

Potential Use of Wireless Technologies for Broadband Communications

produced for

**Commonwealth Government of
Australia**

**House of Representatives Standing Committee
on Communications, Information Technology,
and the Arts**



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CONTEXT

Purpose of this Document: This document is intended for use by the House of Representatives Standing Committee on Communications, IT and the Arts and Federal Government to assist with its inquiry into the use of wireless technologies and the impact of those technologies on the overall telecommunications framework.

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1. Executive Summary

Wireless technologies that can be cost effectively deployed for both portable computing and wireless local loop markets have rapidly improved in the last 12 months and will continue to do so even more quickly in the next few years.

Viable wireless access technology for portable computing and wireless local loop access can realistically provide real and sustainable competition in the last mile access. It will be increasingly difficult for a single commercial interest to exert control at the last mile point of the network. This will shift the focus of equal access from the last mile to that of equal access to services across the whole telecommunications infrastructure.

The scope of the regulatory & competitive framework will need to expand to consider competitive and issues of control at all points in the telecommunications network. A regulatory framework will need to take into consideration core / backhaul network, control functions of networks, and services in addition to those of last mile access.

As the capabilities of wireless technologies expand and thus the scope of services they can bring to consumers & business expands via last mile access, the government will need to facilitate & encourage the adoption of these technologies through the regulatory framework on use of wireless technologies. The government will need to create a set of regulations that ensures both a competitive commercial telecommunications environment and makes the optimal use of available spectrums for data communications.

Cisco as a strategic supplier of both Internet / Data and wireless access technologies can & will provide ongoing advice to the government on the most optimal uses of wireless technologies and the associate implications on the rest of the telecommunications framework.

2. Introduction and Overview

Wireless technologies have had a very large impact on both business and consumers in the last number of years. This impact will continue and accelerate greatly in the next 5-10 years.

Most of this change will be driven by two continuing developments:

- the rapid evolution of wireless technologies which have the potential to carry a large amount of information at minimal cost
- a relentlessly growing demand for consumers and business to communicate using Internet/data based applications

Cisco, as a strategic supplier of Internet technologies and Wireless access technologies, has a number of views on how these technologies can be used for the maximum social and economic benefit to Australia.

Through this submission and ongoing consultation, Cisco would like to assist the parliament and government in its reviews of wireless technologies in the following areas:

- Education regarding the various wireless technologies with an emphasis on the realistic capabilities & uses of each technology
- The impact of wireless technologies on the overall telecommunications & data communications framework of Australia
- Specific Recommendations on the overall regulatory, legislative, and competitive on the overall telecommunications framework resulting from the impact of wireless technologies
- Specific recommendations relating to the use of wireless technologies in Australia

All of the statements and recommendations in this paper are designed to help deliver & support a telecommunications framework that:

- will provide for sustained profitability of licensed Service Providers in Australia
- will make optimal & reasonable use of wireless technologies such that various technologies do not try to deliver the impossible, but also make sure the widest breadth of technologies are used and deliver value
- will provide sustainable competition in the for services that allows both full service providers and niche application providers to be profitable
- provides both business & consumers with the largest practical range of competitive service offerings for consumer & business applications

3. Overview of Wireless Use Models and Technology

Many models and Many technologies

In the last few years the number of available wireless technologies available for carriage of data has exploded. Each technology has unique characteristics and capabilities which make it suitable for different applications and different deployment scenarios.

