Enabling Wireless Applications
including Fixed Mobile Convergence

Portable Computer and Communications Association

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Introduction

The mobile computing and wireless industry has become a major force in the global economy, with tremendous growth and future potential. However, interdependencies between networks, devices, operating systems and applications are creating tremendous complexities. Only through concerted efforts can the full potential of these technologies be realized. Nowhere is this more true than in areas such as fixed-mobile convergence, where multiple architectures can be employed to achieve complex functionality spanning multiple vendor systems, mobile platforms, radio access networks, core networks and enterprise systems.

The Portable Computer and Communications Association (PCCA) is playing a leading role in highlighting the issues and possible solutions for complex systems such as FMC. The PCCA will specifically examining FMC as part of its 2008 project plan. This includes a meeting in Dallas on February 19-20.

Fixed Mobile Convergence

Concurrent with radio technology evolution, wireless technologists are working on seamless operation across multiple types of networks (convergence), as well as moving all services and applications to IP protocols.

The term “convergence” has been with us for some time, and it’s meaning has changed. The latest emphasis is on fixed-mobile convergence. The goal of FMC is a tight integration of applications, including voice and data, across disparate networks. FMC goes hand in hand with wireless evolution for a number of reasons. First, the move to packetized voice, combined with QoS capabilities in both wide-area and local-area networks facilitates FMC. Second, as wireless-data services become more widely used, carriers will become anxious to hand off data sessions to higher-capacity wireless LANs whenever possible to maintain capacity in the wide area for truly mobile users. FMC can also address problems of indoor coverage, and can enable new creative calling plans.

One FMC approach is to hand off voice calls between cellular and Wi-Fi networks, with a common phone number and common underlying services, e.g., voice mail and data

services. This provides a number of benefits, including coverage inside buildings, homes or businesses, where Wi-Fi may be available, but a cellular signal is weak or unavailable. Another benefit is being able to offload minutes from the cellular network, which cost more, to a private network. There are two standards supporting this type of FMC, including Unlicensed Mobile Access (UMA) and IP Multimedia Subsystem (IMS). There are also Wi-Fi centric approaches involving gateways between IP PBXs and Wi-Fi networks.

A completely different approach to FMC is with femto cells which are small low-cost base stations installed at customer locations that use carrier licensed frequencies, and that operate at low power levels. There is a considerable amount of industry debate about which FMC approach makes most sense. Neither has a clear overwhelming advantage over the other, and likely both approaches will become common.

FMC will be facilitated by the move to all IP architectures. All advanced wireless systems today, including UMTS, EV-DO and WiMAX can support voice in the IP domain, at least in their most recent specification releases, though cellular systems today still handle voice in a circuit-switched mode. However, all 4G systems will handle all communications strictly as IP traffic. While FMC and 3G systems integration will occur on a case by case basis across enterprises and carriers, it will be a fundamental aspect of 4G deployment.

FMC makes a lot of sense for both users, businesses and carriers, but it is a complex undertaking, requiring new infrastructure in both carrier and enterprise networks, and new capabilities in handsets, not to mention new business models. Like mobile broadband, many are bullish on the technology, but widespread deployment will likely take longer than many in the industry would like. There are baby steps today from carriers and vendors, but it may be 2010 before there are interoperable and cost-effective solutions available.

Nevertheless, fixed-mobile convergence is slowly becoming a reality as multi-mode (e.g., cellular and Wi-Fi) devices become more common. The PCCA will be holding a meeting in February whose purpose is to assess the current state of this technology, key issues, implications on devices, operating systems and networks, and likely industry directions moving forward.

The meeting will address questions such as:

1. What is the status of key standards enabling fixed mobile convergence?
2. What are all the types of fixed-mobile convergence approaches?
3. What are the benefits of these systems?
4. What is the degree of interoperability in today's systems; what components are proprietary?
5. What are the pros and cons of dual-mode systems versus femto cells?
6. How are IP PBXs evolving to support FMC?
7. What are the greatest technical obstacles towards wider adoption?
8. What are the pros and cons for enterprises for systems that they control versus operator-hosted systems

Meeting presenters, and many of the attendees, are world leading technologists on the subject material. The PCCA allocates sufficient time for discussion so that attendees can ask questions of greatest interest. Moreover, the meeting and workshop will allow informal networking during breaks where attendees can exchange important information. Information about the meeting is as follows.

Meeting. February 19, 2008. 8:30 AM to 4:30 PM.

Meeting attendees obtain access to all content presented at the meeting and detailed minutes.

