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Views and Comments to IDA Consultation Paper

Flarion Technologies, Inc. is honored to share our views and comments with the Infocomm Development Authority (IDA) of Singapore regarding the deployment of wireless broadband technologies.

Comments – Section 1 and 2

IDA welcomes views and comments on the potential of and benefits arising from the deployment of wireless broadband technologies, the likely services/applications to be deployed and the potential demand from businesses and consumers

FLARION COMMENTS:

Potentials and Benefits

Both cellular voice and broadband data have altered the way we communicate in the business, lifestyle and public safety environments. There are well over 1 billion cellular phone subscribers throughout the world – all of which are attracted by the freedom of ubiquitous telephony access (CTIA - 2003). Additionally, 64 million users across the globe subscribe to wired broadband services (ITU - Sept 2003), with global business dominated by such access.

Mobile, wireless broadband will combine the attributes of cellular communications (ubiquitous access, voice capability, full vehicular mobility and wide area coverage) with those of wired broadband (high speed data access - >1 Mbps to the typical user, low latency <50 ms, and always on connectivity) to increase overall productivity, enhance our lifestyles, and improve public safety.

The market opportunity for a wireless wide area network that offers this LAN-like wireless broadband experience is enormous. There are approximately 100 million mobile/remote workers worldwide. Imagine if these workers and a billion others were offered a truly mobile broadband connection!

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Services

Services that will drive initial demand of mobile, wireless broadband will mirror those enabled by wired broadband technology - web browsing, email (with large file attachments), file transfer, Virtual Private Network (VPN) access, Customer Relation Management (CRM), online audio and video, video conferencing, online gaming and a multitude of others. Additionally, cellular IP voice is introduced (in the FLASH-OFDM mobile broadband system), which means instant voice services and more flexible voice capabilities than circuit-switched voice solutions (3G). Finally, imaging services such as wireless video surveillance and IP camera capture and transfer is demanded by certain industries (real estate, security, insurance, financial), and the entire public safety community. With full mobility, users have everywhere broadband access - at home, at work, and anywhere in between (backyard, backseat, nearby park , etc.).

Business demand

In business, productivity, cost and revenue motives continue to drive decision-making. The massive productivity gains in offices around the world introduced by the Local Area Network (LAN) and Internet connectivity have been historic, but also restricted to people sitting behind a desk. The ideal wireless solution extends the LAN to 'wherever the user goes', thereby unlocking the incremental productivity benefits associated with anytime, anywhere access.

However, with any wireless broadband solution, all the applications (MS Office, MS Outlook, Internet Explorer, File Transfer, Email with large attachments) must perform as they do on the corporate desktop if demand is going to materialize. This means the same high speeds and low delays - but with added mobility and always on access.

Different industries will make use of mobile connectivity in different ways. For one, business users around the world are becoming more mobile with globalization and telecommuting, as well as more PC literate. Laptops and other wireless devices continue to capture market share away from desktop PCs.

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Consumer demand

The consumer segment defines the mass-market opportunity.

Recent statistics[1] have arisen to support the notion that consumers will adopt mobile broadband data at the right price point and if given compelling "always-on" applications, provided the experience is as good as on wired broadband networks. Imagine children playing online games in the backseat using a wireless broadband connection. Imagine downloading audio clips while at the beach. Imagine web browsing at a nearby park. The possibilities of mobile broadband are limitless.
A number of applications that currently drive wireline usage are particularly suited for the mobile environment:

	Broadband	Mobile
Online Gaming	- 11% of broadband usage dedicated to gaming - 50m people globally played online games in 2001 alone	Over 100m GameBoy® devices shipped to date
Streaming Audio/Music	- 17% of typical broadband usage consists of online music - 50m people in U.S. have downloaded music/MP3s	Over 30m portable audio devices and over 600k MP3 players sold each year. Over 2 million IPODs sold to date.
Digital Imaging	- 14% of typical broadband usage consists of displaying/developing photos - 17% of Internet users have posted photos to the Web	20 million digital cameras sold globally in first 6 months of 2004

Other data applications ideal for consumers in the wireless environment:

- High speed web browsing
- Email
- Mcommerce
- Instant Voice and Messaging

[1] Sources: Consumer Electronics Association, DFC Intelligence, InfoTrends, Ipsos-Reid, Jupiter Media Metrix, McKinsey, Nintendo, Pew Internet & American Life Project

