

11 April 2002

Review of Radiocommunications Acts  
Productivity Commission  
Locked Bag 2  
Collins St East  
Melbourne Vic 8003

via Email: <[radiocomms@pc.gov.au](mailto:radiocomms@pc.gov.au)>

Dear Sir/Madam

**Subject: Review of Radiocommunications Acts**

Please find attached submission from Electronic Frontiers Australia Inc. to the Commission's inquiry.

We advise that Ms Raena Lea-Shannon will liaise with your office regarding EFA's interest in appearing at a hearing and any inquiries relative to EFA's submission should be directed in the first instance to Ms Lea-Shannon who can be contacted by telephone on (02) 9318 2900.

Yours faithfully

Irene Graham  
Executive Director  
on behalf of the Board  
Electronic Frontiers Australia Inc.

Encl.



# **ELECTRONIC FRONTIERS AUSTRALIA INC. SUBMISSION ON PRODUCTIVITY COMMISSION DRAFT REPORT ON RADIOCOMMUNICATIONS, FEBRUARY 2002**

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11 APRIL 2002

## *Part I - INTRODUCTION*

### **1. ABOUT ELECTRONIC FRONTIERS AUSTRALIA INC**

Electronic Frontiers Australia (EFA) is a non-profit national organisation formed to protect and promote the civil liberties of users and operators of computer based communications systems. EFA was formed in January 1994 and incorporated under South Australian law in May 1994.

Our major goals are to advocate the amendment of laws and regulations in Australia and elsewhere (both current and proposed) which restrict free speech, to educate the community at large about the social, political and civil liberties issues involved in the use of computer based communications systems, to support, encourage and advise on the development and use of computer based communication systems, and related innovations and to research and advise on the application of the law (both current and proposed) to computer based communication systems and related technologies.

EFA is independent of government and commerce and is funded by membership subscriptions and donations from individuals and organisations with an altruistic interest in promoting civil liberties.

### **2. SCOPE OF SUBMISSION**

This Submission seeks to highlight those issues of most relevance to EFA's members and to its objects. Those issues are:

1. universal and affordable broadband access to the Internet, and
2. innovation of the Internet, its media, applications and content.

#### **2.1 TERMS OF REFERENCE**

The Terms of Reference expressly refer to the issues within the scope of this Submission being:

1. At Term of Reference 3(b), that, (amongst other things) the competitiveness of business including small business and efficient resource allocation must be taken into account by the Commission in its assessment of the Radiocommunications legislation/regulation efficiency, and
2. At Term of Reference 5(a) that the Commission is required to report on the effectiveness of reforms of the Radiocommunications legislation in
  - (ii) encouraging innovation and investment in radiocommunications services and
  - (iii) in facilitating access to spectrum by users, including public and community services as defined in the legislation.

## *PART II SUMMARY OF SUBMISSIONS*

1. **Whilst Spectrum Licences are in use Competition Limits should be retained.** Sections 60 and 106 RC Act 1997 competition limits be retained.

2. **The Commission's Recommendation 10.1 to transfer spectrum planning and licensing of broadcast service bands to the ACA from the ABA is welcomed.**
3. **The *Telecommunications Act 1997* should be amended as follows:**
  - (i) remove any uncertainty over the definition of "non commercial".
  - (ii) The definition "non-commercial" should expressly include without limitation uses by a non-profit organisation which impose no fee for use other than to recover the actual costs of the base and network units (WLAN) and internet connection exclusive of any overheads of the organisation.
  - (iii) include a Second Class of Carrier Licence for Small Business.

The Second Class Carrier Licence should be for businesses with turn over less than say \$3m per annum. Licensees should only be charged an Administrative cost annual Fee; have limited SMS core Carrier Obligations and no provision of pre-selection in favour of carriage service providers.
4. **The RC Act be amended to include provision for a Public Domain Spectrum (PDS) including:**
  - (i) statutory right of nuisance;
  - (ii) regulation and complaint supervision with ACA;
  - (iii) maximum term of Spectrum Licence 5 years;
  - (iv) reversion of existing Spectrum Licences into PDS on expiration;
  - (v) existing unsold spectrum and Class Licences to become PDS;
  - (vi) PDS to permit listen in on and use Licenced Spectrum, and
  - (vii) Existing Spectrum and Device Licenses to be use it or lose it.

### *PART III EXECUTIVE SUMMARY*

#### **1. 1992 RADIOCOMMUNICATIONS ACT REFORMS**

The 1992 reforms are an improvement on the prior legislation.

When comparing the 1992 Reforms with the prior legislation however the prior system should not be used as a performance bench mark for the 1992 or further reforms. The heavily administrative, cumbersome and inefficient licence system replaced by the 1992 reforms, created a crisis in spectrum management. Any assessment of the 1992 Reforms should be measured against objectively acceptable levels of efficiency and competition fairness.

The Commission risks underestimating the impact of new spectrum technologies. More than merely having "the potential to improve spectrum efficiency greatly" (Report Box 3 at p.XLII) the rapid change occurring in Spectrum science and technology has changed and will continue changing completely presumptions of scarcity and interference.

Legislation/regulation should avoid second guessing technologies and uses (Report at XLVI). In so doing future legislation/regulation must permit that new market paradigms will be necessary to accommodate the emergence of innovation. In proposing to "leave these choices to the market" ( Report at XLVI) the Commission is placing the responsibility for that innovation and those future markets in the exclusive control of incumbents whose vested interests are in existing markets.

#### **2. SPECTRUM LICENCES**

A market for spectrum must

1. include a market for small and medium business spectrum users especially in the supply of Internet services, and
2. take into consideration the extremely rapid development currently taking place in spectrum technology.

### **3. LICENCE TENURE**

Security of tenure is a disincentive to innovation and creates barriers to entry. The notion of security of tenure by definition creates exclusivity of access and artificially inflates entrance prices to the market. This favours oligopolistic market structures built up of current incumbents. This structure will inhibit innovation and opportunities for new businesses to exploit developments of Spectrum science and technology.

Making an objective of spectrum licences indefinite tenure, relies upon the assumption that spectrum will always be significantly scarce and that it will always be materially susceptible to interference. This places that market's reliance upon those assumptions being perpetuated.

### **4. CLASS LICENCES**

The creation of Class Licences for very low interference devices such as cordless phones, automatic garage doors and private and some business wireless LANS is a common sense solution allowing unrestricted use of these devices without needless administration. It is not accurate to view them as a 'public park', (Report p.LIII).

