3GPP UMTS Release 5 – Ethernet vs ATM: Why not both?

By Michael Gyger

This article explores the layer 2 protocol choices faced by Telecom Equipment Manufacturers (TEMs) of deploying IPv6-based services on either Ethernet or Asynchronous Transfer Mode (ATM) lower-layer protocols in 3rd Generation Partnership Project (3GPP) Universal Mobile Telecommunications Systems (UMTS) Release 5 networks. The focus is on extolling the virtues of providing PCI Industrial Computer Manufacturer's Group (PICMG) CompactPCI standards-based solutions that allow co-existence of both Ethernet and ATM protocols in a 3GPP – Release 5 UMTS wireless network.

ATM cells, Ethernet packets – all are currently being deployed today in the wireless infrastructure under the guise of ATM AAL2, IPoATM, and IPoHDLC. As if this wasn't confusing enough, many are now trying to develop new fabric solutions to add to the confusion. It's time to get back to basics. An "ALL IP" network composed of both Ethernet and ATM provides the optimal hybrid solution needed to deploy a seamless UMTS Release 5 wireless capable of signaling, management and transport of data, voice, and video in a cost-effective and seamless manner.

Today in the wireless network: ATM in 3GPP wireless networks

Release 99 – ALL ATM 3G Networks

The 3GPP took the bold step in their UMTS/W-CDMA Release 3 and Release 4 offerings to supplant both TDM and Ethernet where possible. Replacing TDM wasn't surprising, but the lessons learned from deploying Ethernet with its QoS limitations in 2.5G GPRS/EDGE networks was enough to also advocate replacing Ethernet with ATM in next-generation wireless network solution where possible. This paradigm has been standardized in the International Telecommunications Union (ITU) and is being heavily deployed in 2002 around the world (see Figure 1).

ATM AAL5 for the Control Path

3GPP has standardized on ATM (AAL5) as the control plane solution of choice for signal transmission over the TDM paradigm. IP over ATM (IPoA) is deployed throughout the control plane. This migration from TDM to ATM (AAL5) will have a significant effect on speeding up the retirement of TDM-based solutions even in non-3G wireless deployments.

ATM AAL2 for the Bearer Path

To recapture the QoS limitations of Ethernet that occurred in GPRS/EDGE (2.5G wireless network) deployments, 3GPP has also mandated that ATM (AAL2 (voice/video), AAL5 (data) be deployed as the bearer service (i.e. data plane) protocol of choice for 3G networks. With the exception of the Gi interface between the wireless network and the Internet which deploys IPSec over Ethernet, IPoA replaces IP over Ethernet (IPoE) – Ethernet is retired in the user plane for UMTS/W-CDMA Release 99 and Release 4 carrier-class solutions.

Today in the PLMN: Ethernet in next-generation networks (NGNs)

Converging the Internet (data network) with the Public Land Mobile Network (PLMN) (voice network) has created the need for new Network Elements (NEs) that act to connect these two divergent networks. Converged NGN architectures dictate the need for three new network elements: Signaling Gateways, Softswitches, and Media Gateways (see Figure 2).

Control plane gateways NEs

Signaling Gateways

Signaling Gateways act as mediation devices between legacy T1/E1-based circuits typically carrying carrier-based ISUP SS7 signals and the new packet-based Internet Engineering Task Force (IETF) Ethernet signaling protocols commonly referred to as SIGTRAN – also known as SS7 over IP protocols. SIGTRAN contains sub-tending protocols that are a melding of SS7 and IP protocols including IUA, SUA, M2UA, and M3UA.

Softswitches

Softswitches, also known as Call Agents or Media Gateway Controllers (MGCs), provide the signaling (control) function between the voice-based Public Land Mobile Network (PLMN) and the data-based Internet. In this component, Ethernet is deployed exclusively as the lower-layer protocol to deliver the new IETF-based signaling and control functions over a packet network. Types of protocols found on this network element include H.323, SIP, SIP-T, MGCP, and H.248/MEGACO.

Figure 1

Copyright 2002 CompactPCI Systems

Figure 2

User plane gateways NEs

Media Gateways

Media Gateways provide the actual bearer path delivery mechanism between circuit-switched voice (e.g. G.711) and packet-switched voice (e.g. Voice over Packets (VoP)) solutions. MGCP and H.248/MEGACO from the Softswitch provides the control mechanisms for precise timing of voice and video session establishment/termination.

Many of the early implementations have experimented with Ethernet as a VoP solution – delivering Voice over Packets is a cost-effective solution when it works. Due to the Quality of Service (QoS) limitations associated with Ethernet, which is a best effort delivery mechanism, real-world experience is dictating that this solution is going to be confined to the Enterprise-only environment. Wireless carriers are looking to ATM to provide their VoP solution due to its QoS superiority.

