# Media gateways – Bridging the gap

## Open systems speed the way

*By Jon Kenton*

*The last 12 months have been a time of much upheaval in the technology marketplace. The telecommunications market has taken more than its fair share of this turmoil, but as economic indicators point towards recovery the window of opportunity again opens for those who can take advantage by speedily ramping new product introduction. The concept of open standards has become synonymous with aiding these rapid development efforts and CompactPCI now plays a significant role as the underlying technology platform for many telecommunications systems.*

*Where should these efforts be directed? An excellent question and one that is, I am sure, being asked in many marketing and engineering meetings. One of the areas that, although slowed by the downturn, is still forecasted for healthy growth is equipment to fuel the build out of next generation or converged networks. A key component of this architecture is the Media Gateway.*

*This trend is substantiated by industry analysts such as the Cahners In-Stat Group who in a report entitled* Creating the New Public Network with Packet Telephony Gateways *stated "Beginning in 2002, much more rapid growth is expected in both port shipments and revenues for packet telephony gateways, resulting in gateway revenues of close to $6 billion in 2005." So what is this new network and how do media gateways play their part?*

The worldwide communications network we all now take for granted has undergone many changes. The old mechanical switches gave way to the digital age and we now see vast and complex mixed technology networks, including wireless technologies and calls transmitted at light speed across thousands of miles of optical fiber. With the introduction of the packet-based Internet and its associated "trunking for free" mentality, the industry has been striving towards combining and integrating this packet technology with the vast installed base of circuit switched equipment. Thus the converged or Next Generation Network.

The converged network will allow many different communications systems to interoperate so that subscribers will be able to share data and voice services. As illustrated in Figure 1, Media Gateways (MGW) provide the enabling interconnection of the PSTN to the IP world. As defined by the Internet Engineering Task Force (IETF), a media gateway is a network element that provides conversion between the information carried over the telephone circuits and data packets carried over the Internet or over other IP networks. Among other functions, a MGW provides conversion of streamed media formats such as voice or video, and manages the physical interconnection and transfers between the two disparate networks.

There are many distinct entry points into these networks and many differing standards and interfaces. A single universal solution that could convert anything to everything would be difficult to achieve and as such, a number of different gateway classifications have been defined. Three primary categories are enterprise, access, and trunking gateways.

Enterprise gateways are typically for installation within an organization's private infrastructure. They would interconnect a corporate intranet and the PBXs at both the headquarters and branch offices. This interconnect would allow for voice traffic for frequent intra company conversations to be carried over existing, owned, data infrastructure rather than that of the local or international carriers the company uses for regular telephone connections.

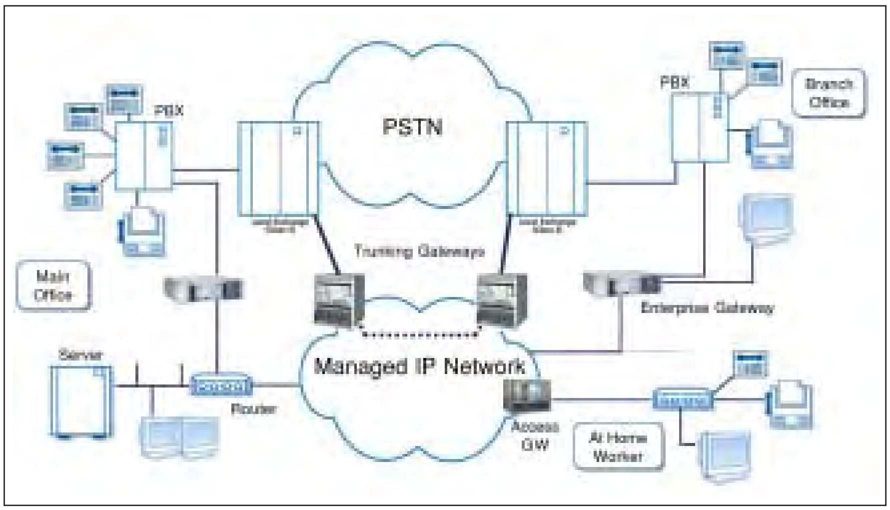


**Figure 1**

Access gateways are installed at the edge of the network and provide traditional analog or primary rate (PRI) line interfaces to a Voice over Packet (VoP) network. The inverse function is also applicable in VoB (Voice over Broadband) applications, where the phone call is digitally encoded before entering the access network and needs routing via conventional telephony once inside the network.

Trunking gateways interface between the telephone network and a VoP network at the core. Such gateways are responsible for bulk conversion and typically manage a large number of digital virtual circuits.

