FRAMEWORK FOR THIRD GENERATION (3G) CELLULAR NETWROK DEPLOYMENT AND SERVICES OFFERING IN SINGAPORE

RESPONSE FROM LUCENT

TABLE OF CONTENTS

INTRODUCTION

In response to TAS consultation paper on "Framework for 3G Cellular Network Deployment and Services Offering in Singapore", Lucent Technologies would like to comment on the following section:

Section 4.1(a) : An assessment of the development of 3G cellular technology, the likely services being developed and the potential demand from business and consumers:

The outline of our response for 4.1 (a) includes:

1. Key market trends and drivers of these trends

2. Promising applications for 3G services

3. Potential demand from business and consumers

Section 4.1(g) : The timing for award of 3G licences and services launch dates

We have included 2 tables on the overview of 3G licenses and launch dates in Asia-Pacific and Europe.

Section 4.2 : Respondents are also invited to comment on any other issues not covered herein that they think are relevant to this review.

In addition, as a major equipment vendor that manufactures and supplies infrastructure to wireless service providers worldwide, and is involved in the research and development of all of the major third generation mobile standards, Lucent Technologies would like to comment on:

1. Spectrum issues –

   a) Spectrum Flexibility

   b) Bandwidth per operator

2. 3G Technologies Support and Global roaming

3. Availability of 3G infrastructure

4. Availability of 3G handsets

In regards to some of the topics in Section 4.1(b) to (f), we feel that we are not in a position to give recommendations as these points are more appropriately relevant to an operator. However, we have provided comments for other appropriate topics in Section 4.2.

EXECUTIVE SUMMARY

3G Development and services

The development of 3G cellular technologies or IMT-2000 is strongly supported and promoted by ITU who is spearheading the drafting of the specifications and they have also laid down guidelines for the spectrum allocation. IMT-2000 standard is all about spectrum and technology transparency, comprising of a family of standards – GSM, TDMA (IS-136) and CDMA (IS-95).

More importantly, 3G development is strongly driven by a series of key market trends that are vital to the success of 3G in the future. Consumers' lifestyles are changing with higher demand for technology mobility and new communications possibilities. Changes in the telecoms market will also hasten the onset of 3G as operators have to deal with falling revenues on their existing 2G networks despite wireless growth and capacity issues. Operators are looking for ways to generate greater revenues and greater spectrum efficiency by turning to FMI and packet-switched networks. FMI and packet-switched networks will in turn fuel the demand for 3G services.

Within the industry, the links between different types of communications devices like mobile phones, computers, printers are strengthened by the success of WAP and Bluetooth operating systems. Demand for mobile data is boosted significantly and this is one of the key drivers of 3G.

There are many promising and exciting applications that are forecasted to meet the end-users' demand. So whether it is for business or personal users, there is something for every different need, taste and lifestyle. This paper will provide details on the types of likely 3G applications available.

3G licensing

Regulators in different countries adopt different time-tables when it comes to spectrum licensing, depending on each individual needs and requirement. For example, in Finland, the regulator has already awarded four 3G licences. On the other hand, in Japan, spectrum licenses are not due till April/May 2000 even though 3G trials are being conducted right now.

While it is good to wait for clearer 3G guidelines or plans from ITU, it is timely that TAS is getting inputs from operators and vendors. We are confident that this exercise will provide the appropriate objectivity for TAS.

Spectrum Issues

ITU has identified a worldwide spectrum allocation of 230 MHz in the bands of 1885 to 2025 MHz and 2110 to 2200 MHz for 3G services.

The migration path for existing GSM 900 or 1800 operators to UMTS for 3G services, requires them to acquire a new spectrum. However, CDMA cellular or PCS operators can re-use their existing 850 or 1900 MHz spectrum to deploy 3G networks.

Lucent Technologies is recommending that TAS considers licensing out the 850 MHz, in addition to the IMT-2000 spectrum identified by ITU, for 3G services in Singapore.

Lucent Credentials

Lucent Technologies is a market leader in the supply of 3G global mobile infrastructure. Our 3G experience with Vodafone, NTT DoCoMo, DDI/IDO, Bell Atlantic, Sprint and AT&T Wireless ensures that Lucent is able to rise to the challenge of migrating to the next generation.

We are proud of our position as a successful CDMA and GSM vendor. Our knowledge of wireless is the basis of our success and deployment plans for 2G networks all over the world.

We are the only vendor actively collaborating with operators in all the global 3G standards. We have a number of existing 3G trials underway and we are the only non-Japanese supplier to have been selected to supply both access and core network elements to NTT DoCoMo.

As part of our ongoing technology demonstrations, we have shown actual over-the-air calls using data rates which are much higher than any other vendor, ie beyond 1 MB per second.