Building ALL IP 3G wireless networks

The challenge of 3GPP UMTS – Release 5 networks is to bring the technology choices together in a cost-effective solution that balances the needs of the wireless equipment manufacturer, the wireless service provider and the wireless end-user. This includes hardware, software, services, and applications (content) offerings.

Increasing wireless service provider revenues

3GPP Release 5 focuses on providing solutions that increase wireless service providers' revenues. This is achieved by increasing opportunities to deploy wireless data content (e.g. multi-media offerings, Internet offerings, etc.). In a usage fee based pricing model, more wireless surfing means greater revenue opportunities for service providers. Introducing multi-media offerings is key to the success of Release 5. Making the right protocol choices is key to delivering this solution.

The seamlessness of IP

IP is the common denominator between the wired Internet and the wireless Internet that enables seamless migration of services originally designed for the wired Internet to be easily delivered over the wireless Internet. No more need for Wireless Application Protocol (WAP) and its cumbersome restrictions that require wireline Internet applications to be rewritten ported in order to work on a wireless Internet framework. Once implemented, it is anticipated that porting e-commerce applications from the Internet to m-commerce applications on a wireless network will be virtually seamless – this is the killer application for 3GPP UMTS networks that will drive their quick deployment.

Network Convergence

3GPP UMTS/W-CDMA Release 5 also merges previous 3GPP wireless networks with the converged NGN architectures into a single packet/cell-based network that provides this platform for IPv6-based services.

High performance network processors (NPs) focusing on I/O

ATM, IP over Ethernet (IPoE), or IP over ATM (IPoA) – all of these I/O services are needed in a Release 5 3G UMTS wireless network. With this versatility comes the need for new high-performance technology solutions. New Network Processor (NP) silicon has emerged that focuses on providing highly-configurable, high-performance solutions in this 3G UMTS space. Silicon devices utilizing Packets over SONET (PoS) and UTOPIA interfaces provides the solutions performance required in 3G UMTS networks. Marrying these new purpose-built 3G Network Processors to standards-based, PICMG-compliant node boards coalesces the high-end performance needs with a standards-based package when 6U CompactPCI blades are utilized.

Reducing I/O development costs and time-to-market (TTM)

Standardization plays a key role in reducing development costs and development life cycles. Telecom Equipment Manufacturers (TEMs) that deploy on PICMG CompactPCI standards-based products are in a position to save time and money in their network element development costs and deployment life cycles.

PICMG 2.16 provides a standards-based solution utilizing 10/100BaseT Ethernet over a Compact Packet Switch Backplane (cPSB). Coupling PICMG 2.16 with standards-based CompactPCI and PCI Mezzanine Card (PMC) board form factors gives TEMs great competitive advantages.

PICMG 2.20 provides a standards-based solution utilizing CSIX over a CompactPCI Serial Mesh Backplane (cSMB). Coupling PICMG 2.20 with standards-based CompactPCI and PMC board form factors gives TEMs great competitive advantages here as well.

Standardization means hardware commoditization (cost savings) and reduced time-to-market.

3GPP navigation rules

Having established the business case for IP-based networks, the network provider is now left with deciding when to use Ethernet and when to use ATM. Deploying both of these time-proven technologies where they fit best in the network is the preference – this is referred to as "the hybrid solution." Below are some guidelines.