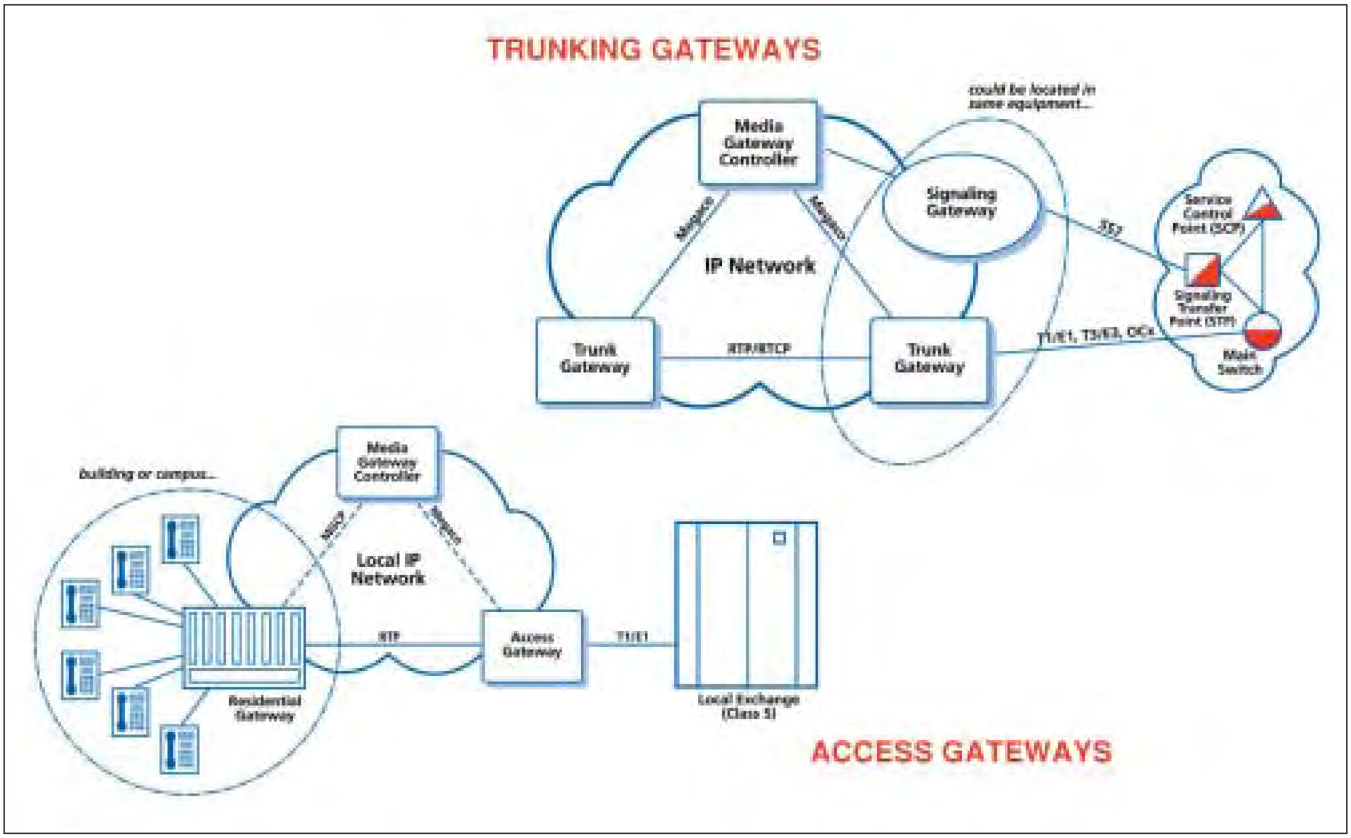


**Figure 2**

As show in the Figure 2, other elements work in conjunction with the MGW to control the NGN. The primary control element is the Media Gateway Controller (MGC) also often referred to as a softswitch.

### Media Gateways and Media Gateway Controllers – The relationship

The IETF defines a functional split between Media Gateways (MGW), which handle the bearer paths, and the Media Gateway Controller (MGC). This split reduces costs and complexity of endpoints. The MGC provides the intelligence, enabling centralized call flow while the MGW becomes an efficient routing device. In this model, the MGW reports all events to its parent MGC. It creates connections and acts in response to commands from the MGC. All the call intelligence is centralized within the MGC.

A standardized interface was developed for MGCs and MGWs to enable this model of operation and is known as Media Gateway Control Protocol (MGCP). The IETF and the International Telecommunications Union (ITU) have collaborated further to create a new and expanded standard called Megaco (Media Gateway Control). The ITU reference for Megaco is H.248.