RESPONSE TO CONSULTATION DOCUMENT

Section 4.1 (a) : An assessment of the development of 3G cellular technology, the likely services being developed and the potential demand from business and consumers.
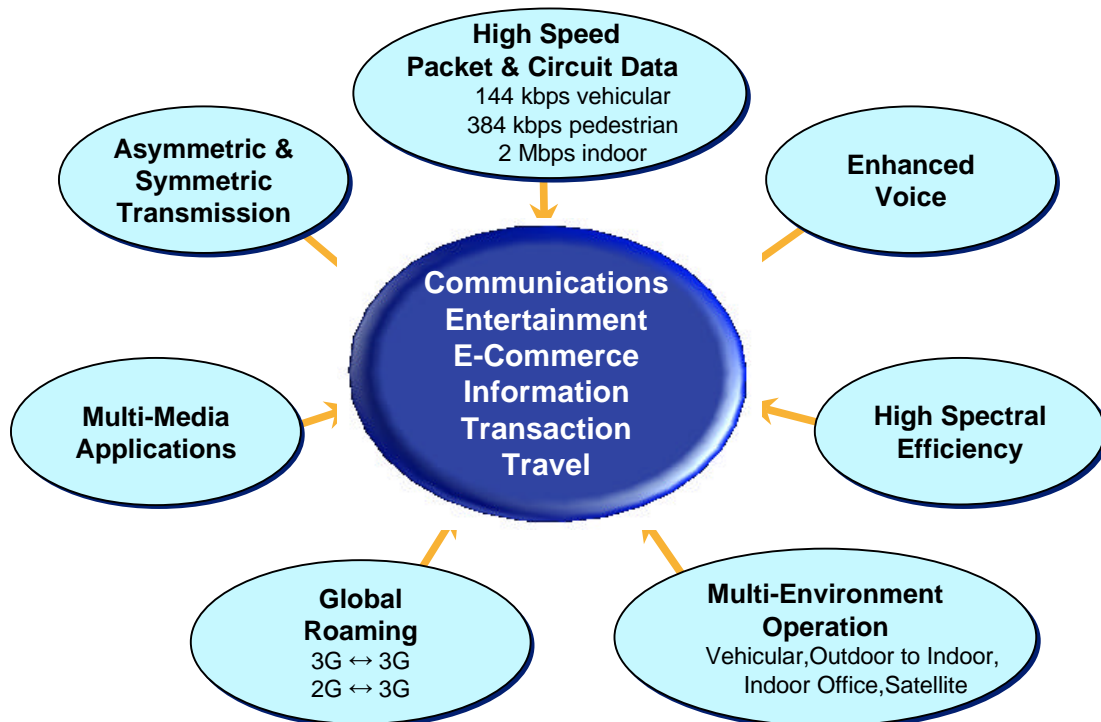
Lucent's response:

Introduction

IMT-2000, a strategic priority of the ITU, provides a framework for worldwide wireless access and evolution from earlier "legacy" systems, which ensures global economies of scale and supply while allowing plenty of scope for product and service differentiation.

IMT-2000 standard will give operators a choice of radio access methods and core networks in order to flexibly implement and evolve their systems based on the regulatory, market or business requirements for each region or country. It aims to unify the diverse wireless access systems we see today into a flexible radio infrastructure capable of offering a wide range of multimedia services, with appropriate quality levels, around the year 2000 in many different radio environments.

The World Administrative Radio Conference of 1992 identified a worldwide allocation of 230 MHz of spectrum in the bands 1885 - 2025 MHz and 2110 – 2200 MHz for IMT-2000.

The diagram below clearly spells out ITU requirements for 3G:

Third Generation (ITU) Requirements

High Speed
Packet & Circuit Data
144 kbps vehicular
384 kbps pedestrian
2 Mbps indoor

Asymmetric &
Symmetric
Transmission

Enhanced
Voice

Communications
Entertainment
E-Commerce
Information
Transaction
Travel

Multi-Media
Applications

High Spectral
Efficiency

Global
Roaming
3G ↔ 3G
2G ↔ 3G

Multi-Environment
Operation
Vehicular,Outdoor to Indoor,
Indoor Office,Satellite

As telecommunications moves into an era where the distinction between voice, video and data will be blurred, convergence of communications, information, entertainment, commerce and computing will lay the foundation for the development of the Information Society.[1]

Personal mobility, enabled by computer-based communications, has become a fact of life. End-users have become accustomed to communications systems that allow them - wherever they are - to maintain contact with their corporate and home environments. New end-user devices, from hand-helds to network appliances, are gaining rapid acceptance with compelling applications and plug-and-play capabilities.

While the basic telecoms services, such as voice, fax, email, and low-speed data messages will remain very important, the demand for new and enhanced services will increase. People will no longer only use wireless technologies to make phone calls; they will use it to obtain share quotes, play interactive games and do video conferencing. Third generation systems will deliver these advanced services to the users, whether they are on the move or in a fixed environment.

3G technology will take the personal communications user into the Information Society by delivering voice, graphics, video and broadband information direct to the user. These systems will move mobile communications forward from second generation systems – which are currently creating a mass market for low-cost digital wireless voice services – to encompass fully personal data communication services.

The response to this section outlines Lucent's view on the future of the 3G market in terms of:

- Key market trends, and the drivers of these trends

- Promising Applications for 3G services

- Potential Demand from business and consumers

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[1] Quote from the UMTS Forum 1999, Report No. 8

1. KEY MARKET TRENDS AND DRIVERS OF THESE TRENDS

Lucent Technologies sees 5 "megatrends" influencing the way operators will do business using next generation mobile networks:

a) Shifts in consumers' behaviour and lifestyle

b) Changes in the telecoms market

c) Fixed Mobile Integration will be increasingly a key component of operator strategies

d) Packet-switched networks will emerge driven by the demand for information

e) Enabling technologies that will drive mobile data

A) Shifts in consumers' behaviour and lifestyle

Explosive subscriber growth will continue as mobile phones increasingly become mass market products fuelled by new applications, the need for personal mobility, affordability/lower prices and wide cultural acceptance. Lucent's view is that wireless subscriber numbers worldwide will grow from 408 million in 1999 to around 1 billion by 2005. And 3G systems will account for 25% of subscribers worldwide by 2010.