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Comments - Section 3

IDA welcomes views and comments on the allocation of the 2.3 GHz and 2.5 GHz bands for wireless broadband technologies and the harmonization of spectrum at the border areas. What are the coexistence issues that need to be considered with regards to the deployment of systems (FDD & TDD) in the same geographical area in adjacent frequency blocks, and the deployment of systems across geographic boundaries in the same frequency blocks? What are the technical assessment and methodology to be used for the deployment and coordination of systems, including separation distances, power spectral flux density limits, out-of-band-emission limits, frequency guard bands etc, to ensure coexistence of system operations? What are the mitigation techniques that could be employed in case of co-channel interference between systems operating in adjacent geographical areas? Does the 5 MHz, 5.5 MHz or 6 MHz channeling plan for the 2.3 GHz band and the 2.5 GHz band meet industry requirements? What is the appropriate duplex separation (Transmit/Receive) for the FDD wireless broadband technologies in the 2.3 GHz and 2.5 GHz bands respectively? What are the minimum, as well as optimal amount of spectrum required by an operator for specific geographical deployment or nationwide deployment? Please provide supporting reasons for each comment and proposal made.

FLARION COMMENTS:

Please see attached whitepaper titled FDD vs. TDD and response to next section (Section 4 – 4.4)

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Comments - Sections 4 – 4.4

IDA welcomes views and comments on the key features and service obligation to be applied for auctioning the spectrum for the deployment of wireless broadband technologies. If the key features are not appropriate, please provide supporting reasons why they are not.

FLARION COMMENTS:

As Mobile Operators move forward with plans to market mobile broadband services to enterprises and consumers, they must be certain that the technology they chose will allow them to offer the user experience that their customers will come to expect. If they are to succeed, operators must be able to offer users a wireless broadband experience that has the same look and feel of wired broadband, with access to all existing web sites and applications.

Most experts agree that high-speed, mobile broadband requires an all-IP and packet-switched system. In addition, that system must meet other unique requirements if a mobile operator is to realize profitable economics. The following is a list of key attributes that a network must have to ensure a mobile operator will deliver true mobile broadband:

1. support all existing wireline applications, with no changes to applications, devices, protocols, and content

2. all-IP and packet-switched, and leverage existing standard-based architectures, all the way to the device

3. broadband data rates: 1-1.5Mbps typical downlink user experience and 300-500kbps typical uplink user experience

4. minimal latency (less than 50ms) to support interactive applications

5. end-to-end IP Quality of Service (QoS) that maximizes revenue through tiered services, and protects from overload

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6. transparent access between wired LAN, wireless LAN and wireless WAN

7. support packet voice applications and "instant voice" services

8. natively support multicast for bandwidth efficiency, and streaming applications

9. provide high, end-to-end security in the challenging mobile broadband environment

Below is additional details regarding each of these nine points.

1. A Network must support all existing wireline applications, with no changes to applications, devices, protocols, and content

The cellular industry did not invent the voice application, it simply unwired it. In exactly the same manner, a mobile communication system should unwire the Internet without re-inventing or re-writing the killer application – the Internet itself.

In addition, the data transmission protocol suite most widely used for the Internet- TCP/IP, must be supported without the need for special translators or filters. To support this, the system must be all-IP and packet-switched. TCP/IP, which stands for Transmission Control Protocol / Internet Protocol, was designed and optimized around reliable wireline links. Mobile wireless communications has traditionally posed a difficult performance challenge for TCP/IP protocols because bit and packet error rates are substantially lower in wireline than they are in wireless communications. When TCP encounters dropped or lost packets in a wireless environment, it assumes that there is congestion on the link, and slows the transmission down to a crawl. This translates to delays for the end-user. If the system airlink is optimized for data transfer, TCP/IP runs smoothly and efficiently over it. There is no need for new protocols, applications, or devices; it is just plug and play.

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2. A Network must be all-IP and packet-switched, and leverage existing standard-based architectures, all the way to the device

The industry community agrees that successful high-speed, mobile data requires an all-IP, packet-switched network. An all-IP network is much more cost effective than the traditional circuit-switched approach (e.g. costs associated with IP technologies are far less than those associated with implementing and maintaining circuit-switches). In addition, the system should use existing standards-based IP. It does not require complex and costly unique translators, gateways, protocol converters, and proxies, as is the case with most next-generation technologies that are not IP-based. It should then be able to take advantage of the many advances in IP QoS, Optical, Ethernet and Multi-Protocol Label Switching (MPLS) technologies, thereby using existing, non-proprietary components to build its network.