A single MGC entity can control multiple MGW devices and includes capability to detect network or line failures and reroute calls as necessary to alternate bearer paths. This means that the network itself can attain 5-nines (99.999 percent) availability without the MGW itself needing to be fully fault tolerant. The MGC also interfaces directly to a signaling gateway that interconnects with conventional signaling networks such as SS7 to receive call information. This call information is presented to call agent applications that can run locally, or remotely on application servers. The interconnection of all these elements creates the overall softswitch environment. The key to flexibility in equipment and network design is in the fact that each of these elements is essentially logical and can reside in individual platforms or can also be combined into single multifunction platforms.

So what is the functional composition of a gateway and how do open systems and CompactPCI help?

Figure 3 is an example of a classic functional breakdown to be found inside and open media gateway platform where you will find four distinct key elements working together

1. The Line termination connection to the circuit switched PSTN

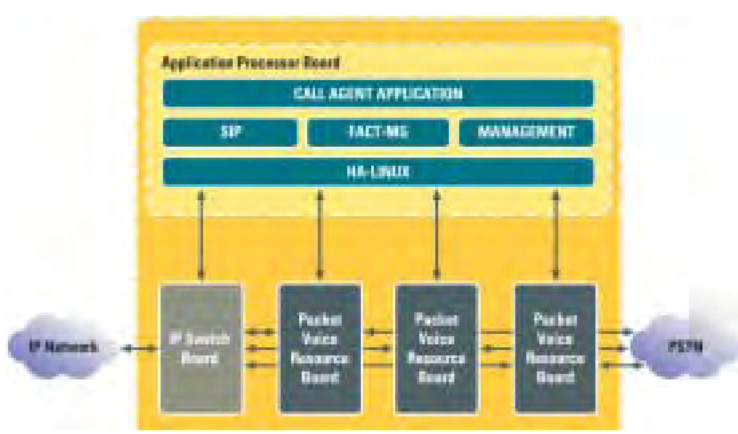


**Figure 3**

2. The voice to packet conversion
3. The packet network interface
4. The control and management software environment

### PSTN line termination

Depending on the type of gateway in question the line termination will vary. A low-density enterprise gateway may have only 120 ports and use T1 or E1 connections. A medium density platform for use in access or trunking applications could range from less than 1000 to 8000 ports and would likely utilize 672 channel T3 interconnects. At the high end, optical interfaces such as OC3 or STM 1 may be deployed with shelf densities up to 20,000 ports.

These circuit switched inputs are separated into individual call streams and then forwarded on to the next stage for conversion and packetization.

### Voice to packet conversion

This stage represents the core of a media gateway. In Figure 4, we can see a number of packet voice resource boards. These boards contain high-density Digital Signal Processing (DSP) resources optimized for fast signal manipulation.

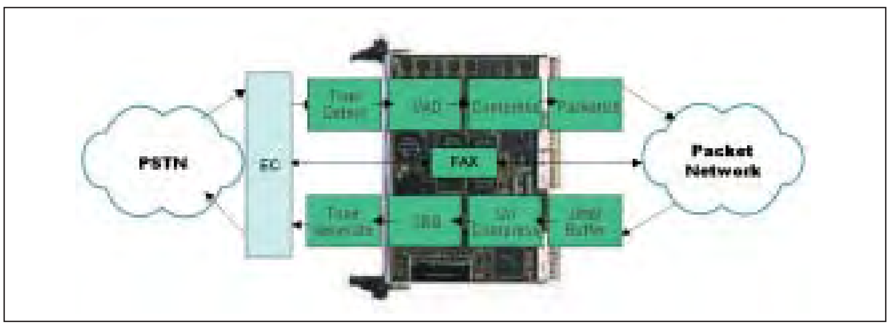


**Figure 4**

Voice to packet conversion performs a series of functions taking the TDM voice samples and preparing them for transmission over the packet network.

- Echo Cancellation is the first link in the chain. Echo cancellation is always required in a VoIP environment as the round trip delay will be greater than in normal telephony, typically more than 50ms. The echo cancellation algorithm must be able to dynamically track the echo path and adjust accordingly.
- Tone detection is a requirement before and during an end-to-end call. For example, it identifies if it is a voice or fax call as well as sensing DTMF tones.
- Voice activity detection (VAD) increases network efficiency by sending packets only when voice signals are present.
- Voice compression is a necessity to enhance network capacity and efficiencies. A single voice call is 64 Kbits/sec. Various codecs can be applied to this standard G.711 encoding to reduce its size. Typical codecs include G.711 u-law and A-law, G.726, G.729, and G.723. For example, G.729 will transcode the 64 kbit/sec audio signal into a compressed 8 kbits/sec format, a ratio of 8:1.
- Packetization is finally applied prior to transmission onto the packet network. Typical protocols include RTP for VoIP and AAL1 or AAL2 for ATM.