The agenda is as follows:

- 9:00 to 9:15 Peter Rysavy, Executive Director, PCCA. Introductions. PCCA meeting schedule and association update.
- 9:15 to 9:45 Host company presentation.
- 9:45 to 10:30 Tammy Wheat, Director Ericsson Enterprise Solutions, Ericsson. "FMC Architectures, Technical Approaches, Product Strategies and Business Models"
- 10:30 to 10:45 Break
- 10:45 to 11:30 Sriram Parameswar, Microsoft. Microsoft Office Communications Server and FMC.
- 11:30 to 12:15 Qualcomm. IMS Voice Call Continuity (VCC) and chipset implementation.
- 12:15 to 1:15 Lunch
- 1:15 to 2:00 George Fry, Director, Technology Alignment, Nokia. "Device Considerations and Nokia Experience with FMC Deployments."
- 2:00 to 2:45 Smith Micro. "IMS Voice Call Continuity: Standards, Mechanisms, Implementation and Deployment"
- 2:45 to 3:00 Break
- 3:00 to 3:45 Håkan Andersson, Vice President & Chief Technical Officer, Ericsson. "3GPP LTE update and FMC Enablement."
- 3:45 to 4:30 Discussion and analysis.

Workshop. February 20, 2008. 8:00 AM to 12:00 PM.

This will be an open workshop format where vendors/attendees can demonstrate their capabilities and technologies, test for interoperability, and gain hands-on experience with these systems. The workshop also provides an excellent opportunity for participants to informally discuss matters of interest. The PCCA is also planning on having an LTE demo available for workshop attendees.

Future Meetings

Future PCCA meetings planned for 2008 will include further examination of FMC, as well as:

Open Wireless Networks. This meeting will examine developments to make wireless networks and devices more open, including what it means to be open, issues raised for carriers and vendors, and opportunities generated.

Mobile WiMAX. Assessment of current WiMAX capabilities and directions, including hands-on workshop.

Personal Area Developments. Examination of directions, standardization, applications, and issues with UWB, Wireless USB, NFC, Bluetooth and related technologies.

Ultra Mobile PCs. Platforms, architectures, operating systems, applications.

Prior Meetings

This section summarizes the meetings that the PCCA has held over the time period 2000 to 2007. Further details of these meetings are available at http://www.pcca.org/news/news.htm.

Multi-Radio Wireless Devices. October 10, 2007. San Diego. Hosted by Novatel Wireless. RF considerations, antenna considerations, connection managers, OS support, application management, co-existence protocols.

HSPA. June 12-13, 2007, Dallas, TX. Sponsored by 3G Americas. This meeting and workshop will focus on latest HSDPA/HSUPA capabilities, devices and applications. The meeting will also examine developments in Evolved EDGE, HSPA Evolution and 3GPP LTE. HSPA workshop June 13 hosted by AT&T.

CDMA2000 EV-DO Rev A Meeting and Workshop. February 27-28, 2007, San Diego, CA. Hosted by QUALCOMM. This meeting will emphasize EV-DO Rev A, but will also examine evolution of CDMA2000, details of the technology, capabilities, devices and applications.

Mobile Computing Policy. September 20, 2006, Seattle, WA. Hosted by NetMotion Wireless. This meeting will examine mobile computing policies that dictate what networks to use, which applications have access and other aspects of connectivity.

IP Multimedia Subsystem (IMS). May 17, 2006, Boston, MA. Hosted by Tatara Systems. The meeting will cover current industry adoption and directions, architecture and protocols, application road map, standards, interoperability, issues and opportunities. This will be a full-day meeting.

Municipal and Mesh Wi-Fi Networks. Feb 2, 2006. San Francisco, CA. Hosted by iPass. The meeting will examine deployments, technologies, architectures, standards, relation to other networks such as 3G and WiMAX, interoperability, best applications, and recommendations for best growth of this market.

Embedded Wireless WAN. September 13, 2005. San Diego. Hosted by Sierra Wireless. Interoperability, standardization, issues and opportunities.

Connection Managers. May 12, 2005, Seattle, WA. Hosted by NetMotion Wireless. Connection managers, wireless management interfaces for applications and other items affecting the user experience with wireless networks.

Ultra Wideband. Feb 1, 2005, San Francisco, CA. Hosted by MCCI. Ultra Wideband (UWB) and related technologies, including Wireless USB.

UMTS. November 16-17, 2004. Redmond, WA. Hosted by Cingular Wireless. UMTS and HSDPA. Meeting and workshop.