Class Licences apply only to devices not spectrum (s.132 RC Act).

Conditions are applied to Class Licences by the ACA at its discretion as to frequency, technical requirements, geographic area, periods of operation and compliance standards. (S133(2)(a)-(e))

Class Licences are used once a new device comes onto the market usually from overseas. It is not a licence in which experimentation is permitted.

### **5. CHARGING FOR SPECTRUM**

The rapid developments of Spectrum science and technologies are rendering current assumptions about opportunity costs (Report p.LII) irrelevant before existing spectrum licence terms will have expired.

The Commission states, "If there is no scarcity, then there is no opportunity cost and charges for spectrum should be limited to recovering administrative and regulatory costs", (Report p. LIII).

Charging opportunity costs based on current market assumptions risks vesting incumbents interests in maintaining assumptions of scarcity and interference. The artificial imposition of opportunity costs creates a disincentive to adoption of technological innovation and new market paradigms.

### **6. THE CHANGING ROLE OF THE REGULATOR**

Unused Spectrum should be placed in the public domain and Spectrum Licences, upon expiration should revert to a public domain spectrum whereby the role of the ACA would be to oversee the expansion of communications services with limited interference across the spectrum and encouraging and ensuring the innovation and development of new technologies.

If, as proposed by the Commission, the only role of the ACA may ultimately become the creation and management of Class Licences, new technologies will have limited opportunity "to deliver on promises to

provide expanded communications services with limited interference." (Report p.LIII) This is because Class Licences are not a 'public park',(p.LIII).

## **7. BROADCASTING**

Broadcasting unnecessarily hoards spectrum.

**The Commission's Recommendation 10.1 to transfer spectrum planning and licensing of broadcast service bands to the ACA from the ABA is welcomed.**

## **8. THE COMPETITION LIMITS**

The removal of competition limits (Recommendation 6.2) and reliance solely upon s.50 of the Trade Practices Act will be prejudicial to small and medium enterprises,(SMEs).

## **9. CONCLUSION**

The Report places great emphasis upon Spectrum Licences and leaving it up to the market to regulate the Spectrum.

The appropriate level of market competition is in the uses and services the spectrum makes possible but not the spectrum itself. Spectrum Licenses merely create exclusive monopoly interests enabling incumbents to maintain existing markets, creating barriers to entry and stifling innovation.

Spectrum spread technologies have already made assumptions of scarcity and interference materially and significantly irrelevant. To create the environment where these and newer technologies can find their full potential the RC Act requires amendments for the creation of multiple bands of Public Domain Spectrum (PDS) and ultimately towards the creation of a spectrum commons.

## *PART IV SUBMISSIONS*

### **1. CHARACTERISTICS OF THE SPECTRUM**

#### **1.1 Spectrum Science - "The Shepard Thesis"**

Any consideration of the technology of the spectrum must also take into account recent modelling and simulations of the behaviour of spectrum in dense packet radio networks. These show that low power dense networks have limitless capacity with no significant interference. Such networks have the potential to carry the same load as a local loop.

Timothy Jason Shepard's PhD Thesis "Decentralised Channel Management in Scaleable Multi-hop Spread Spectrum Packet Radio Networks" (Massachusetts Institute of Technology, Cambridge Massachusetts July 1995 (<ftp://ftp-pubs.lcs.mit.edu/pub/lcs-pubs/tr.outbook/MIT-LCS-TR-670.ps.gz> ) is not included in the Report references.

The Shepard Thesis asserts that as the density of packets and users increases in a network the distance between nodes decreases and thereby power decreases whilst the capacity for the spectrum to accommodate

the transmission of data increases with no significant interference. This thesis redefines the spectrum as potentially infinite for populous areas where previously it was thought to be the scarcest.

In a subsequent paper by Shepard, "A Channel Access Scheme for Large Dense Packet Radio Networks" (August 1996 Stanford University, (<http://www.tapr.org/tapr/html/FSS.shepard.html>) Shepard develops his model for communication in a packet radio network. In his paper he concludes:

"A single-channel packet radio system can scale to millions or billions of stations within a metropolitan area while maintaining the ability for each station to communicate with its nearby neighbours at a rate that will not continue [to] (sic) sink appreciably as the system continues to scale beyond a million stations. With completely decentralized control, and only a single transmission to convey each packet, packets can be transferred to nearby neighbours without any loss due to collisions."

Shepard observes that, "We can imagine that in less than ten years it will be feasible to build spread spectrum systems in this band [59-64GHz millimetre-wave band\*] with spreading code chip rates of around 2GHz. In this band, and with 6dB of directional gain, a packet radio system could have raw transmission data rates of around 200 megabits per second, have transmitter duty cycles of 23% to 50% and be scaleable to millions of stations within a metropolitan area...

"The performance of such a system could rival that of traditional metropolitan area telephone systems." (Shepard, p.11)

\*[NB. The 59-64 GHz millimetre-wave band is allocated as unlicensed for approved devices under Part 15 of the Telecommunications Act 1996]

## **2. THE LIMITS ON NEW TECHNOLOGY**

The Report notes, by way of example of the impact of new technologies, that Software Defined Radio (SDR) devices "could be used for a range of different wireless services, including mobile phone, cordless phone, fax, email, global positioning system, Internet and video conferencing." (Report Box 2.6) The Report also refers to the potential of Ultra-Wide Bandwidth (UWB) technologies in high speed internet access.

All of these applications are potential rivals to existing technologies. The lower the barriers to entry of new technologies the more new and SME businesses can enter and compete. In this environment it is essential that spectrum management and related laws do not create unnecessary barriers for SME's to enter into new markets.

The following examples indicate that existing regulation does create unnecessary barriers.

### **2.1 U-NII, LMDS and MMDS**

CISCO manufactures and sells a wide range of devices for wireless networks. One such range of devices is designed to utilise the USA Unlicensed National Information Infrastructure #3 band (6.75-5.825 GHz, U-NII#3).