Copyright 2002 CompactPCI Systems

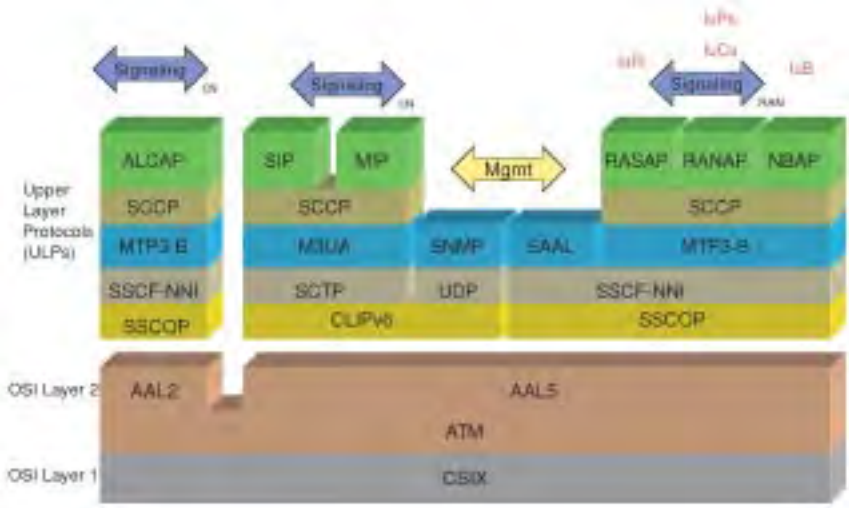

Figure 3

Ethernet for the control/management path

Ethernet is simple, cost-effective, and easy to deploy – in short, it's ubiquitous. It's a proven data networking technology that should be deployed as much as possible where it works best. PICMG 2.16 legitimized Ethernet's crossover role to the telecom arena by providing a standardized Ethernet CompactPCI Packet Switch Backplane fabric at either 10/100BaseT or 1000BaseT rates. In release 5, Ethernet-based signaling protocols approved by the IETF such as SIGTRAN, H.248/MEGACO, MGCP, and SIP take on paramount importance as control path protocol solutions while SNMP is preserved as a management plane protocol solution that also resides nicely on top of Ethernet (see Figure 3). For these upper layer protocols, Ethernet is the preferred Layer 2 protocol solution that can easily reside under an IPv6 protocol middleware.

ATM for the bearer path

Because of the Quality of Service (QoS) limitations of Ethernet that spring from its connectionless nature, it is doubtful that Ethernet will gain widespread acceptance as a reliable bearer path solution (aka user plane, data plane, or transport plane) for real-time telephony applications until the QoS problem is resolved. As a consequence, VoIP solutions are now morphing into Voice over Packet (VoP) solutions as other lower layer low latency fabric solutions are being considered such as VoATM and VoDSL (which is also over ATM).

ATM is a proven technology solution for the bearer path – it is residing in enterprise environments for over a decade and has even branched into telecom applications over the last couple of years. It is admired for its fast transport capabilities and its end-to-end QoS guarantees. ATM embeds its QoS capabilities in the ATM Adaptation Layers (AALs) (see Figure 4). It was designed from the beginning with the concept co-existence of Video, Voice, and Data in mind – the superset of applications that many are trying to emulate with Ethernet and its QoS handicaps in large-scale telecom networks today. With a large, installed base in the enterprise environment, migrating to an ATM solution in the wireless environment provides the seamless convergence of both data and voice networks that operators are seeking while protecting the investment that many have already made in ATM networks. PICMG 2.20 Compact Serial Mesh Backplane uses the CompactPCI form factor to standardize the backplane for ATM solutions delivering an ATM-based backplane for real-time voice and video.

Figure 4

Conclusion

3GPP UMTS Release 5 gives the systems engineer the choice of his OSI Layer 2 data network solution. Whether the need is ATM AAL2/AAL5, IPoEthernet, or IPoATM, versatility is key. Network Processors are emerging on the market that are purpose-built for these types of Ethernet and ATM-based I/O services. IPv6 can be deployed on either Ethernet or ATM fabrics and protocols. Deploying Ethernet in the control and management path and ATM in the bearer path addresses the QoS shortcomings of Ethernet-only networks by providing the ATM QoS capabilities for voice, video and data applications – it's the best of both worlds. Placing IPv6-based services on both of these lower-layer protocols provides a transparent and seamless interworking between wireless applications and their underlying protocols. With ATM you get the QoS guarantees required for mission critical, real-time telephony service in the bearer path that Ethernet doesn't provide. Other fabric solutions offer very little added value over the Ethernet and ATM technologies that are already widely deployed today. With Ethernet and ATM, you get the best of both worlds. PICMG 2.16 Ethernet cPSB and PICMG 2.20 CSIX/ATM cSMB answer the challenge of the 3GPP – Release 5 UMTS/W-CDMA network.

Michael Gyger, *Technical Marketing Manager at Interphase Corporation, has more than 15 years experience in the telecommunications industry*

Copyright 2002 CompactPCI Systems

spanning enterprise (PBX), local (LEC), long haul (IXC), and wireless software design/development for GSM, TDMA, and CDMA systems. Michael also has product management experience in 2.5G GPRS/EDGE networks and products. Michael's most recent role is managing technical marketing initiatives for 3G Wireless Internet and converged Next Generation Network (NGN) embedded system components. Michael serves on the PICMG 2.20 CompactPCI Serial Mesh Backplane (cSMB) subcommittee that Interphase is co-sponsoring with Motorola, IBM, and SBE. He also serves on the PICMG 3.0 Advanced Telecom Computing Architecture (AdvancedTCA) sub-committee that is developing next-generation embedded platform specifications targeted primarily towards the telecom industry. Michael joined Interphase Corporation in 2001 and holds a Bachelor of Science degree in Computer Science & Engineering from the University of Texas.

For more information, contact Michael at:

Michael Gyger
Technical Marketing Manager
Interphase Corporation
13800 Senlac Drive
Dallas, TX 75234-8823
Tel: 214-654-5611
E-mail: mgyger@iphase.com
Web Site: www.iphase.com

Copyright 2002 CompactPCI Systems