Wireless Optimization. June 16-17, 2004. Hosted by Flash Networks. Newark, New Jersey. Wireless Optimization, including TCP optimization, Web acceleration, e-mail acceleration, and VPN optimization.

1xEV-DO. February 11-12, 2004. Hosted by Qualcomm. San Diego, CA. Topic: 1XEV-DO (and 1XEV-DV) in detail, including interoperability workshop.

Hotspots. November 12 , 2003. Hosted by iPass. San Francisco Bay Area. Topics: Hotspot Technical Developments, Service Continuity.

EDGE. August 19-20, 2003. Hosted by Cingular Wireless. Indianapolis, IN. Topic: EDGE technology in detail, including interoperability workshop.

Tethering and PANs. May 28, 2003. Redmond, WA. Hosted by Microsoft. Topic: Tethering and personal-area networking developments including Bluetooth, IR, USB and ultra wideband (UWB).

Mobility. Feb 4-6, 2003. San Francisco, CA. Special joint meeting with The Open Group. Topic: Mobile IP, Application Persistence and Roaming. Special workshop: Enterprise adoption of Cellular Data - Barriers and Solutions.

Hotspots. November 6, 2002. Research Triangle Park, North Carolina. Hosted by IBM. Wireless hot spots: client considerations and cellular integration.

Enterprise Applications. July 16, 17, 2002. Redmond/Bellevue, Washington. Hosted by Intel. Enterprise applications and cellular-data networks. GPRS workshop on July 16, hosted by VoiceStream Wireless.

CDMA2000. April 24, 2002. San Francisco, CA. Hosted by Qualcomm. CDMA2000, Wireless VPNS, Wireless Security.

Multi-Network Integration. January 16, 2002. Las Vegas, NV. Hosted by NetMotion Wireless. Integration of wireless personal-area, local-area and wide-area networks.

Java. November 7 2001. Java for mobile platforms: interfaces, application considerations, interoperability.

Wireless PDAs. August 23, 2001. Redmond, WA. Hosted by AT&T Wireless Services. PDA Platforms and Wireless Networking.

GPRS. May 23, 2001. Boynton Beach, Florida. Hosted by Motorola. GPRS Interoperability.

Interoperability. February 7 and 8, 2001. Maui, Hawaii. Joint meeting with Mobile Computing Promotion Consortium of Japan. Wireless Data Interoperability.

Mobile Management. October 18. Santa Clara. Mobile Management. Co-hosted by the Wireless Data Forum and the Open Group.

Interfaces. August 23, 2000. Redmond, WA. Wireless Device Interface Issues

Wireless Standards. May 31, 2000. Chicago. The Impact of Internet Standards on Wireless Networks

VPNs. March 1, 2000. New Orleans. VPNs and Wireless

Historical Projects

PCCA STD-101 - Wireless AT Commands

This standard, the first major achievement of the standards committee, addresses how the AT command set (normally used for controlling modems) can be extended into wireless environments. One key aspect of this standard is its concept that the wireless modem may have a connection to one (or more) of many different types of wireless data networks, and provides a mechanism (the +WS46 parameter) for the attached computer to query or set the type of wireless network used.

Using STD-101, developers of communications applications can use a consistent set of commands to control wireless modems, irrespective of the modem manufacturer and the type of network being used.

STD-101 was submitted to the TR30.2 subcommittee of the TIA as a contribution and has subsequently been published as TIA standard 678. Key portions of this standard

have been incorporated into Microsoft's modem implementation guidelines, GSM data standards from the European Telecommunications Standards Institute as well as standards of the International Telecommunications Union (ITU) which is the leading world body for communication standards. PCCA STD-101 has been implemented in a number of wireless modems being sold today.

A number of annexes have been developed for STD-101. One of these covers miscellaneous commands related to wireless networks, such as for signal strength, registration status, battery level, and antenna selection. Another covers the use of packet assembler/disassembler functions in a wireless modem, and the most recent annex addresses AT commands for Cellular Digital Packet Data (CDPD) modems. These annexes are also being incorporated into TIA-678.

STD-201 - Wireless Extensions to NDIS

The PCCA worked closely with Microsoft to develop a standard that specifies a set of wireless extensions to NDIS (network driver interface specification). NDIS defines an interface between protocol stacks (or network management software) and underlying networking systems. See figure one. With NDIS, a protocol stack can use the same interface in the same way to communicate across any network for which an NDIS driver is available. The NDIS driver is supplied by the network hardware vendor, e.g., Ethernet card vendor or wireless modem vendor. In effect, the NDIS driver translates between standardized networking functions and the proprietary hardware interfaces of the network adapter.