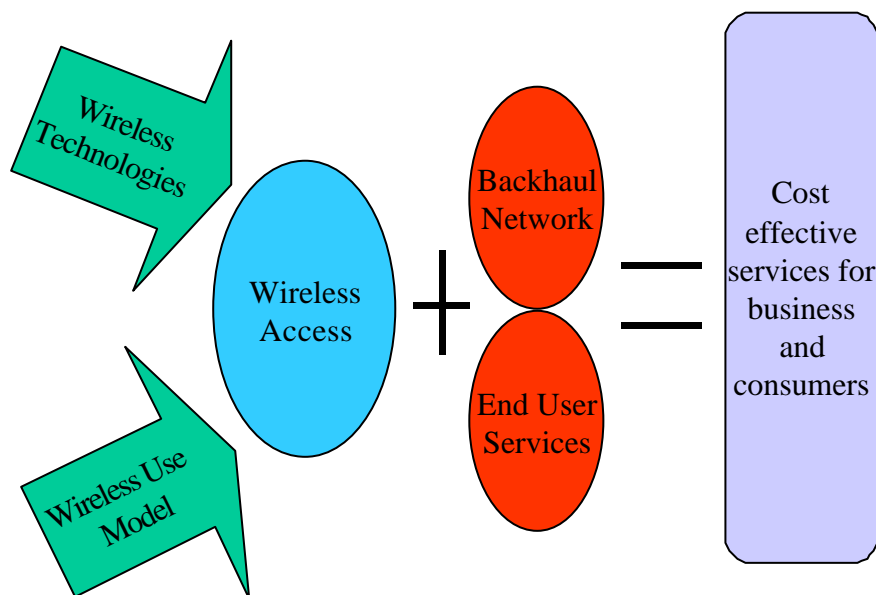
To best understand what wireless technologies will best suit which applications, it is important to first categorize the models of Wireless data use. Briefly, these are:

- 1) Mobile Data Communications
- 2) Portable Data Communications
- 3) Wireless Local Area Networks
- 4) Wireless Personal Area Networks
- 5) Wireless Local Loop Networks

Each of these usage models serves a different purpose and thus is best served by different & perhaps a multitude of technologies.

Each wireless usage model in turn plays a part in a particular business model.

This is summarised in the following diagram.



We detail each of these wireless use models below. We then describe each of the wireless technologies that can be applied to these models with their respective capabilities and limitations. The business models that can be built out of these

wireless access models are covered in the next section in the context of overall telecommunications

Finally a summary table is provided that maps technologies to wireless models.

Wireless Usage Models

Mobile Wireless Data Market

This segment is defined by data communications that have the following characteristics:

- short transaction based style of services
- need while mobile and/or actually moving
- performed from a small device with minimal power needs and long battery life
- scope for rich interaction and rich content is extremely limited
- method of access when away from all other forms of wireless access
- access will be more universal and ubiquitous than other forms of wireless access to data

Portable Wireless Data Market

This model is defined by data communications needs that have the following characteristics:

- rich and complex data communication needs similar to those currently experienced with high bandwidth fixed line communications to the internet from business or high bandwidth broadband at the consumer's home
- the communicating device can range from a PDA to a laptop to any number of devices in the future such as music or video players
- communication is performed while away from a "home base", but not necessarily while mobile
- access is provided in places where the user is *likely* to be when away from the home base of an office or home such as a hotel, airport, shopping centre, or other business (known as "hot spots")
- access is not universal, but may be partially or semi-ubiquitous based on the business model that is in use

Wireless Local Area Networks (WLANs)

This model is defined by the following characteristics:

- used as a supplementary technology to wired Local Area Networks within business or within residential premises
- not generally used to provide communication services from a service provider to a consumer for revenue
- operates in a range of 0 – 200 metres

- connects devices such as PDAs & laptops for purposes of high speed and fully featured data interactions
- can be used to connect other vide, audio, and multimedia devices within the home as these devices become available
-

Wireless Personal Area Networks

This model is defined by the following characteristics:

- Communication within 0-10 metres
- as a cable replacement technology for cables that are attached to a single device such as a mobile phone, laptop, PDA, multimedia devices
- will generally not be used as a replacement for fixed line data communication in the local area network

Wireless Local Loop Networks

This model is defined by following characteristics:

- use of wireless technology as a substitute for wire line local loop access for consumers and business
- not intended to provide mobile or portable communications support
- intended to provide bandwidth capable of supporting rich & interactive multimedia classes of data interaction with the internet and business networks

Wireless Technologies

There are a number of wireless technologies which collectively support the above wireless access models.

These technologies are:

- 900/1800 GSM with data capabilities, or 2.5G Mobile network technology
- CDMA & W-CDMA mobile networks with Data Capabilities, known as 3G networks
- Wireless LAN
- DOCSIS on MMDS
- Low Power, Low Range Wireless Technologies

GSM with data Capabilities

This technology, also known as 2.5G networks has following capabilities

- the largest practical physical coverage
- mobility support for data
-

This technology also has the following significant limitations:

- inability to provide sufficient data rates to the customer to provide a rich & interactive experience that many internet & data applications demand

- a very high cost per unit of information transfer to the client device over the wireless spectrum

- This capabilities & limitations clearly indicate that this technology will only be used for short & 'bursty' transactions while mobile or while not able to use any other form of internet or data network access. It will not be capable of delivering rich & complex data interactions cost effectively.