CISCO's wireless devices create a system that can be set up quickly and inexpensively compared with fibre optic and cable, according to a Cisco White Paper. (CISCO - White Paper Building New World Networks with Unlicensed Wireless Spectrum Using U-NII Spectrum to Penetrate the Broadband Market. Posted Mon Jan 15 2001, [http://www.cisco.com/warp/public/cc/pd/witc/wt2700/2750/bbfw\\_wp.htm](http://www.cisco.com/warp/public/cc/pd/witc/wt2700/2750/bbfw_wp.htm))

"Telephony magazine estimates that the cost of connecting an individual office building to a fibre network is between \$300,000 and \$500,000 and predicts that only between 5% and 7% of the 750,000 office buildings in the US will be connected with fibre during the next decade (Source: Fixed, a supplement to Telephony Magazine, May 22, 2000)

'Compare the fibre costs to the total cost of a Cisco WT2750 Multipoint Broadband Wireless System, which can be deployed for less than \$200,000. Each base station can support hundreds of business customers and thousands of residential customers for an even lower per-subscriber capital cost compared to wireline networks. "

In Australia the U-NII#3 Band is covered under Class Licence Radiocommunications Class Licence (Spread Spectrum Devices) dated 21 May 1996, (see Class Licence infra at 4.2.1.) The CISCO WT2700 wireless networking solution can therefore be legally deployed in Australia, subject to compliance with technical specification approval and with the Carrier requirements of the Telecommunications Act, (see below at 2.3 802.11b).

CISCO's in its White Paper considers that where no licence is required markets become open to any provider and is concerned that;

'Rules for licence allocation create barriers to entry in other BBFW (Broadband Fixed Wireless) spectrum bands such as Local Multipoint Distribution Service and Multipoint Multichannel Distribution Service. For these bands, lengthy FCC rule making and spectrum auction proceedings, as well as potential negotiations with incumbent licence holders in each market can create significant delays for service roll outs."

The Spread Spectrum Device Class Licence (See infra 4.2.1) as in the USA Part 15 Ruling precludes LMDS (Local Multipoint Distribution System) and MMDS (Multichannel Multipoint Distributions System Bands). The requirements set by the FCC in the U-NII band demand lower power the higher the speed. The RC Act Class Licence also has these restrictions.

Hughes\*, (Interview with Dave Hughes, The Cook Report on the Internet, Volume IX, No.4 July 2000), points out that for acceptable speeds under the Part 15 Ruling the range of a U-NII#3 radio cannot exceed 5 miles which is too small for the rural school districts that the U-NII band was intended to serve.

Under the RC Act Spread Spectrum Class Licence the same power restriction applies ie., in the 5725MHz - 5875 MHz (U-NII#3) Band the power cannot exceed 1 watt.

\*[ Dave Hughes owns an ISP Company in the USA, (Old Colorado City Communications) and uses wireless in both up and downstream connections. He is a renowned expert and advocate of wireless broadband networks and internet connections. He has worked extensively on linking remote school to the Net.]

## **2.2 SOFTWARE DEFINED RADIO**

In the case of Software-defined radios (SRD) these devices are designed to scan and utilise broad ranges of spectrum and to select very efficient negligible interference. They are capable of listening in and selecting un-used spectrum in preference to busy spectrum. SRD technology can also be used to swap between devices making it possible for example to have a mobile phone that switches from CDMA to UWB then to hot plug as a wireless modem to connect your laptop to the net.

The ACA Class Licence on spread spectrum defines spread spectrum device as:

"a radiocommunications device that employs direct sequence spread spectrum modulation technique, frequency hopping spread spectrum modulation technique, or both, to transmit information."

An SRD device does both these and can do more. To the extent that an SRD device does do more the technology is being limited by the Class Licence as to its device capabilities.

Furthermore, Hughes argues that in the USA if the FCC permitted higher power rules to 10 or 20 watts these [SRD] devices could cover distances of 50-100-250 miles in rural bands where interference is minimal and scale down to a quarter of a watt in densely populated areas.



But, says Hughes,

"it has to be approved by the Regulator the FCC, which is way behind the power curve on approving these new possibilities .... There's going to be a debate, both technical and regulatory, because technology that operates under these premises makes it possible to change the very way that the FCC regulates spectrum...But now we're getting into the area with the software defined radios, where, if the FCC is smart, they will also shorten the life of [spectrum] licences." (Hughes, Cook report report 8)

### 2.3 802.11b

802.11b is a wireless network protocol. It can operate within the RC Act Class Licence device, frequency and power restrictions. It is used for PC's and in Apple MacIntosh's Airport is built around 802.11b.

The 802.11b protocol has become an industry standard (as Ethernet is to a wired LAN) whereby a home or office LAN can use it to connect directly to the Internet.

It is technically possible, using one base radio to connect, by way of example, everyone via Wireless LAN in a residential building to one broadband (2mbps) internet connection. This can be done at a fraction of the price of each resident having their own separate broadband connection. However under the Telecommunications Act 1997 (C/W) the Carrier provisions impose prohibitive costs and obligations on such networks.

ISP's (Internet Service Providers) either obtain their own Carrier Licence or they purchase rights to use a carrier network from the holders of Carrier Licences to supply internet connection services. It is also possible to hold surrogate Carrier rights from another carrier by means of a Nominated Carrier Declaration, (Section 84 *Telecommunications Act 1997*).

Where an ISP uses Radiocommunications equipment including Class Licence equipment to provide Internet access on a commercial basis the ISP will require a carrier licence or a Nominated Carrier Licence, otherwise it will be in breach of the *Telecommunications Act* (See ss.7, 23, 42 and 44).

Non Carrier ISP's require no licence to operate. Carriers though, must pay an annual licence fee of \$10,000 (s14(1) *Telecommunications (Carrier Licence Charges) Act 1997*) plus a variable amount based upon a Carrier's eligible revenue, (s.67 *Telecommunications (Consumer Protection Service Standards) Act 1999*). Carriers also have mandatory consumer and community and competition obligations including compliance with the ACA determination for provision of pre-selection in favour of carriage service providers, (See Parts 6, 7, 9, 10, 12, 13, 14, 15, 17, 18, 21, 22 *Telecommunications Act 1997*)

As at the date of this Submission there are 895 ISP's in Australia and a further 50 Telephone and Internet Service Provider ISP's. On top of these, 3 ISPs and 2 Telephone ISPs are in Liquidation; the Telecommunications Ombudsman is unable to contact a further 53 ISPs and 4 Telephone ISPs; there are 22 ISPs and 3 Telephone ISPs under Administration. (Source Telecommunications Industry Ombudsman, TIO). ie 8.4% of all TIO recorded ISPs are either uncontactable by the TIO or insolvent.

The ACA and TIO both advise that they do not keep records of how ISPs deliver services i.e. broadband, or wireless, satellite, wired, etc. The Whirlpool\* web site lists only four links to wireless ISP's and approximately 70 links for DSL and ADSL (ie., 0.45% of existing ISPs).