The forecasted growth will be driven in part by a number of key shifts in consumer behaviour, lifestyle changes and technology advancements. They include:

- **The trend toward individualisation and mobility** is creating a need for access to information anytime, anywhere. End-users are spending more time travelling, creating a need to have access to corporate Intranets, and gain access to private and public information. Customers want to operate on the move and have access to information that is available in a fixed environment. In addition, consumers are becoming more flexible in the time and location of where they work.

- **As people become used to technology in their everyday lives, they are becoming more sophisticated.** End-users have become accustomed to communications systems that allow them to maintain contact with their corporate enterprise environment

- **There is an increasing demand for information and services**. The powerful takeoff of the Internet and rapid acceptance of consumer devices demonstrates the increasingly mobile and information hungry society. The power of this trend is captured in the enthusiasm with which the internet "click-to-everything" model has been adopted in areas ranging from entertainment to commerce to business information needs, as well as the speed with which new and more advanced applications are being introduced.

- **Key technology advancements will help enable 3G growth.** These include advances in cellular system technology, microprocessor miniaturisation, battery technology and reductions in cost of these technologies.

- **3G will offer end-users new communication possibilities.** These can be classified into six main areas of content: general communications, entertainment, e-commerce, travel, access to information systems and machine to machine communications. The figure below outlines the content areas and the technology enablers that will open new market segments. Lucent believes that 3G consumers will expect flexibility and competitive pricing combined with landline-like high bandwidth quality, reliability and ubiquity.

3G WILL DELIVER SIX MAIN KINDS OF CONTENT

Because 3G Can Deliver...	...3G Offers People New Mobile Communications Possibilities...	...Which are Grouped into Six Content Types
• Voice and data together	• Fast Internet, intranet, and E-mail access • Simultaneous data and voice on the move	General communications
• Very high data speeds required for intensive data applications and video	• Access to Internet games • Real-time video; audio/video streaming on demand	Entertainment
• Links to transaction systems	Reservations and purchasing from the terminal	Electronic commerce
• Different types of information based upon the user's location	• Access to driving/traffic advisories Maps showing location of nearby businesses as users move	Travel
• Links to the Internet as well as private intranets and other corporate systems	• Access to corporate sales databases; allows salespeople to respond to customer queries on the spot, facilitates price quotes • On-the-spot order entry, delivery confirmation	Access to Information systems
• Visual displays	• Electronic car monitoring to provide pro-active maintenance • Portable monitoring aids to enhance effectiveness of mobile security patrols	Machine-to-machine communications

B) Changes in the telecoms market

Here are some of the changes that currently going through in the telecoms market. They are powerful drivers towards 3G:

- **Average Mobile Revenue Per User**, despite growth, will continue to fall with increasing competition across all markets for basic mobile telephony. For example, from 1996 to 1999, cellular pricing has decreased by 33% in Asia Pacific. (Source: Yankee Group reports)

  Operators the world over are looking for other ways or means to help them to grow their revenues. And mobile data services are increasingly becoming important.

- **Consolidation and New Entrants** – As subscriber numbers have increased and additional operators have entered, competition has intensified, weaker players have

been acquired or withdrawn. Opportunities for new licenses are reducing and 2G spectrum becoming more scarce.

- **New services and applications** – In advanced markets, operators continually develop new data driven services (news, banking, information, etc.). In less developed markets, cellular substitution of fixed service is occurring, but with high customer expectations. For both types of market, current 2nd generation mobile technology limits capacity and complexity, and hence restricting growth.

- **New areas/diversification** – Progressively more and more Asia Pacific mobile operators are acquiring ISP licenses. But current 2nd generation technology is inadequate for true internet access.

C) Fixed Mobile Integration

End-users expect services anytime, anywhere, with the same convenience, speed, quality and flexibility at the office or home, on fixed or mobile networks. Recent end-user research conducted by Ovum shows that:

- Residential end-users would welcome an increased offering of integrated services. 57% would be strongly interested in buying FMI services; 24% would switch operators to get this service; 44% said their satisfaction level would increase, ie churn would fall; 29% said they would increase their phone usage.

- Business users see integrated numbering and a single phone as key benefits of a mobile VPN (Virtual Private Network)

Furthermore, the UMTS Forum maintains that by 2010 end-users will not distinguish between fixed and mobile services; they will expect the service to be delivered to them when and where they want it.

Therefore, FMI will become the key component for operators' strategies towards increasing their revenues. Being able to meet the surge in subscribers on their network, operators have to find ways to increase capacity. And 3G technologies can provide that.

D) Packet-Switched networks will emerge driven by the demand for information
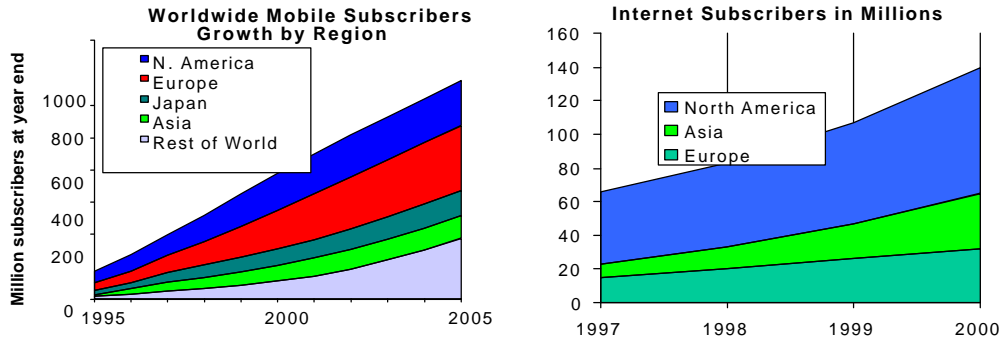
Graphs: Worldwide Mobile and Internet Subscriber Growth

We are already seeing this happening with our eyes as the industry moves toward packet based networks for 2 principal reasons – revenue generation and cost reduction.