CDMA & W-CDMA Mobile Networks

This technology, also known as 3G networks, will have the same capabilities and limitations as data enabled (2.5G) GSM networks. 3G mobile networks will be a significant improvement to the current 2.5G infrastructure with regards to voice mobility and data mobility, but will in no way address the fundamental limitations of the networks as a data platform as described above under 2.5G networks.

3G mobility networks will not be able to cost effectively deliver the data rates demanded by complex internet based applications. It will only be able to provide a mechanism for mobile data that is short, transaction based and demands only low data throughput from the network

WLAN technologies

Wireless LAN technologies refers to the collection of 802.11x standards which include multiple spectrums and both non-OFDM and OFDM spectrum use technologies to carry data.

There are currently two types of Wireless LAN technologies. These are:

- 802.11b – transfer of data using spread spectrum techniques at 11Mbps
- 802.11a/g/h – transfer of data using OFDM techniques at multiples of 56 Mbps

The OFDM technology variants of the 802.11x family are considered leading edge and have been brought to the global market by Australian technology developers.

Australia is a global technology leader in the creation of technology for very high speed wireless LAN technologies.

Wireless LAN technologies have the following characteristics:

- high throughput data rates capable of delivering rich multimedia based internet & data applications
- low cost per unit of data transfer
- scalability to handle a very number of simultaneous clients

Wireless LAN technologies started with some limitations which have either been already addressed or will be very soon:

- early implementations had security concerns, but now have solid security frameworks associated with them with EAP / 802.1x security frameworks
- scalability is now much higher due to OFDM spectrum technologies and networking protocols which very effectively allow many more users to simultaneously use the same amount of network resources and thus drive the cost per user down dramatically

In the near future, Wireless LAN technologies will be improved and or supplemented by other technologies that will allow them to operate as an effective local loop technology. Briefly some of these are:

- extended Spectrum Management Capabilities
- abilities to deliver very high data rates of up to 1 Gbps
- ability for many users to share spectrum at high data rates, low cost, and in a individually secure manner

DOCSIS Wireless Technologies

DOCSIS itself is not a wireless technology, but rather a method for effectively using spectrum in a wide range of what is loosely referred to as MMDS spectrums. DOCSIS is a layer 1 / Layer 2 networking protocol that effectively manages all aspects of data transfer on a number of spectrums.

We specifically raise DOCSIS technology as it is one of the main standout technologies that has been effectively proven to use spectrum to deliver high data rate services to consumers and businesses in a very cost effective, easily manageable, and highly secure manner.

There is some perception that MMDS spectrum did not deliver on its promises. While this has been true to some extent, there is a single reason for this and use of MMDS spectrum going forward will be very important to Australia.

MMDS models have traditionally not delivered due to the high cost associated with delivering service to a customer. DOCSIS wireless is the one standout technology that allows spectrum in the MMDS band to, on a per-user basis, allow cost effective delivery of high speed data services capable of delivering full multi-media on wireless spectrum. Late 2001 and 2002 have seen extensive interest expressed in using DOCSIS Wireless on a variety of MMDS spectrum bands.

DOCSIS on MMDS spectrum bands comes in two varieties:

- 1) DOCSIS on QAM/QPSK modulation on carrier frequencies in MMDS bands
- 2) DOCSIS on OFDM modulation techniques on frequencies in MMDS bands

Both varieties provide the following important capabilities:

- per user or business high BW capable of delivering full motion video & full interactivity
- highly secure infrastructure

- low cost per subscriber and thus very low cost per unit of data transfer

DOCSIS on OFDM provides the essential additional capability that line of site is not always required.

Bluetooth & Similar Technologies

Bluetooth and similar technologies will be important as a cable replacement technology. These technologies have the following important characteristics:

- range best suited for communication between peripheral devices such as headsets to a main device such as a laptop, PDA or mobile phone
- power management capabilities well suited to the needs of peripheral devices

These technologies have the following limitations:

- range required to operate as a replacement for a data network
- spectrum management capabilities required to manage many devices communicating at high data rates to a business network or Internet

Mapping of Usage Models to Technologies

The following Table maps the effective use of each Wireless technology with the most appropriate Models for data service delivery.