Despite declining prices of wireless network technologies and increasing performance these figures tend to indicate that it is presently unviable for ISP's to take advantage of these new technologies. The Carrier Licence provisions of the *Telecommunications Act 1997* seem to be a direct material cause of this lack of viability. (see also. 4.1.1, and ref to Tim Watts at 4.1.4)

\*[Whirlpool is a web site servicing the Australian Broadband user community.]

## 2.4 UWB

UWB technology was developed by US and Soviet spy agencies due to its highly secure capabilities.

UWB uses billionths of pulses per second at very low power (one ten thousandth of a cell phone) to carry vast amounts of data across small distances of about say one kilometre.

The pulses can occur on all frequencies at the same time. The pulses are precisely timed at rates set by computer code algorithms. Only the receiver set to interpret those codes can make sense of the signal. Due to the low power a UWB phone can last for weeks before re-charging. UWB radios use standard computer chips and do not require tuning. UWB technology therefore promises to be inexpensive to manufacture and use.

The most immediately likely commercial application for UWB will be mobile phones and wireless computer networks. The networks are anticipated to be run at 40-60Mbps (cf 3G Mobiles 2Mbps). It is believed that UWB networks may ultimately run at 1gpps enabling the technology to cater for voice, audio, video and data well beyond capabilities of 3G without any interference and much greater security than 802.11b.

UWB technology is highly suited to the dense packet networks described by Shepard. Even at ranges of one kilometre and less it can be used for mobile phone networks and the so called "last mile" internet services connection.

In the US it is expected that UWB products will be available within the next 2 years.

Of all the new technologies it is UWB that is the most paradigm shifting.

"UWB is even worse for those companies that are regulated communication monopolies or have exclusive licences to certain parts of the radio spectrum. Having given billions to the FCC for those licences, are they now going to be worth nothing? That is a possibility." (Robert X., Cringely, The Pulpit PBS 24 January, 2002, "the 100 Mile-Per-Gallon Carburettor How Ultra Wide Band May (or May Not) Change the World")

For UWB to fulfil this potential a device Class Licence will have to be unrestricted except as to power. Class Licences only apply once a device has been developed and have met technical standards for use. A Class Licence does not permit innovation by experimentation. The frequency for UWB would have to be unlimited and the range of devices would also have to be unlimited.

## 3. SPECTRUM MARKETS

### 3.1 INTRODUCTION

The spectrum is a natural phenomenon that can be utilised by technologies. Those technologies create certain products and services for which markets exist e.g. mobile phone market, ISP market, television and radio markets.

The greater adoption of spread spectrum including SRDs and UWB technology across the spectrum the less scarcity. It is in the commercial application of these very technologies that the greatest demand exists. ie., where the greatest demand exists so too does the greatest supply. If however, the regulating authority imposes divisions in bandwidth by the auction of licences to spectrum then a false scarcity is created by limiting the ability of spread spectrum UWB SRD devices to be fully deployed.

The Report relies upon distortions of the properties and nature of the Spectrum to compel spectrum into a false market model. It has always been artificial to presume a market can exist in a naturally occurring phenomena. Without scarcity or interference as excuses it becomes meaningless and anachronistic to model arbitrary bands of the spectrum into markets.

Buck et Al propose in their multidisciplinary paper that,

"Spread spectrum and other digital radio technology has rendered the government's spectrum management regulation obsolete"

Buck Stewart, Dutcher Donna, Kumar Devendra, Rodriguez Andres (Harvard Law School) Carter Dedric, Garcia Andrew, Pearah David (Massachusetts Institute of Technology), 1998 Harvard University, Spread Spectrum: Regulation in Light of Changing Technologies (1998)  
<http://www.cyber.law.harvard.edu/ltac98/student-papers.html>

### **3.2 SCARCITY**

The entire concept of a commercial market for Spectrum relies upon the notion of scarcity. This scarcity first triggered the United States Government into passing laws in 1912 for Spectrum control when interference was blamed for distress signals by the Titanic not being picked up in time.

Current commentators believe there is no longer any spectrum scarcity.

"Spectrum scarcity is artificially manufactured in Australia by specifying limits designed for congested cities and based on old technologies. ... Get a hold of a good scanner or spectrum analyser and attach it to an antenna. Then scan the bands in Melbourne or Sydney (our most 'radio-congested' cities) and record how often you detect radio carriers above the noise floor.

'You'll be lucky to find more than a few percent of the spectrum in use at anyone time; much of the spectrum isn't used at all, and most dispatch and messaging channels are only used occasionally.'" (Stewart Fist, Crossroads The Australian, June 1998 Spectrum Auctions -Part 2

And in the United States in an article in WIRED Brent Hurtig found that, "FCC regulations create an essential contradiction: scarcity amid plenty." In that article he interviewed Motorola Chief technology officer Dennis Roberson, also a member of the Technology Advisory Council who said, "In New York City on September 11, there wasn't enough spectrum to go around,... Yet, if you had looked at the airwaves using a spectrum analyser, you would have seen that most of it was unused." (Brent Hurtig, "Broadband Cowboy" WIRED magazine 10.01 Jan 2002.

In their comprehensive multi-disciplinary article entitled, Buck et Al state that, "Despite the differences of opinions [on the FCC Board] the scarcity rationality is not any more of a solid argument to support than any new spectrum regulation." the authors propose that "The time is ripe for a new concept of spectrum management that will be based on a new paradigm." (ibid p.8

The historic disaster of the Titanic has its modern counterpart in September 11 but with the opposite message. Assumptions about scarcity of spectrum are perpetuating wastage and hindering the communication demands of modern emergency situations.

### **3.3 SPECTRUM AS PROPERTY**

The nature of the spectrum itself, regardless of notions of scarcity and interference does not suitably fit a property classification. This was noted by Ronald Coase himself, who in 1958 founded the idea that radiofrequency could be auctioned,(Report p.178).

"Indeed, what is really being allocated by the FCC", said Coase, "is not a property right at all, but simply the right to use a piece of equipment to transmit signals in a particular way."

Buck et Al at p 63, ref to Ronald Coase, The Federal Communications Commission, 2 J.L. & Econ. 1 (1959); Leo Herzl, "Public Interest" and the Market in Color Television Regulation, 18 U. Chi. L. Rev. 802 (1951).

In accordance with Coase's 'idea', spectrum licences were required to be technology neutral so that the purchaser was free to move to the most efficient technology.