First, next generation networks will be driven by access to content and new services. Subscribers will demand revenue generating services and applications over the air (wireless video-conferencing, email, file transfer and other multimedia services) that will require higher bandwidth data capabilities. The current circuit switched infrastructure cannot efficiently support the higher data rates that will be required. It is inevitable that an evolution to packet-based networks will be necessary so as to satisfy market demand. For example, effective wireless video-conferencing will require synchronous data speeds at around 384 kbps. Lucent believes that networks will change to accommodate the strong demand for these types of 3G services and the increasing demand for information anywhere, anytime.

Second, the change in network architecture required will lead to a more cost effective solution as operators will have the capability of offering multi-service solutions on one distributed backbone network based on IP/ATM.

Tomorrow's network will be about the core network; the packet switching, the distributed servers to enable service creation, Intelligent Networks and Network Management. The core network will become increasingly more important, as operators will have to support the seamless delivery of new applications and services.

The evolving value chain will have an impact on the way operators do business and share revenues with other players in the industry. For example, in GSM, the basic application is 'built in' to the operator's network – the equipment is designed to provide customers with dial up voice circuits. There may be additional services such as voice mail and IN features

but the contribution towards revenue these currently add for operators is small compared to voice. With 3G the picture will be more complex. There will be a wide range of revenue generating data services targeting different customer segments. In addition, content providers and value-added applications providers will emerge to play a role in delivering these services. Network operators will need to interface with these new players to provide a service creation environment that will allow third parties to deliver services over their networks.

E) Enabling technologies that will drive mobile data

We believe WAP and Bluetooth operating systems are currently the most significant enabling platforms for mobile data. These operating systems will push up the consumer demands for data services, which ultimately will increase the demands for 3G services.

WAP

Wireless Application Protocol (WAP) is an open industry global standard based on Internet standards including Extensible Mark-Up Language (XML) and Internet Protocol (IP). It has been developed to facilitate access to the Internet and Intranets via mobile phones and other wireless devices. In fact, the industry formed the WAP Forum to develop a specification for a global protocol that would work across differing wireless network technology types.

The objective of WAP is to put the "web" onto small devices and screens, e.g. handsets, so that users can get important information in an efficient manner despite the current slow wireless data rates and limited handset form factor.

The vast majority of handset manufacturers are committed to WAP. WAP is also supported by many network operators. Interestingly, WAP is radio access standards independent, hence it will work on GSM as well as TDMA and CDMA networks.

Some WAP Agreements to-date:

WAP Terminals Today
Alcatel   One Touch Pocket
Nokia   MediaPhone 7110
Samsung   SGH-800

(Source: Merrill Lynch)

WAP Operators to-date:

DDI (Japan) on PDC

Sunday (HK) on GSM 1800

Taiwan Cellular Corporation (Taiwan) on GSM 1900

Optus (Australia) on GSM 900

Telstra (Australia) on GSM 900 & 1800

Bluetooth

Bluetooth is a standard developed for establishing connectivity between devices up to 3 or 4 metres apart using a radio link.

The link is important as it allows a portable communications device such as a portable computer or smartphone to talk to other devices such as a laptop, desktop computer, printer or telephone. In time, this could be extended to include wireless joysticks, small headsets for hands-free mobile phones, electronic components in cars and set-top boxes for cable television.

Most Bluetooth chips that have been announced in the market to date have been multi-chip. Over the next 12 months we will see single chip transceivers over radio that will improve costs and power consumption. Connectivity speeds are expected to reach up to 1 Mbps.

We believe that there will not be "one" mobile data terminal of choice but many. Some end-users will want integrated devices, others will want one specialised functionality, and teenagers of tomorrow may want something completely different. Bluetooth allows for all tastes of the end-users to be met due to the ability for devices to speak to each other and physical elements to be located separately. Ericsson is expected to launch its Bluetooth data transceiver module with a complete Bluetooth radio launch in 1Q2000 incorporating a VLSI technology-based baseband processor.

2. PROMISING APPLICATIONS FOR 3G SERVICES

Lucent has carried out a detailed study to identify promising applications and to forecast the demand for these services. The demand forecast identifies a number of potential multimedia applications divided into three categories:

- **"Workhorse"** applications.   These arise mainly in business or professional environments, and respond to well-defined user needs that can be the basis for a specific "benefit case". See table 2 (A) below.

- **"Visionary"** applications.   These are based on innovative ideas which require a major change in behaviour; many of them involve residential users. See table 2 (B) below.

- Applications **"options"**.   This refers to well-known and large application opportunities where the implementation of 3G alone is necessary but not sufficient to make the application happen, for example automotive applications.