The goal of the wireless extensions was to add useful information regarding wireless networks. Using the extensions, applications and protocol stacks can know what wireless connections are available, can choose between them, and can monitor network conditions. For example, using the NDIS extensions a mobile computer could determine that it is no longer in coverage of a wireless local-area network and could automatically switch to a wide-area network connection. Applications could then automatically reconfigure themselves for the lower bandwidth. For instance, an e-mail application might no longer download large attachments unless explicitly directed by the user.

TCP/IP Recommendations for Wireless Networking

TCP/IP has evolved over the years to operate reliably over many different types of networks. But wireless networks present a new set of challenges that can affect the reliability and performance of TCP algorithms. For example, variable latency is common with wireless-data communications, and can occur when a weak radio signal or heavy interference causes packets to be retransmitted multiple times before they are received without error. TCP incorrectly interprets such delays as network congestion, and throttles back the rate at which it transmits data. The result is significantly lower throughput than the channel itself provides.

Recognizing these types of problems, the PCCA developed a set of recommendations for how TCP/IP should be implemented to handle wireless connections. These recommendations encompassed experience gained by member companies using Mobitex, CDPD and the Metricom Ricochet Networks. A technical discussion of the most important recommendations is as follows:

- Adjustable parameters. Stack parameters should be adjustable. Wireless-aware applications can then make the adjustments they need for optimal performance.

Different wireless networks may need values adjusted differently. Some specific parameters are discussed next.

- Window size. TCP/IP connections over different wireless networks work better with different window sizes. Metricom found that a 16 Kbyte window size gives the best performance for their Ricochet network. For other networks, a smaller size may be better.
- Slow start. How "slow start", the way TCP gradually increases the rate at which it transmits data, is implemented in a stack can make a large difference in performance over wireless connections. What can help slow start is to set the initial congestion window to allow for at least two packets to be sent. Since many stacks only acknowledge every other packet, this will prevent a delayed acknowledgement, which could otherwise result in a retransmission. One way to accomplish this is to set the initial congestion window to at least twice the maximum segment size.
- Round trip time. Due to higher latencies in wireless networks compared to LANs and wireline WANs, too low an initial setting will result in retransmissions. Higher values such as four seconds work better for some wireless networks. It can also be set by TCP based on knowledge of the link speed.
- Quick recovery. The Van Jacobsen Quick Recovery algorithm should be implemented. Three identical acknowledgements constitute a reasonable trigger value.
- Maximum segment size (MSS). Maximum size should be set through a process of Maximum Transmission Unit (MTU) discovery. Starting with a large value (e.g. Ethernet frame size), TCP can send data with the "don't fragment" bit set. If it receives an ICMP (Internet Control Message Protocol) message from a router indicating an error, it can reduce the size and try again.
- Dynamic link recovery. It is common with wireless connections to lose the radio link for short intervals of time. If the layer-two link can be quickly reestablished without dropping the layer-four TCP connection, users will find the connection to be more reliable and more convenient. Such a capability though it is not a trivial undertaking. At the minimum the stack should prevent the link from being easily dropped.

IP Modem

Another specification developed was a packet interface between computers and wireless modems. The intent was to make it possible to support multiple data streams simultaneously, allowing a user for example to have simultaneous voice, data, fax and messaging connections with future multimedia wireless phones. Current interfaces only allow for one active-data type. The standards committee decided to base this interface on Internet Protocols. The advantage of IP is that it readily supports multiplexing of multiple data streams. Another advantage is that nearly all computers already have IP protocol stacks, so no specialized software or drivers will be required to take advantage of next generation wireless modems that implement this standard.

The way that IP modem works is that once in an online mode, data is transferred between the mobile computer and the IP Modem using IP over a suitable link protocol such as PPP. Within the IP Modem, an internal IP router then directs datagrams to appropriate "service agents" within the modem. Some of these service agents provide

local services such as a directory. Others provide connectivity to external networks, which may or may not be based on IP communications.

About the PCCA

Founded in 1992, The Portable Computer and Communications Association is a non-profit trade association whose mission statement is to promote interoperability and deployment of mobile computing and communications through standards, recommendations, testing, education and technical assessment. PCCA members include wireless carriers, wireless device vendors, computer companies, infrastructure vendors, and networking companies. Membership is open to all companies and individuals with an interest in these disciplines. For information on PCCA committees, standards and membership, visit the Web site http://www.pcca.org.