The Report acknowledges that "complete neutrality of use and technology is difficult if not impossible to achieve." (Report p.102) The Commission cites core conditions as the reason for this lack of technology neutrality. But there is also a commercial reason.

The division and sale of a band of spectrum can have no market value without some pre-conceived use. The ACA has to date selected bands of spectrum most commercially sought based upon such anticipated use. Once sold to sustain that value the licence itself must reflect that use. The spectrum licence itself then creates the value since it creates exclusivity of that use and a presumption against any competitor breaching that exclusivity.

The ACA becomes compelled to set terms of use in all spectrum sales because if it does not it will expose an incumbent to loss of its exclusivity reducing the value of its purchase, (in the same way as the Lessor of a Shopping Centre is restrained from leasing a competing identical business within the same Centre.)

By way of example, even though the 500Mhz band auctions in 1997 were purportedly technology neutral (Report p180, Table 9.1 and Report p.182) indicates that the typical use for the spectrum was pay television. Pay television licenses can only be bought by incumbents holding a Broadcasting License. Despite the purported neutrality the value of this auction was created by exclusivity under the *Broadcasting Services Act* licence to operate pay television services.

### **3.4 CHARGING FOR SPECTRUM**

#### **3.4.1 AUCTIONS**

The Report states, "For efficiency reasons, market-based pricing of spectrums represents the Commission's preferred approach." (Report p.177)

However, rather than being bought by new users who value the spectrum most and who are motivated to take up new technologies, auction results indicate that existing incumbents are the main benefactors of the Auctions.

By way of example:

- A. Auction for 27GHz - [Broadband Wireless - LMDS] 28 November, 2000  
Total raised \$37.603 million.

Purchasers (2):

1. Agility Networks Pty Ltd 26.5GHz-26.85GHz in Perth, NT, Cairns, Rockhampton, Townsville, Sunshine Coast, Central Queensland, Brisbane, Gold Coast, Northern NSW, Regional NSW, Regional SA, Regional WA, Adelaide Regional, Victoria Melbourne, Newcastle Sydney.  
  
Agility Networks is wholly owned by Optus.
2. Shin Satellite Public Company Ltd. 26.85GHz-27.25GHz in Perth, NT, Cairns, Rockhampton, Townsville, Sunshine Coast, Central Queensland, Brisbane, Gold Coast, Northern NSW, Regional NSW, Regional SA, Regional WA, Adelaide Regional, Victoria, Melbourne, Newcastle, Sydney

Shin Satellite is a Publicly Listed Thai Company established by the Prime Minister of Thailand. Currently its footprint does not cover Australia.

Agility paid about \$18m for its LMDS Licence to compete for broadband with Telstra and set up an alternative wholesaler. The auction took place after lobbying by Optus/Agility. "Agility had to convince the government to auction more 27-GHz spectrum." (Broadband Wireless On Line Vol 2 No.66 June/July 2001).

On this business model the Spectrum auction process only makes it possible for Optus to compete with Telstra through creating a competing carrier service monopoly in the 27-Ghz spectrum using LMDS. This then requires Optus (through its subsidiary Agility) to build and/or sub-out a nationwide wireless infrastructure. "? the risk was mitigated by the fact that Alcatel agreed to provide equipment gratis until after the licence was in the bag." (ibid, Broadband Wireless).

"... the auctioning process functions more as a barrier to entry than as a facilitator of new industry. By forcing companies to pay large up front fees for access to the spectrum, auctions may in many cases represent a substantial barrier to innovation and experimentation." (Buck et Al)

Optus/Agility hoped by this spectrum sale to be able to compete with Telstra for Broadband services throughout Australia especially in regional areas, yet Optus has remained in financial circumstances whereby it has been close to being sold to Singtel for the last year. Agility is included in the prospective purchase by Singtel.

According to Hughes, CISCO has available an LMDS radio that operates 30 Miles, is priced at USD\$20,000 each end and runs at 45mbps on what is called DS3. DS3 LMDS radio integrates with the CISCO wireline routers enabling efficiency through hardware and software compatibility. The point being that this sort of technology makes it viable for SME's to set up their own infrastructure by utilising the spectrum direct, linking users to low interference devices in dense areas and with adequate lack of interference in the country and remote regions.

Rather than have one huge Telco fight it out with another not so huge Telco resulting in inflated wholesale band width, if Spectrum is made freely available directly to many businesses without licence restrictions Hughes explains that technology like Cisco's, "could represent a big paradigm shift from the Telco Model of Business". (Hughes, Cook Report, p.3)

#### B. Auction for PCS (Personal Communication Services) (GSM CDMA)

\$1.327 billion (15 March 2000)

Buyers at Auction were AAPT, Hutchinson, Optus, Vodaphone, Onetel, Telstra and Catapult

Purchase at Auction, eg, Sydney

Telstra	8 bands
Hutchison	8 Bands
Vodaphone	6 Bands
Optus	6 Bands
OneTel (In Liquidation)	5 Bands

16 Regional and Country Areas about 80% Telstra with rest to AAPT and Catapult 2 Bands, Cairns and SA and Hutchison 1 Band Remote Central

In this example the existing incumbents must purchase Spectrum rights at auction in order to purchase exclusive use of band-width to maintain their businesses.

"... we create a world where the resources for these new alternatives are held by those with the strongest incentive to stop them. As Eli Noam puts it, it is like "having the old AT&T auction off the right to compete against it. Under such a system, MCI would not have emerged."  
(Lessig, 226, ref to Noam "Beyond Liberalization II" 473)

### 3.4.2 SECONDARY MARKETS

The Report states that turn over in 2000-1 is estimated at 8%. (Report p142) (Included in those figures presumably would have been the sale to Telstra of spectrum licence in the 3.4GHz auction in 2000. Telstra was excluded from the original auction for purchasing some of this spectrum but circumvented this proscription by use of the secondary market, (Report at 113).)

In a thriving industry adopting new cheaper more convenient technologies a high level of secondary market activity would be indicative. The Report compares 8% to the real estate market (Report p143) which is an indication of a level of activity in a conservative personal investment market not a new technology innovation market.

Since the insolvency of Onetel, Dingoblue and Simoco Pacific have gone into insolvency, (see also *ibid* 2.3 p.7) Multiple insolvencies do not indicate that spectrum prices and existing regulation are encouraging viable market.

### 3.4.3 GOVERNMENT CONFLICTS OF INTEREST

To the extent that Government relies upon meeting core policy commitments with expected revenue from spectrum auctions it has a conflict of interest with limiting charges for spectrum to recovering administrative costs. (See Report p 182.). Government has a vested interest in the model of spectrum as scarce.