2a) " Workhorse" Applications

Name of Application	Brief Description
Super Scheduler	Enables an extended work group to share diary/calendar/scheduling information on a systematic basis
	Facilitates/supports/communicates scheduling decisions and commitments
Find It/Show It	Allows a company's in-house data and documents to be located by searching from the 3G terminal, accessed remotely, and displayed in an easy-to-read format
	Provides a wireless Internet and Intranet browser adapted to characteristics of a radio link, 3G network and 3G terminal
Present-on-the-Run	Enables lap-top computer and 3G wireless card to be used as a presentation tool, drawing remotely on pages from a server at the user's office
	Can also incorporate live results from simulations; animation; and video clips from a video server
Selling Assistance	Enables sales person to:
	• Find/display information to answer sales prospect's objections, queries
	• Do product configuration work and develop price quotes on-line
	• Enter orders and confirm delivery commitments
RunTime	Enables 3G terminal to:
	• Access and run major programs or models on a remote server, and display the results
	• Download software (e.g., Java applets) for execution on the 3G terminal

2b) "Visionary" Applications

Name of Application	Brief Description	Sources of Revenue	Examples of Potential Partners to Implement Application
The Entertain-ment Machine	Multimedia entertainment integrating video games with still pictures and moving sequences	Sales of downloaded software; advertising possibly subscription to group-play activities	20th Century Fox/News Corp., Panasonic, Sony
Family Link	A "social expression" product enabling "virtual" participation in live events, such as weddings and other family gatherings, via video link from digital, wireless-connected, next generation camcorder	Usage charges; sale of software	Hallmark, Kodak, Sony
Road-Mate	Assistance to drivers: navigation information on traffic conditions, parking, restaurants and hotel reservations	Advertising, subscription, transaction charges to service suppliers, e.g. hotels	AA, Visa or Master Card
Where It's At	A social application for the young and gregarious: listing locations and communicating information about activities and entertainment, facilitating shared participation by groups of friends	Advertising, transaction fees	Time Out Magazine, Virgin, Warner, Rank, Visa or Master Card
You Bet	On-line games, quizzes, crosswords and similar amusements betting (football, pools, National Lottery)	Advertising, transaction fees, margin on betting	Singapore Pools, Camelot, Coral, Granada, Ladbroke, Rank
Pocket Finder	On-line shopper guide for people "on the move": incorporates powerful geographically-oriented search software and displays product information and	Advertising	American Express, Visa or Master Card

	shop with location maps		

2c)   Likely Applications at launch of 3G

Our studies also showed there are certain applications that are likely to debut at the launch of 3G technology. We believe that although personal users will not be ignored, business users will form the main target market in the early years after launch. Prepaid users will also be important and are factored into the business plans.

Here is the preview of the top five business and personal application categories:

Messaging (Person to Person and Unified)

Lucent views person to person messaging as a key driver of personal data use. At network launch, messaging will be important to both personal and business users. The message may be in the form of a voicemail, email, fax etc. The numerous types of messages will mean users will spend time tracking down messages that are stored in different applications. The solution should be based on the concept of unified messaging which bridges together multiple mail boxes and enables users to access messages from a single platform. Lucent believes that unified messaging will significantly drive growth in mobile data.

Mobile Office Application i.e. Remote Corporate LAN

Corporate mobile users will demand the range of services that are available in a fixed environment. These include a wide range of services including:

- *Internet access, browsing*

- *Intranet access, browsing*

- *Corporate database access*

- *E-mail with possible attachments*

- *Rapid File/Data transfer*

- *Collaborative working (tele-presence)*

- *Agenda synchronisation*

- *Expert on line*

- *Remote diagnostics / maintenance*

Location Based Services

Lucent believes location based services will be an important application in the market and both business and personal customers will be willing to pay. Examples include accessing directions in a foreign city and retrieving traffic information updates.

Other examples are:

- *Finding out where is the nearest 4-D or Toto sales outlet*

- *Navigation services*

- *Traffic information*

- *Tourist information / virtual tourist guide*

- Maps, images download

E-commerce

E-commerce is dramatically taking off in the fixed environment. Lucent believes that we will see the same trend in the mobile market. This is called m-commerce. The reason is primarily due to advances in security (encryption) and technology. 3G will offer higher bandwidth to facilitate m-commerce.

Operators will have to be prepared to offer the following services at launch in order to compete in the market and meet the expectation of the services 3G will deliver:

- On-line banking

- E-cash integrated in the mobile

- Electronic ticketing

- Interactive shopping

- Intelligent brokering

Revenues will come from Operator transaction fees on products and services from retailers.

Information Services

Information services are primarily content services delivered to the end user via the network operator or service provider. These services can generally be classified into push and pull. Pull services involve the user searching the web for information. Push information tends to be personalised and timely such as stock quotes, news clips etc. Lucent believes there will be a large demand for push information in both the personal and business market where end users will want access to tailored information while on the move. An example includes vacationers who, while away from home, want to stay on top of his or her stock portfolio without calling back home or frequenting an Internet cafe.

Other examples include:

- Travel and holiday

- Yellow pages

- Push & pull news / information

- E-newspaper

- Health

- Education, training

- Locator services

- Fleet management

3. POTENTIAL DEMAND FROM BUSINESS AND CONSUMERS

Explosive Market Growth in Mobile Telephony and in Data Communications points to a latent demand for 3G Data Services

Data services are available on existing 2G networks, but do not yet represent a significant share of operators' revenues. In most markets, data is only a few per cent of the total traffic. The barriers to uptake of 2G data include: low data rates (currently limited to 14.4 kbps); high prices (approximately 10 to 15 times more per bit than over a PSTN line); and the operators' tendency to focus on securing market share in voice, rather than on developing and marketing attractive data applications.

As we can see from the discussions above, the trends in the telecommunications market suggest, however, that there will be a substantial demand for data if these barriers are removed:

- Mobile penetration is catching up with penetration of fixed lines in developed countries.

- Demand for data services is growing strongly, particularly data retrieval via the Internet.

- Sales of portable computing devices are growing strongly.

Lucent Technologies
Bell Labs Innovations

Section 4.1 (g) : The timing for award of 3G licences and services launch dates.