Table 1: Map of Wireless Models to Wireless Technologies

	GSM / 2.5G	CDMA/ 3G	WLAN Technologies	DOCSIS on MMDS	Bluetooth / InfraRed
Mobile Data Access	Suitable	Suitable	Un-Suitable	Un-Suitable	Un-Suitable
Portable Data Access	Un-Suitable	Un-Suitable	Suitable	Un-Suitable	Un-Suitable
Wireless Local Area Network	Un-Suitable	Un-Suitable	Suitable	Un-Suitable	Un-Suitable
Wireless Local Loop	Un-Suitable	Un-Suitable	Suitable	Suitable	Un-Suitable
Personal Area Network	Un-Suitable	Un-Suitable	Un-Suitable	Un-Suitable	Suitable

Two key points fall out of the above table.

Firstly, there is more than one viable wireless local loop technology that can provide secure, cost effective, and scalable services to consumers and businesses. The current lack of commercial success of these WLL technologies can not and should not be taken as indications of future use of these models & technologies.

Secondly, the family of wireless LAN technologies has applications in several wireless use models and business models. Furthermore, this is technology where Australia leads the world.

3. Wireless technologies as part of overall Telecommunications Environment

It is clear that wireless technologies have significant upside potential to provide a number of alternatives to wire-line data communications. If regulated and deployed appropriately these technologies can bring competitive data access solutions to the market in a number of profitable models.

Later in this submission, Cisco makes a number of specific regulatory recommendations with specific regard to use of wireless spectrum. Cisco believes the issues that competitive wireless access raise, go beyond that of wireless and into areas of overall telecommunication frameworks.

With wireless technologies capable of providing reasonable competitive access over the “last mile” competitive & regulatory issues will need to be more carefully considered in other key aspects of the telecommunications & data communications framework.

In the diagram below, we depict what a telecommunication or a data communication service means to the end user of the service. The end user can be a consumer or a business user of a service.

Definition of a Service

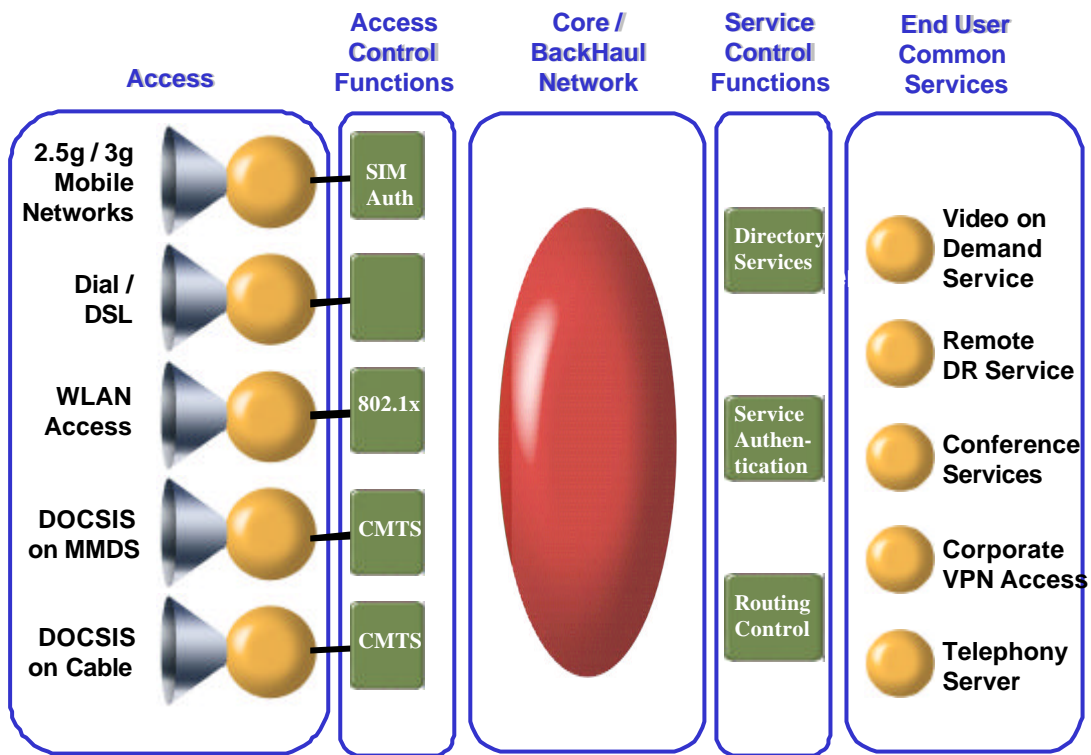
Briefly, a service is defined as something the end user relates to. Examples are:

- connection of a telephone call
- download of a music or video from the internet
- managed backup of a business’s critical data
- access to a teleconference or a videoconference
- access to and distribution of electronic diary & scheduling information
- access to a companies private intranet from outside that companies intranet

Conversely, a service is *not* defined as any of the following:

- high speed data access via Cable Modems or DSL Modems
- high speed data access via a wireless local loop or Wireless hotspot
- data access to a Service Provider network via a mobile phone

The Service Delivery Framework



From the above diagram, it becomes clear that any service from a Service Provider has several critical components that are involved in delivering the service.

These are:

- 1) The Service Logic – that which controls what the end user sees value in and is trying to use
- 2) The access from the business or consumer to the Service Provider network
- 3) The core network of the Service Provider whose function it is to connect the disparate access paths of end users to the consumers
- 4) The control framework of the service provider whose function it is to control which end user gets access to which service. This has two parts, the “access control functions” and “service control functions”

Definition of Competitive Access & Telecommunications

For a competitive telecommunications environment to exist, there must exist competitive services for the consumer & businesses to have access to. This most certainly implies a different definition of what competitive access to services mean:

“A competitive service provider must be able to roll out a service that has meaning to the end user without restriction at the access point, the core networking point, the network control points, or the services control point.”

“Conversely, the end user must have access to competitive services at the service level and not just at the access, core network, and network control points.”

Points of Restriction and Impediment to a Competitive Framework

We highlight below what restriction might mean in the context of core networks, network control points, and Service Control points.

Restrictions at the access point

This is now a well understood issue in Australia and reasonable progress has been made to ensure that there is equal access on some fixed line access to consumers and business. The government must continue this effort in the area of making sure the consumer & business market has a number of choices for wireless access and that wireless access can not be controlled by a single group. There are specific recommendations to address this in the Wireless Regulation Section below.

Restrictions in the core / backhaul network

Effective competition in the customer access network will be meaningless unless the core (or backhaul) networks in Australia are free of restrictions and / or reasonable competition is brought to the provision of core / backhaul network services.

Examples of restriction would be:

- refusal by a core / backhaul wholesale service provider to provide a transparent backhaul service
- refusal by a core / backhaul wholesale service to provide an SLA on packet based services that relate to both throughput & latency
- the application of any filter what so ever on a packet based core / backhaul service that looks for and subsequently modifies in any way packets with particular content or meaning

Restrictions in the core / backhaul control framework

An essential part of the provision of services across a core / backhaul network from a client access point to the end service is the control function which administers which client can access what services at the service layer. This function can not and must not be encumbered in any way. By control framework, we refer to the access and service control functions depicted above.

Authority over these functions must be open to competition or must be regulated in such a way that they are not encumbered in any way.

Examples of restrictions that may occur at this point are:

- lack of access or delayed access to authentication and authorization functions which allow a user to access the core / backhaul network and subsequently use a service
- lack of access or delayed access to a directory service of any kind which are an essential part of Internet Based services & applications, one of the most common of these is the Domain Name Service

- lack of access to any other resource deemed essential to provision of a service such as telephone addressing ranges and Internet addressing ranges

Restrictions to Service Competition

The last point in the framework where it is necessary to ensure a competitive framework to the consumer or business is to ensure that there is reasonable choice for the consumer for a particular service.