Government also has an inherent conflict of interest in auctions so far as it is a 51% share holder in Telstra. The fact that Telstra has been the greatest beneficiary of by far the majority of the Spectrum Auctions (See ACA Web Site [http://www.aca.gov.au/database/radcomm/spectrum\\_licence\\_snapshot.htm](http://www.aca.gov.au/database/radcomm/spectrum_licence_snapshot.htm)) gives Telstra exclusivity of competition in those band-widths until the expiration of those licenses. For a Government intending to sell the other half of Telstra this is the equivalent of fattening the turkey for thanksgiving.

### 3.4.4 COMPETITION LIMITS

**Whilst Spectrum Licences are in use Competition Limits should be retained.** To solely rely upon the Australian Consumer Competition Commission's (ACCC) powers under Section 50 *Trade Practices Act* will not protect existing and new Small to Medium Enterprises.

Section 50 is historically drafted and has an existing body of law related to prior existing markets and is not suited to circumstances where Spectrum Sales are intended to create new markets whose parameters and characteristics are unknown ie *ex ante* markets. It is in these exceptional circumstances that the Competition Limits powers of the Minister exist under the RC Act.

The Australian Telecommunications and Communications Industry is dominated by Telstra so much so that the ACCC can be placed in circumstances where it is compelled to tolerate monopolistic markets. Telstra has also behaved adversarially towards the ACCC in its operation.

The ACCC would be ill inclined to act under s.50 unless it involved large enterprises of the industry and unlikely to respond to harsh or unconscionable outcomes against SMEs. This has historically been the experience of small business and is one of the principle reasons for the introduction of amendments to extend rights of small business under Part IVA TPA. Part IVA does not require the ACCC to intervene.

The enforcement of Part IVA or lobbying to get the ACCC to act under s50 is prohibitively expensive, time consuming and uncertain to SME's.

The ACCC does not have the staff and resources to act to protect the interests of small business. The ACCC's focus is only upon market power of large enterprises.

Whilst Spectrum Licensing is in operation, in the absence competition limits under ss60 and 106 of the RC Act the market will favour oligopolistic scales of economy and create barriers to entry for small and medium enterprises.

It is significant that the ACCC in its Submission (Report Box 5 P. LVII) supports keeping the RC Act competition limits whilst the large incumbents Optus and Telstra were in favour of their repeal.

## **4. PUBLIC DOMAIN SPECTRUM**

### **4.1 AT THE FRINGE OF THE SPECTRUM**

Frustrated by over regulation various users in the US, UK and Australia have resorted to taking access to the spectrum into their own hands. These examples illustrate how,

"If there were a rich and developed physical layer of free spectrum access - permitting many competitors to offer Internet access using this final link of free spectrum - then the need for the government to worry about other modes of access to the Net would be lessened."

(Lawrence Lessig "The Future of Ideas" p 244)

#### **4.1.1 CONSUME**

[Source Ref : James Stevens, dot.life "What if the net was as free as air?" 18 March, 2002]

Consume is an organisation in London UK to promote cheap immediate access to wireless networks. In London as at March 2002 there are 400 Consume nodes connecting many more users.

Consume was founded by James Stevens who started with his idea for sharing an expensive high-speed net link with other local businesses. As this could not be done with wire without illegally hanging cables across street he used a point to point microwave network.

All that is used is a PC connected to the high speed internet connection networked via wireless 802.11b card. For the price of a network card,(about \$AUD200) members have a shared low cost wide band connection.

"We found that there was indeed the potential for wide adoption and easy utilisation of the 11 megabits per second wireless kit for free networking. That's 'free' as in speech." (James Stevens, dot.life "What if the net was as free as air?" 18 March, 2002)

In the UK such WLANS are legal provided they control both ends of the connection and do not seek to make a profit.

*The Telecommunications Act 1997* s.42 prohibits anyone owning or controlling a network to supply carriage services to the public (See also infra at 2.3 802.11b). Under s34(2) there is an exemption where the services are "non-commercial".

There is no definition in the *Telecommunications Act* of "non-commercial". This leaves a great discretion with the ACA. It is unlikely that an applicant for exemption from a carrier licence will be able to afford an administrative appeal case if they are not happy with the ACA's determination of "non-commercial".

It is unclear whether a non-commercial Wireless Local Area Network would be permitted to share an Internet connection and remain non-commercial where the users of the WLAN would have access to the Internet for commercial activities.

This has led to much confusion among Wireless Associations in Australia who can not afford to pay a specialist telecommunications lawyer to advise and assist with an exemption application.

The Telecommunications provisions prohibit small businesses from taking advantage of WLAN technologies and deter Wireless non-profit associations from utilising and experimenting with the technology.

**The Telecommunications Act 1997 should be amended:**

1. **to remove any uncertainty over the definition of "non commercial".**

**The definition "non-commercial" should expressly include without limitation uses by a non-profit organisation which impose no fee for use other than to recover the actual costs of the base and network units (WLAN) and internet connection exclusive of any overheads of the organisation.**

2. **to include a Second Class of Carrier Licence for Small Business.**

**The Second Class Carrier Licence should be for businesses with turn over less than say \$3m per annum. Licensees should only be charged an Administrative cost annual Fee; have limited SMS core Carrier Obligations and no provision of pre-selection in favour of carriage service providers.**

#### **4.1.2 CAFÉ WLAN IN SEATTLE**

In Seattle a Mr. Matt Westervelt is building a wireless network to be owned by the people who use it. The cost of the hardware is a couple of hundred dollars plus software and an antenna. The network operates at 6 megabits or more per second, six times faster than a cable modem connection.

The idea developed from setting up a wireless connection in his favourite coffee shop so he could connect to his office from his table at the cafe.

[Source Ref: Alan Boyle, MSNBC, "Welcome to Your Future Internet",  
<http://www.msnbc.com/news/720246.asp?cp1=1>]

#### **4.1.3 WI-FI**

[Source Ref: WIRED April 2002, 10.04]

Across America in cafes, hotels, airports, restaurants and non-commercial sites wireless LANS are being made available to the public. A company named Boingo Wireless has set up business negotiating aggregate use agreement with groups of the WLANS so that for one subscription (\$75 per month) a User can utilise WLANS in 750 sites. A complete list of access points is available at [www.wired.com/wired/infoporn/wireless.pdf](http://www.wired.com/wired/infoporn/wireless.pdf).