Lucent's response:

In this section, we would provide summary information we know currently on what other regulators are doing on their 3G spectrum licensing and commercial launch dates for TAS' reference. Please refer to the attached 2 tables on the situation in Asia-Pacific and Europe.

TABLE 1 - AP OVERVIEW

Country	Australia	Hong Kong	India	Indonesia	Japan	Korea	Malaysia	NZ	Philippines	Singapore	Taiwan	Thailand
IMT-2000 Spectrum Status												
Name of Regulator	Australia Communication Authority (ACA)	Office of the Telecommunications Authority (OFTA)	Ministry of Information Technology (MIT), Telecom Regulatory Authority of India (TRAI)	DG Postel	Ministry of Posts and Telecommunications (MPT)	Management Info & Communications (MIC)	Communications & Multimedia Commission (CMC)	Ministry of Commerce	National Telecommunications Commission (NTC)	Telecommunications Authority of Singapore	Directorate General of Telecommunications (DGT)	Post and Telegraph Dept
Plans:												

Country	Australia	Hong Kong	India	Indonesia	Japan	Korea	Malaysia	NZ	Philippines	Singapore	Taiwan	Thailand
Number of licenses	TBD	TBD	TBD	TBD	3 licenses per region; a total of 9 regions in Japan	2 or 3 (TBD)	TBD	TBD	TBD	4 to 6	TBD	TBD
Spectrum range	TBD (Following ITU's guidelines)	1885-1980/ 2010-2170 MHz currently open for IMT-2000	TBD	TBD (Following ITU's guidelines)	1920-1980/2110 -2170 MHz	TBD (Following ITU's guidelines)	1920-1980/2110 -2170 MHz)	1920-1965/ 2110-2155 MHz (Overlaps with 1900 spectrum)	TBD	1920-1980 MHz/ 2110-2170 MHz	1920-1975 MHz/ 2110-2165 MHz	TBD
Total Spectrum	TBD	TBD	TBD	TBD	2x60 MHz	2x60 MHz	2x60 MHz	2x45 MHz	TBD	2x60 MHz	2x55 MHz	TBD
Bandwidth per operator	2x15 + 5MHz; 2x10 + 5 MHz	TBD	TBD	TBD	20 MHz/ 5 MHz at launch	20 MHz or 30 MHz (TBD)	TBD	Open	TBD	10 to 15 MHz	TBD	TBD
Years of license	15	TBD	TBD	TBD	??	N/A	20	20	TBD	17 to 20	TBD	TBD

Country	Australia	Hong Kong	India	Indonesia	Japan	Korea	Malaysia	NZ	Philippines	Singapore	Taiwan	Thailand
Spectrum Acquisition:												
Planned release - when?	Joint industry working groups currently working out the spectrum details. Proposal to ACA due March 2000. Spectrum release likely to happen in late 2000. Commercial deployment - 2 years later.	Ofta is currently seeking its members' views on spectrum allocation for IMT-2000. Ofta has no immediate plan to release the spectrum.	No decision has been taken for IMT-2000. Ongoing gathering inputs from vendors on specs. The proposed IMT band is currently being used by Defence services. Status - Watch and wait	The regulator will be following ITU's guideline for IMT-2000 spectrum. However, there is currently no plan for release.	End Mar 2000 - Finalising spectrum guidelines; April - May - Application; July - Award of licenses; April 2001 - Commercial deployment	2Q 2000 - License application; End 2000 - Licensing award; 2001 - Commercial deployment	Industry groups in Malaysia are currently working out the proposal for spectrum licensing. Date for licensing TBD.	31 Jan 2000 - Bid for spectrum opens	Demand and market not ready. IMT-2000 spectrum is not likely to be released till early 2002.	TBD	Spectrum release - 2003. But likely to be earlier.	Thai govt does not currently have a clear decision on 3G spectrum allocation.
How?	Likely - auction	TBD	TBD	TBD	Application of	Auction or	TBD	Auction	TBD	TBD	Legally - Auction,	TBD

Country	Australia	Hong Kong	India	Indonesia	Japan	Korea	Malaysia	NZ	Philippines	Singapore	Taiwan	Thailand
					spectrum; Award to operators	Application/Award (TBD)					but DGT is trying to change the system	

TABLE 2 - EUROPE OVERVIEW

Country	Finland	UK	Germany	France
IMT-2000 Spectrum Status				
Plans:				
Number of licenses	4 nos. of 20-year licenses awarded in March 1999.	5 (including one for new entrant)	4 to 6	4
Spectrum range		2X60 MHz	2X60 MHz paired and 30 MHz unpaired	
Total spectrum				
Bandwidth per operator	2x15 MHz paired spectrum plus 5 MHz unpaired spectrum	Three licenses with 2x10 MHz paired spectrum; Two licenses with 2x15 MHz paired spectrum;	12 spectrum blocks of 5 MHz each	2X10 MHz each in the initial phase and possibly extending to 2X15 MHz in the second phase of licensing.
Years per license	20 years	?		
Special Requirements		Roaming: UK government has ruled that roaming to GSM/GPRS will be enforced.		
Spectrum Acquisition:				
Planned release - when?		1Q2000	Mid/end 2000	1Q2000
How?		Auction	Auction	Competitive Assessment
Commercial Service Launch		1Q2002	1Q2002	Jan-02

According to the most aggressive estimates, rollout of 3G networks could start as early as 1Q2000 in Japan. We believe the licensing process for 3G will make considerable progress over the next 12 months in many markets, particularly in Europe. Decisions about how to price the data services, cost of deployment, nation-wide or selected coverage and how the various 2G, 2.5G and 3G networks tie in will have to be evaluated.