3. A Network must support broadband data rates: 1-1.5Mbps typical downlink user experience and 300-500kbps typical uplink user experience

To support the experience that users have come to expect on their wired network, a mobile network must deliver a broadband connection. The network must meet the following criteria:

User Data Rates:
Downlink: Peak burst rate –3 Mbps
Downlink: Typical user experience –1 to 1.5 Mbps
Uplink: Peak burst rate –900 kbps
Uplink: Typical user experience –300 to 500 Kbps

4. A Network must have minimal latency (less than 50ms) to support interactive applications

Besides throughput, a low latency characteristic is vital for network operators to provide a user experience similar to today's wired broadband technologies. Latency is defined as the time it takes for the network to respond to a user's command. If a system's latency is high, creating a delay of several seconds to

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download a Web page, than the experience feels nothing at all like broadband, no matter how high the data rates are. The system must be optimized for data transmission and provide a fraction of the delay in setting up the data link (downloading a web page) than proposed next generation systems.

In addition, interactive applications such as gaming, video and VoIP require that a network's latency be less than 50ms. For circuit-switched technologies, it becomes a challenge. Other proposed systems, with their complex, circuit-based designs, have delays between 250 and 500 ms.

5. A Network must support end-to-end IP QoS that maximizes revenue through tiered services, and protects from overload

Efficient IP QoS prioritizes users based on service class, thereby stretching available bandwidth, maximizing revenues per subscriber, and providing network operators with an alternative to over provisioning. Revenues per hertz of radio spectrum are also maximized. In addition, QoS enables the operator to offer differentiated, multiple classes of service in much the same way that airlines distinguish among their various classes of service.

The system should support efficient IP QoS by placing it over the airlink, creating a non-contention-based system that assigns a priority to each packet, with those users paying the most for service getting the highest priority. Therefore, traffic moves in an orderly manner. With circuit-based systems, each packet is identical (according to these systems, all packets are created equal), making the uplink contention-based. As a result, traffic has to slow down before it reaches the control channel. Because each packet is trying to get onto the "highway" at the same time, congestion occurs, causing the user to experience significant delays.

6. A Network should support transparent access between wired LAN, wireless LAN and wireless WAN

The ability to support seamless access between wired Local Area Networks (LANs), Wireless Local Area Networks (WLANs) and Wireless Wide Area

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Networks (WWANs) is becoming a critical component for network operators. The system should allow a seamless handoff between 802.11 (Wi-Fi) and the WWAN technology. This transparent access allows enterprise users leaving their corporate locale to continue their wireless broadband session without having to disconnect service. With this capability, network operators will be well positioned in the enterprise space.

7. A Network should support packet voice applications and "instant voice" services

Voice networks are rapidly evolving to a pure-packet approach. VoIP technologies offer price points that circuit-based technologies cannot reach. The system should support Packet voice through an industry standard called Session Initiation Protocol (SIP), which is a revolutionary protocol designed to make VoIP easier, more flexible and cheaper. As data devices offer improved voice capable platforms, and as VoIP voice quality continues to move closer to being on par with circuit-switched service, pure packet voice will become the norm in the industry.

VoIP also allows for multi-tier marketing (different levels of voice quality) through IP QoS. Circuit-switched voice technologies do not. The system should support "instant connect" services (voice and video) such as those used in two-way radios (i.e. "push to talk").

8. A Network should natively support multicast for bandwidth efficiency, and streaming applications

Multicast is defined as communication between a single device and multiple members of a device group. The circuit-oriented nature of today's cellular/ mobile networks require that data be delivered to mobiles *individually*, thus destroying the multicast economies of scale as multiple copies of the same multicast packet must be sent over the air to mobiles in a given cell. The airlink should natively support both multicast and broadcast at the link layer, enabling bandwidth-efficient, economically viable delivery of multicast traffic to mobile users. Multicast can be put to economic use in streaming applications such as

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broadcast audio and video, global data dissemination applications such as stock quote delivery, and interactive applications such as group-based gaming, chat, and instant voice services.