There are two primary ways that service competition could be restricted in Australia:

- a single entity somehow gains control of content or other components required to deliver a service to business or consumers
- the end service is price-bundled with other aspects of the overall framework such as backhaul or last mile access such that any discreet component is effectively priced below what it otherwise would be when sold as an isolated component

4. Regulatory Recommendations

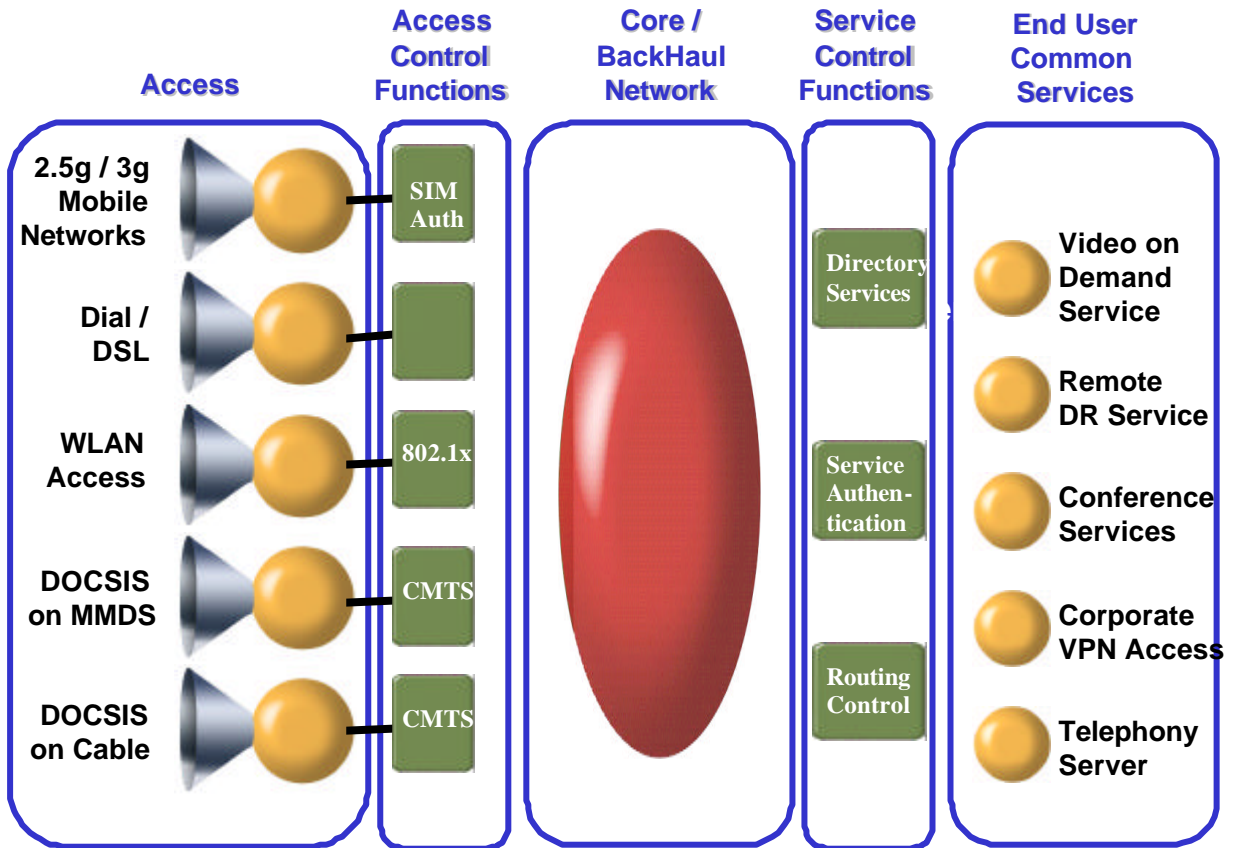
Cisco has a number of recommendations for potential regulation of the industry.

These recommendations fall into two categories:

- recommendations regarding overall telecommunications framework
- recommendations regarding use of wireless access technologies

General Recommendations

The general recommendations made in the following section refer to the services model discussed in the previous section & re-produced here.



- 1) In the Services model depicted above, an end user needs to access a service via a core / backhaul network. The government needs to make sure that one of the following mechanisms is in place so that end users have no restriction on their access to a service:
 - a. There needs to be more than one provider of wholesale bandwidth between an access aggregation point and the service provision point.
 - b. In an environment where having more than one provider of bandwidth is not practical, wholesale bandwidth must be provided to alternative access providers and alternative end-service providers. In addition this wholesale service must be completely transparent and in no way monitor or interfere with the traffic travelling over it. Any interference would need to be treated as a breach of the requirements for providing a wholesale service.

In addition, there must be bounded time limits on how long it takes for the wholesale service to be provided.