In Europe, Finland has already awarded four 3G licenses. Three of these went to the existing operators (Sonera, Radiolinja and Telia) and one to a group of regional companies called Kolmegee.   (Source: Merrill Lynch)

UK and France are planning to release the spectrum in 1Q2000 while Germany is expected to release in mid/end 2000. Commercial services are expected to launch in 1Q2002 for UK and Germany respectively and Jan 2002 for France.

In Asia-Pacific, Japan, Korea, Australia and New Zealand are most advanced. These countries are expected to release the spectrum in 2000 sometime; the earliest being Japan.

Other countries like Hong Kong, Malaysia and Taiwan are in the process of seeking inputs from industry groups and there are no concrete plans for release yet.

The rest of the countries in Asia-Pacific are adopting a wait-and-see attitude.

On the other side of the globe, in the USA, the FCC is requesting industry comments on the possible use of a number of frequency bands with respect to the identification of new spectrum for 3G wireless. The US has yet to make its draft proposal on spectrum public and has not finalised its position on how much or what additional spectrum should be identified for IMT-2000.

Section 4.2 : Respondents are also invited to comment on any other issues not covered herein that they think are relevant to this review.

Lucent's response:

Introduction

For this section, we would like to present our views on the following issues that we feel are relevant for TAS' considerations :
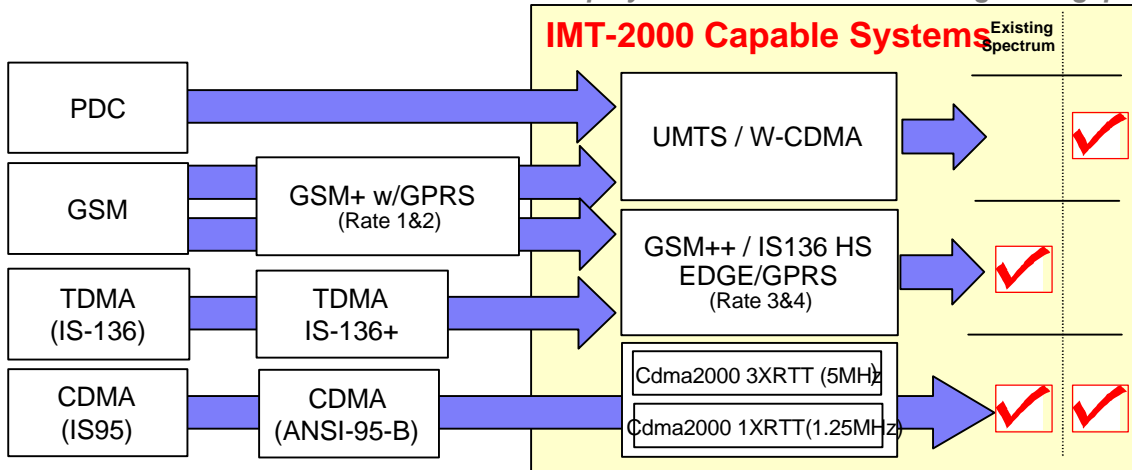
- Spectrum Issues

- 3G Technologies Support and Global Roaming

- Availability of 3G Infrastructure

- Availability of 3G Handsets

1. Spectrum Issues

a) Spectrum Flexibility

As mentioned in our response in section 4.1 (a), ITU, through the World Administrative Radio Conference of 1992, has identified a worldwide allocation of 230 MHz of spectrum in the bands 1885 - 2025 MHz and 2110 – 2200 MHz for IMT-2000.

Although the reason for this specification was mainly to produce a unified standard, this did not happen. Instead we see a family of standards emerging as in the next page.

IMT-2000 Capable Systems Existing Spectrum

PDC			
GSM	GSM+ w/GPRS (Rate 1&2)	UMTS / W-CDMA	✓
TDMA (IS-136)	TDMA IS-136+	GSM++ / IS136 HS EDGE/GPRS (Rate 3&4)	✓
CDMA (IS95)	CDMA (ANSI-95-B)	Cdma2000 3XRTT (5MHz) / Cdma2000 1XRTT(1.25MHz)	✓ ✓

- Lucent supporting multiple 3G Standards (Time Division <u>and</u> Code Division)
  - UMTS / W-CDMA
  - cdma2000
  - UWC-136 / EDGE

- Committed to the evolution all current Second Generation Systems
  - CDMA (IS95), GSM, TDMA (IS136)

As the chart above clearly illustrates, the GSM migration path to 3G has no alternative but to move to a new spectrum range as GSM is fundamentally a different technology from W-CDMA..

However, for cdmaOne (IS-95) systems, there is no requirement to acquire new IMT-2000 spectrum when evolving to 3G.

It is our belief that 3G services should not be restricted to a particular spectrum band. A number of regulatory bodies and operators have associated 3G technology and services only to the 2.0 GHz band. However it should be noted that 3G services can also be provided on the lower frequency spectrum i.e. 800 or 1900 MHz that is currently used for cdmaOne systems. There are a few advantages for using the lower 800 MHz band for 3G, the key advantage being superior RF performance and penetration. Most of the major cdmaOne vendors, including Lucent Technologies, have made known their commitment to develop cdma2000 products for the 800 and 1900 MHz bands.

Hence, in Singapore, the current 20 MHz @ 800 MHz spectrum could be utilised for full 3G services, ie a cdmaOne system evolving to 1XRTT system and then to a 3XRTT system.