9. A Network should provide high, end-to-end security in the challenging mobile environment

Access must be made secure in the mobile data environment. To support this, the system design should be secure at the link layer, while enabling end-to-end security at the application layer. Industry standard authentication algorithms and encryption ciphers will be used for link layer protection, while SSL (Secure Sockets Layer), IPSec (IP Security) or other end-to-end mechanisms, are enabled for strong security at the application level. SSL is extensively used at the application layer for authentication and data encryption between a web server and a web browser, while both SSL and IPSec are widely used for VPN access.

The system should secure the air interface by supporting strong user/device authentication and data encryption. Authentication is achieved based on secret information shared only by a mobile device and its home AAA server. The mobile and the AAA server use a lightweight protocol to mutually authenticate each other prior to the mobile being granted access to network services. Session encryption keys are derived from this authentication phase, and are used to encrypt user and control data over the air interface.

Upon handoff, a mobile's s session encryption keys and authentication information should be securely transferred from one base station to the next. This makes handoff expeditious while still secure, by avoiding contact with the AAA server and using the fast and secure IP network that the base stations are connected through.

In short, the network should be transparent to any application-based encryption, providing high, end-to-end security for web-based financial transactions.

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Comments - Sections 4.5 – 4.6

IDA welcomes views and comments on whether spectrum should be auctioned in generic lots or in blocks with specified frequencies; the appropriateness of the lot sizes; and the maximum amount of spectrum to be set.

FLARION COMMENTS:

For a wide area mobile system, the preferred frequency allocation is a paired duplex (FDD) format. The spectrum allocated will depend on the amount of spectrum available and the number of potential bidders. The spectrum should be auctioned such that the owners can provide service independent of other providers, without the need for coordination among service providers for a wide area operation. In an FDD mode blocks, with preferred UL/DL separation of at least 70 MHz, preferably more than 100 MHz, to enable smaller and lower price devices. 10MHz blocks (2x5 MHz) are the minimum block size that should be used. Power limits should be consistent with 3G mobile systems.

Comments - Sections 4.5 – 4.6

IDA welcomes views and comments on the deployment of wireless broadband technologies in the 3G spectrum bands. Are there any technical considerations that the IDA should consider? Please provide detailed supporting reasons for each comment and proposal made.

FLARION COMMENTS:

The emissions rules should be set to allow for reasonably priced mobile devices. Ideally, the rules for 2.3 and 2.5 will be the same as in the 2G and 3G spectrum.

Users should have access to a data network that offers the same experience as their wired desktop, but with full wide area mobility. This is critical to unwiring demand for wireless broadband service.

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Comments - Section 6

IDA welcomes views and comments on the eligibility of existing 3G and broadband infrastructure providers for the 2.3 GHz and 2.5 GHz spectrum, and the limit on the spectrum amount for which they could bid.

FLARION COMMENTS:

Economic rationale exists for keeping the spectrum independent of technology / vendor and not mandating the use of any specific technology. The eligibility should be completely open and let the market decide what the spectrum is worth and who should get it.

Comments - Section 7

IDA welcomes views and comments on whether there are issues that may pose problems to achieving transparent and seamless interconnection and open access. IDA further seeks comments on the type and level of Quos standards that will be appropriate and whether the existing set of QoS standards for broadband service providers are applicable for service delivery using wireless broadband networks. Please provide supporting reasons for each comment and proposal made.

FLARION COMMENTS:

The FLASH-OFDM system enables full and open interconnection with any existing IP-based network. Mobile wireless broadband systems such as FLASH-OFDM make use of bandwidth-constrained, licensed spectrum for access, which can easily become congested during periods of heavy utilitization due to user application usage and/or mobility. Consequently it is not possible to guarantee that all network access will meet the desired latency bounds more typical of wired broadband networks. The FLASH-OFDM QoS Architecture is IP-based, making use of FLASH-OFDM Service Class IP QoS over the air interface and DiffServ IP QoS throughout the remaining internetwork (including the backhaul link).

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Comments - Section 8

IDA welcomes views and comments on the Market Trial Licence framework and the specific features set out in Annex 2. Is the Market Trial Licence framework conducive in helping market participants test the commercial viability of innovative service? Are there additional issues that IDA should consider? Please provide detailed supporting reasons for each comment and proposal made.

FLARION COMMENTS:

Flarion would supply the technology and equipment for a market trial. We would work with a mobile operator for a market trial, so the mobile operator would need to secure the license and manage the trial. However, given our experience with working with other operators around the world, this market trial license scheme seems reasonable.