- 2) In the services model depicted above, there are a lot of necessary control functions to maintain integrity of networks from a security, stability, and scalability point of view. These functions are in turn points of potential control over access to network resources. The government must make sure that in cases where a single entity may control one or more of these functions, that:
- a. Equal access is given to any and all to make use of these functions at a reasonable market cost
 - b. There are bounded time limits on how quickly the single provider must provide access to these control functions

An example, but by no means exhaustive, list of these functions are:

- shared authentication mechanisms for access to access networks, core / backhaul networks, and services
- shared directory services, the most common being the Domain Name Service
- allocation of addressing entities for services including domain names, telephony number ranges, Internet routing table assignments
- other service control & directory functions

Wireless Recommendations

- 1) The spectrum bands that are currently not licensed to specific owners and users must remain as they are. A number of business and consumers have invested in technology that uses these spectrums and depend on this technology to operate their business or effectively operate consumer devices
- 2) The government should in no way specify the type of modulation techniques that are to be used in spectrum that is licensed to specific owners or users. To do so, potentially limits the number of choices and thus the optimal use of a scarce resource. Spectrum should ultimately be used to deliver the lowest cost per unit of information over a wireless access mechanism. Any pre-supposition of what wireless technologies should use a user licensed spectrum carriers the risk that cost effective technology will not be useable in a spectrum. This recommendation does not apply to non-user licensed spectrum as some technologies may better share spectrum than others.
- 3) The government should consider releasing & licensing additional spectrum for use with Wireless LAN technologies. It will not be long before Wireless LANs running in ISM spectrum bands become congested and the user experience drops in quality and usefulness. At the same time, these technologies will be considered essential by business & consumers. As a result of these two trends, a market will emerge for the provision of these services in a premium model using licensed spectrum and thus guaranteeing a reasonable Quality of Service.
- 4) The government should mandate that wireless devices operating in shared non-user licensed spectrum provide up front consumer education about the spectrum that these devices operate in. Specifically, both business users and consumers must be informed prior to purchase of the risks associated with using shared spectrum.
- 5) With many potential users competing for use of shared & free spectrum bands, conflict involving commercial interests will invariably arise. There must be an arbitration mechanism for determining who has the right to use shared spectrum when conflicts arise. Most commercial business models involving the use of wireless technologies in shared spectrum will rely on and be linked to a commercial interest involving some form of real estate such as hotels, airports, shopping centres, coffee shops, etc. As such, arbitration involving commercial interests must invariably give control of shared spectrum to the owner of the physical real estate and the air space that it accompanies. The arbitration must further insist that all other users cease & desist using the spectrum in that physical location. This must apply to all channels and not only part of the spectrum.
- 6) The government should put in mechanisms to prevent “spectrum squatting” so that a commercial interest with financial assets is not capable of limiting access to spectrum by other commercial interests who may wish to roll out services using the spectrum. Specifically, the government should make it a part of the spectrum license rules, that within a finite period of time from

spectrum purchase (say 12 months), that the spectrum be used to deliver commercial communication services. Failure to do so would result in the government re-auctioning the spectrum to another party without financial consideration towards the original licensee.

- 7) An essential component of wireless access mechanisms is the security framework. A critical part of the security framework is the authentication of access to the network. There are several proven and robust security frameworks surrounding wireless access networks. Each has different capabilities, but all satisfy security requirements. As such the government need not and should not mandate any single security framework and associated access authentication mechanism. To do so, would unnecessarily limit the number of technologies that can provide wireless access to businesses and consumers. As an example, mobile SIM authentication should not be a mandated authentication mechanism. Similarly, an EAP on the 802.1x authentication framework should not be a mandated authentication mechanism.

- 8) A single commercial interest must not be allowed to control all or even a majority of the spectrum bands that are best suited for a particular type of wireless technology. This applies to both the situations where an owner may own non-wireless access mechanisms and where the owner may have licenses on spectrum intended for other wireless access technologies. As an example, an owner of a cable plant (HFC, copper, or optical) which provides access to a high percentage of businesses / consumers in an area, must not be allowed to own a large and certainly not dominant share of spectrum best suited for particular high speed wireless access technologies. Another example would be the existing owner of 2.5G or 3G mobile network spectrum. Such an owner of a competing wireless access spectrum should not be allowed to control access to spectrum best suited for competing wireless access technologies.