Therefore, we would strongly urge TAS to consider licensing out the 800 MHz spectrum for 3G services, in addition to the currently earmarked ITU's IMT2000 spectrum.

B) Bandwidth per operator

In UMTS #5 report on 8 Sep 1998, the UMTS Forum has recommended 2x15 MHz (paired) + 5 MHz (unpaired) as the preferred minimum spectrum requirement per UMTS operator in the initial phase. The allocation of unpaired spectrum is foreseen to handle asymmetric traffic in an optimised way.

Here's a technical summary of the recommendation for TAS' consideration:

- 2x5 MHz will allow a single layer only; a hierarchical cell structure is not feasible in this case.

- 2x10 MHz gives room for a two-layer structure, e.g. a macro cell layer together with either a micro cell layer or pico-cell.

- 2x15 MHz allows the deployment of a complete hierarchical cell structure where the traffic demand is high or a mix of layers such as one macro cell and two micro cells.

- 2x20 MHz allows increased increased flexibility and additional capacity.

Therefore, for optimisation of 3G traffic, Lucent would like to recommend TAS to allocate at least 2x15 MHz per operator.

2. 3G Technologies Support & Global Roaming

Mobile phone users, especially the business users, who are used to the convenience and transparency of roaming on current 2G GSM networks when travelling overseas, will no doubt demand the same feature to be available on future 3G networks.

Theoretically, it is possible in future for global roaming to occur on 3G networks. One of the objectives of ITU spectrum specification is to pave the way for a true global network. However, in reality, this appears to be not likely to happen. As we see in the current 2G technologies, true global roaming is limited to within the same technology. In future, it is possible to have roaming within each standard and its evolutionary path.

Spectrum commonality is only one of the issues in global roaming that ITU tries to solve. Given the current situation, roaming across different standards has not been possible, even though when the spectrum is the same. There are four areas of contention that will need to be resolved before 3G gives full interoperability. They are:

- Network to Network Interface - For inter-working between different core networks. The inter-working between two different core network standards will be critical to enable smooth access to billing, customer care, network management and Intelligent Network functions.

- User Identity Module (UIM) - This is like the current GSM SIM card. It allows for "plastic" roaming, ie a WCDMA phone can roam onto a cdma2000 network or vice versa by just changing the UIM card. This would enable over the air programming of services and applications.

- Radio (Air) Interface - Currently, GSM 2G is not able to roam across to cdmaOne 2G. For roaming to occur over different air interfaces, one solution could be in having a dual-technology handset. As of today, there is no concrete plan for the release of a dual-technology phone. Hence, it is difficult at this moment to predict how and when a development for such a 3G phone will take place.

- Compliance to ITU's spectrum allocation - Global roaming will depend on whether the allocated 3G spectrum in different regions bridges the same frequency bands. For example, in the US, we know that the new PCS licensed operators have used the lower band frequency ranges that were allocated to 3G technology by ITU. However, within the same radio interface standard, dual or triple mode handsets can minimise issues. The real obstacle to true global roaming is the different radio interface standards.

Singapore is a key business and financial hub in the Asia Pacific region. Many mobile users from all over the world travel to Singapore for business and leisure. Lucent believes that

TAS should be flexible in the issuance of licensing conditions and allow the deployment of any of the major 3G technologies in Singapore. Potential 3G operators should not be restricted to a particular band or technology, as market forces will ultimately guide them in their choice.

3. Availability of 3G Infrastructures

By all aggressive estimation, the industry predicts that cdma2000 1XRTT infrastructure will be available in the second half of 2000 (with data rate of up to 144 kbps). Following that, cdma2000 3XRTT with data rate of up to 384 kbps would be available in early 2002.

In Japan, WCDMA infrastructure is expected to be available in the beginning of 2001 (with data rate of less than 384 kbps).

The table below gives an indication of the 3G infrastructure availability.

Infrastructure Evolution Timeline

GPRS Phase 1 (43.2 kbps) – 3Q 99

GPRS Phase 2 (86.4 kbps) – mid 2000

WCDMA – ARIB (384 kbps) – early 2001

WCDMA – ETSI (more than 384 kbps) – mid 2001

Cdma2000 1XRTT – Korea (> 64 kbps, < 144 kbps) – 2nd half of 2000

Cdma2000 1XRTT – Japan (closer to 144 kbps) – mid 2001

Cdma2000 3XRTT – Japan (>144 kbps, < 384 kbps) – 2Q2002

4. Availability of 3G Handsets

As 2nd generation operators start to deploy 2.5G networks today, the issue on the availability of handset becomes more critical.

CDMA2000 1XRTT

Qualcomm has indicated that they will have prototype 1XRTT chips available in 4Q1999 and production volumes should be ready in early 2000. Qualcomm expects to release its first 1XRTT phones later in 2000. (Source: CDMA World)

Samsung has also announced that they are developing core semiconductor chips for IMT-2000 handsets. Commercial product launch of handsets is expected by mid-2000.

GPRS

Today's industry will probably see GPRS handsets being pushed out to the market in the second half of 2000. Full 115 kbps speed will likely not be available in the initial handset releases.

Handset Availability of GPRS Handsets

	Prototype Availability/Testing	Commercial Availability
Motorola	End 1999	2Q2000
Ericsson	Late 1999	2nd Half 2000
Nokia	1Q2000	2nd Half 2000
Alcatel	1999	End of 1st half 2000

(Source: Merrill Lynch)

WCDMA/UMTS

Given that Japan is planning to commercially launch WCDMA services in April 2001, we would expect WCDMA handsets to be available around the same time-frame.