 162(35).

Hall, C. (1986). Apparatus for production of three-dimensional objects by stereolithography. US Patent no. 4,575,330. Google Patents.

Holland, A. (2009). IP As You Know It Is Dead: The IP Implications of Cheap 3D Rapid Prototyping and the Radical Democratization of Manufacturing. Available at SSRN: http://ssrn.com/abstract=2787260. Retrieved from http://ssrn.com/abstract=2787260

Hopkinson, N., Hague, R., & Dickens, P. (2006) Eds. Introduction to rapid manufacturing. Rapid Manufacturing: An Industrial Revolution for the Digital Age, 1-4. John Wiley and Sons, Ltd.

Kellock, B. (1989). Excitement of technology trends. Machinery and Production Engineering, 147, 273.

Kostakis, V., Niaros, V., Giotitsas, C. (2014). Production and governance in hackerspaces: A manifestation of Commons-based peer production in the physical realm? International Journal of Cultural Studies. 13 Feb 2014. doi: 10.1177/1367877913519310

Krogmann, C. (2012). The Impact of Direct Digital Manufacturing on Supply Chains. Berlin: GRIN Verlag.

Lemley, M. A. (2015). IP in a World without Scarcity. NYUL Rev., 90, 460.

Luckman, S. (2015). Women's Micro-Entrepreneurial Homeworking. Australian Feminist Studies 30(84): 146-160.

Mendis, D., & Secchi, D. (2015). A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour. The Intellectual Property Office, UK.

Moilanen, J., Daly, A., Lobato, R., & Allen, D. (2015). Cultures of Sharing in 3D Printing: What Can We Learn from the Licence Choices of Thingiverse Users? Journal of Peer Production, 6.

Moilanen, J., & Vadén, T. (2013). 3D printing community and emerging practices of peer production. First Monday, 18(8).

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. Policy sciences, 4(2), 155-169.

Pham, D., & Gault, R. (1998). A comparison of rapid prototyping technologies. International Journal of machine tools and manufacture, 38(10), 1257-1287.

Scardamaglia, A. (2015). Flashpoints in 3D printing and trade mark law. Journal of Law, Information & Science.

Schrock, A. R. (2014). "Education in Disguise": Culture of a Hacker and Maker Space. InterActions: UCLA Journal of Education and Information Studies, 10(1).

Seng, D. (2014). The State of the Discordant Union: An Empirical Analysis of DMCA Takedown Notices. Virginia Journal of Law and Technology, Forthcoming.

Smithson, J. (2000). Using and analysing focus groups: limitations and possibilities. International journal of social research methodology, 3(2), 103-119.

Söderberg, J. (2014). Reproducing Wealth Without Money, One 3D Printer at a Time: The Cunning of Instrumental Reason. Journal of Peer Production (4).

Stake, R. (2000). The Sage handbook of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), (pp. 435-454): Sage Publications, Incorporated.

Weinberg, M. (2016). 3D Scanning: A World Without Copyright*. Retrieved from Shapeways: http://www.shapeways.com/wordpress/wp-content/uploads/2016/05/white-paper-3d-scanning-world-without-copyright.pdf

Weinberg, M. (2010). It Will be Awesome If They Don't Screw it Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology: Public Knowledge.

Wholers, T. (2015 May, 29) Keynote Address. Inside 3D Printing Conference and Expo. Melbourne, Australia.

Wood, L. (1990). Rapid prototyping. Uphill, but not moving. Manufacturing System, 8(12), 14-18.

Yin, R. K. (2008). How to do Better Case Studies. In L. Bickman & D. J. Rog (Eds.), The Sage handbook of applied social research methods: Sage Publications.

Yin, R. K. (2011). Applications of case study research: Sage Publications.

http://doi.org/10.18080/ajtde.v4n3.64