#### **4.1.4 DEWAYNE HENDRICKS**

Dewayne Hendricks is on the FCC Technological Advisory Council. It is his view that no technological reason exists to prevent the USA from having an "inexpensive, ubiquitous, high performance broadband access", using technologies that are already available and in development.

In his words there would be "No more digital divide. No more last-mile problem. No more compromises. The only things standing in the way are the FCC Congress, and 'other people who just don't get it'" (Brent Hurtig, "Broadband Cowboy" WIRED Magazine 10.01 Jan 2002

Hendricks is setting up a wireless network on an Indian Reservation at Turtle Mountain Chippewa North Dakota. The network will initially just use Part 15 (ie unlicensed free access) devices and bandwidth. He is seeking to prove to the FCC and the US Government that this technology should be universally accessible. He intends to use the Reservation land rights to exceed the Part 15 restrictions and show how making more spectrum freely available can provide universal inexpensive broadband.



"The only way to deliver high-performance broadband to everyone, everywhere, Hendricks says, is to give all transmitters access to the full spectrum, or at least a lot more of it" (WIRED 10.01, Jan 2002)

#### 4.1.5 AUSTRALIA URGED

[Source Ref: ABC 7.30 Report, Transcript 26/02/2002 "Aust. Urged to embrace the Wired World"]

On the ABC's 7. 30 Report (26 February, 2002) Matt Barrie a Computer Security Consultant was interviewed and said that there are numbers of Australian's disregarding the Carrier requirements and acceptable use policies of ISP's by sharing single broadband connections on short range Class Licence Wireless LANS.

Tim Watts Public Policy Researcher said on the Program,

"Given that there are a lot of, sort of, community groups and non-profit local churches and so on and schools which are interested in using this technology as a cheap, easy way to connect their people to the Internet at a very fast speed, the current conditions attached to this unlicensed spectrum use for Internet access are just too onerous."

## 4.2 THE ARGUMENT FOR A COMMONS

### 4.2.1 LAWRENCE LESSIG

The Commission considers that the current licensing system appears able to accommodate spread spectrum applications. The Report notes that according to the ACA (sub. 9, p.47) an extension of class licensing may handle ultra-wideband. Australia and the United States have already issued class licenses for 'spread spectrum' devices." (Report p106)

The Report makes reference to Lawrence Lessig's book, "Code and Other Laws of Cyberspace", (Report at p.106) and says of Lessig's work,

"It has been claimed, for example that 'spread spectrum' or open access technologies will reduce or obviate the need for licensing the exclusive use of bands"(Lessig 1999. p184).

Conditions are applied to Class Licences by the ACA at its discretion as to frequency, technical requirements, geographic area, periods of operation and compliance standards. (S133(2)(a)-(e)). The Radiocommunications Class Licence (Spread Spectrum Devices) contains the following limitations:

*4. This class licence is subject to the condition that a spread spectrum device must be operated only:*

- (a) on a frequency band set out in the following Table; and*
- (b) with the EIRP set out in the Table opposite to the frequency band.*

**TABLE**

*Frequency band*

**EIRP**

915 MHz - 928 MHz      *Not exceeding 1 W*  
2400 MHz - 2463 MHz   *Not exceeding 4 W*  
2463 MHz - 2483.5 MHz   *Not exceeding 200 mW*  
5725 MHz - 5875 MHz   *Not exceeding 1 W*

*General conditions: interference*

5. This class licence is subject to the condition that the operation of a spread spectrum device must not cause interference to another radiocommunications device.

[NOTE: A spread spectrum device will not be afforded protection from interference caused by other radiocommunications services. Also, in accordance with the requirements of footnote AUS 32, and footnotes 752 and 806, to the Table of Allocations in the Australian Radiofrequency Spectrum Plan, a spread spectrum device is not to be afforded protection from interference that may be caused by ISM applications in the ISM bands 918 MHz-926 MHz, 2400 MHz-2500 MHz and 5725 MHz-5875 MHz.]

*General conditions: compliance with technical standards*

6. This class licence is subject to the condition that the operation of a spread spectrum device must comply with the requirements of:

(a) section 15.247 of the "Rules and Regulations of the Federal Communications Commission", published by the Federal Communications Commission of the United States of America and as in force on the day on which this class licence commences, other than:

(i) the requirements set out in paragraph 15.247 (b) relating to frequency bands of operation; and

(ii) the requirements set out in paragraph 15.247 (b) relating to transmitter power and antenna gain; or

(b) standard ETS 300 328, published by the European Telecommunications Standards Institute in November 1994 and as in force on the day on which this class licence commences.

As noted infra at 2.1 both CISCO and Hughes observe that the FCC Part 15 restrictions severely hamstringing the potential of the new technologies.

Since "Code and Other Laws of Cyberspace", Lawrence Lessig has written in much more depth on the idea of a spectrum commons in his book "The Future of Ideas", (Random House 2001).

In "The Future of Ideas" Lessig argues that spectrum auction licensing is in effect putting the cart before the horse.

Lessig in his Chapter "Controlling Wire-less (and hence the Physical Layer) says that,

"So strong is this idea of property, so unbalanced is our understanding of its tradition, that we embrace it fully, without limitation, even when it doesn't yet exist, and even when the asset being assigned a property right is not - like the wires of AT&T's cable or the creative genius behind Disney's Mickey Mouse - something anyone has created. We are racing to assign property rights in the air, because we can't imagine that balance could do better." (p233)

The spectrum in his view, at this point in time needs most to be made into a commons to permit the necessary experimentation across the entire spectrum necessary to discover, invent and design the most efficient technologies. Lessig argues that current technologies have arrived at a level where such experimentation will lead to the fastest innovation without substantial or material disruption from interference.

The licensing of spectrum and devices (as proposed by the Commission in Recommendations 6.1,6.5, 6.7, 6.9) would in Lessig's scenario place the spectrum out of the hands of such innovation.

"My argument is not that exclusive control is not needed. ... The congestion in the airwaves may push us to build out a property system. Spectrum auctions - either in advance or in real time - may turn out to be needed to use the spectrum in the best possible way.

'But we don't know that yet, and we certainly don't know enough yet to know how spectrum will be used. Thus, rather than architecting the space exclusively for control, we should begin, as much as possible, as we began with the Internet; by building a regime that by design leaves a significant part of these resources in the

commons. And once we see how that commons gets used, we can then change how that commons gets used."

Lessig proposes that to achieve this significant bands from across the spectrum must be set aside for the commons so that all properties of the spectrum can be examined. This would include freeing commercial radio and television spectrum.

He suggests an interim proposal for a mix of both commons and property.

The property spectrum would be subject to the right of users to use it if on a "listen first" ("The Future of Ideas", p230) basis where the property spectrum was not being used it would be made available in the commons.

#### 4.2.2 A MODEL COMMONS

Buck et al describe a commons comprising a variable model for standardization limiting any potential for interference; a nuisance tort style rule for enforcing against any interference, and good neighbour and best effort policies for spectrum use.

They submit that the focus of Government reform should be upon moving incumbent spectrum towards a commons. In doing so the authors, "envision a transitional phase (which may last for a long time) when the present-day unlicensed uses co-exist with unlicensed devices, allowing the unlicensed device industry to develop on an experimental basis."

#### 4.2.3 TOWARDS A PUBLIC DOMAIN SPECTRUM

Another way of considering Lessig's and Buck et Als' proposals is to look upon the opening of access to spectrum as a public domain. **A Spectrum Licence could be in this way be viewed, (similar to copyright), as a temporary monopoly in which the owner has the opportunity to maximise its economic benefit.** Once that licence expires the spectrum can go into the public domain.

Since the Spectrum is not the invention or creation of the purchaser, and since the License holder will obtain patents to the devices it may develop from its exclusive opportunity, the duration of that license should be much shorter than copyright. In light of the current rate of innovation the period of 5 years should be the maximum, on a use it or lose it basis.

Again where the licensed spectrum is not in use it should be available for use on a "listen first" basis.

Section 82 RC Act arguably reflects this principle in that the re-issue of a spectrum licence can only take place for services specified by Ministerial determination or special circumstances in the public interest., i.e. circumstances beyond the private benefit of the incumbent. Indeed the Commission itself in Recommendation 6.6, proposes that the ACA should publish its reasons for any spectrum licence renewal.

This signals the intention of the RC Act and the Commissions agreement that a spectrum licence is only ever to be a temporary monopoly other than in exceptional circumstances.

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#### References

Australian Communications Authority (ACA), Oct 2001, Submission, Productivity Commission Review of the Radiocommunications Acts and the Role of the ACA

ACA, July 1999, Guide to Service Provider Obligations

ACA, July 2000, Guide to Carrier Licence and Nominated Carrier Declaration

Blackwell Gerry, June/July 2001 Agility Networks Bets the Farm and Wins Australian Carrier Seeks Leverage Against Behemoth, Broadband Wireless Online, Vol 2 No 06 <http://www.shorecliffcommunications.com/magazine/volume.asp?vol=16>

Boyle Alan, MSNBC News E-Mail 2002, Welcome to Your Future Internet, Pioneers go beyond wires, walls and the World Wide Web

Buck Stewart, Dutcher Donna, Kumar Devendra, Rodriguez Andres (Harvard Law School) Carter Dedric, Garcia Andrew, Pearah David (Massachusetts Institute of Technology), 1998 Spread Spectrum: Regulation in Light of Changing Technologies, Harvard University, <http://cyber.law.harvard.edu/ltac98/whitepaper.html>

CISCO Systems Inc., 2001, White Paper Building New World Networks with Unlicensed Wireless Spectrum Using U-NII Spectrum to Penetrate the Broadband Market

Cokenias Thomas N., July 2000, Spread Spectrum Worldwide Regulatory Guidelines for Product Developers, Conformity, <http://www.conformity.com/008emcl.html>

Cook, July 2000, Broadband Spread Spectrum Wireless Extends Reach of ISPs & Field research Scientists Increase Radio Spectrum Speed and Decline in Price Enabling Smaller ISPs to Compete with Cable and DSL Internet Access NSF PI Dave Hughes Explains How Wireless Data Gathering by Environmental Scientists Will Yield Huge Increase in Network Traffic, The Cook Report on Internet, Vol IX No 4 July 2000, <http://www.cookreport.com>

Craddock Ashley, Nov 1998, Dave Hughes Delivers Universal Net Access, WIRED 6.11

Cringley Robert X, 24 Jan 2002, The 100 Mile-Per-Gallon Carburetor, How Ultra Wide Band May (or May Not) Change the World, PBS I, Cringley The Pulpit

CSIRO, 2000 Broadband Wireless Systems <http://www.csiro.au>.

Davidson Paul, 1/3/2002, FCC set to Expand Wireless Frontier, USA Today

Durham Mark, April 2002, Wireless Nation Where to find High Speed Internet Access, WIRED 10.04

Fist Stewart, June 1998, Spectrum Auctions Part 2, Crossroads The Australian's Email Feb 2002

Hurtig Brent, Jan 2002, Broadband Cowboy, WIRED 10.01

Lessig L. 1999, Code and Other Laws of Cyberspace, Basic Books

2001, The Future of Ideas, Random House

Productivity Commission, Feb 2002, Radiocommunications Draft report, Commonwealth of Australia

Shepard's Timothy J., "Decentralised Channel Management in Scaleable Multi-hop Spread Spectrum Packet Radio Networks" (Massachusetts Institute of Technology, Cambridge Massachusetts July 1995 (<ftp://ftp-pubs.lcs.mit.edu/pub/lcs-pubs/tr.outbook/MIT-LCS-TR-670.ps.gz>) ) PhD Thesis "Decentralised Channel Management in Scaleable Multi-hop Spread Spectrum Packet Radio Networks" (Massachusetts Institute of

Technology, Cambridge Massachusetts July 1995 (<ftp://ftp-pubs.lcs.mit.edu/pub/lcs-pubs/tr.outbook/MIT-LCS-TR-670.ps.gz> )

Shepard Timothy J. Aug 1996, A Channel Access Scheme for Large Dense Packet Radio Networks,  
<http://www.tapr.org/tapr/html/FSS.Shepard.html>

Stevens James, 18/3/2002, What if the Net was as Free as Air, Consume BBC News  
[http://news.bbc.co.uk/1/hi/english/in\\_depth/sci\\_tech/2000/dot\\_life/news](http://news.bbc.co.uk/1/hi/english/in_depth/sci_tech/2000/dot_life/news)

Transcript, 26/02/2002, Aust Urged to Embrace Wired World, 7.30 Report ABC,  
<http://www.abc.net.au/7.30/s491420.htm>

Wireless Institute of Australia, Oct 2001, Submission, Productivity Commission Review of the Radiocommunications Acts and the Role of the ACA