On the return leg from the packet network, a series of inverse functions are performed:

- Jitter buffering. Because packet networks often add variable transmission delays, the packets need to be collected and re-ordered. This process is done by an adaptive jitter buffer, which also inserts any comfort noise packets as well as silence when packets arrive too late to be inserted in sequence.
- Decompression is applied as an inverse function to that used when directing voice streams on to the packet network.
- Comfort noise generation. There is no inherent noise in the packet network so to prevent the listener on the other end of the call hearing silence, background noise levels are constantly monitored and then inserted into the call as comfort noise whenever the originator stops speaking.
- Tone generation as required is inserted into the stream before finally heading back to the circuit network.

Additionally, a packet voice processor must have the ability to handle fax relay and modem calls. Due to the inherent delays in the packet network, many fax calls would likely time out. To accommodate this, a relay or store and forward function is implemented.

### Packet Network Interface

The Packet Network Interface provides the interconnection of the equipment to the packet network. In a Media Gateway, this function is required to provide any necessary packet aggregation from multiple Packet voice resources and to add any necessary final packet routing address fields. For example, in a Voice over IP application, the DSP based voice packetization function may create an RTP format packet, but the UDP and IP addresses need to be added at this stage.

This function must be able to perform any local bearer signaling required to set up data paths to the next stage in the packet network, including any bandwidth reservation or packet prioritization tagging necessary to achieve an acceptable Quality of Service for the link. These functions may be distributed for better scalability – for example the basic packet formation can be done on a DSP board but the quality of service queuing can be done on a dedicated IP switch board.

As well as supporting all the standard routing protocols such as Routing Information Protocol (RIP), Open Shortest Path First (OSPF), and Border Gateway Patrol (BGP), the in-built IP switch can be software programmable so embedded networking controls can be added. Examples include such features as DHCP, IP multicast or Network Address Translation (NAT).

### Control and Management

The Control and Management Module provides the element management interface to configure and maintain the other functions. These functions would all run on a host-processing module under the overall control environment of the operating system. In our example, this is the High Availability Linux (HA Linux) offering from Motorola Computer Group. The overall call control application would sit atop the packet voice management software – in this case FACT-MG – which provides such features as the interface to configure the default call processing parameters and set the IP address of the data stream sent to the network interface. Chassis management and interfaces to a high level network manager would be included using for example SNMP.

### Rapidly getting to market

In the past, network equipment providers had to create their solutions essentially from scratch. Certain open standard components were available but significant extra work was required in both hardware and software design. Over the last few years, many of the individual components necessary to create a media gateway have appeared on the market. Such packet processors would include all the necessary functions that we outlined above. For example, the CPCI5421 from Motorola Computer Group can support up to 120 channels using the toughest compression algorithms and is combined with a fully featured gateway software environment, FACT-MG. For developers, these open products are a big advantage in their quest for time to market reduction.

There is still a significant amount of effort required to integrate packet processors with all the other necessary components required for a finished product. Motorola has taken the open standards approach a stage further with the introduction of their Integrated Gateway Platform (IGP) series. The IGP has brought together all the elements into one off-the-shelf, fully integrated solution that provides the gateway developer with a platform on which to place their call control software. The initial platform, the IGP1000, is based on a 5 slot carrier-grade CompactPCI chassis and is configured with a fully featured control processor, a choice of from one to three packet voice resource boards for a maximum capacity of 360 channels and an optional IP switch card. The control environment is managed by HA Linux and includes a preconfigured install of FACT-MG as well as a set of sample applications in binary and source versions.

This platform enables software development to start immediately and is capable of moving directly from the development lab into deployment. This is a classic example of how open systems can truly help speed products to market.

## Summary

The next-generation network is the evolution, and bringing together, of a number of technologies. Successfully bridging the old circuit switched networks and the new packet infrastructure is a fundamental necessity. The new network has constructed a logical architecture that defines sets of discrete functions. It is gateway functionality that provides the bridging and acts as the glue that joins everything together.

Within the gateways, as always, the ability to switch is at the core of the architecture. The logical functions call for certain features, but moving the TDM and data packet streams around the system is key to realizing ultimate performance and throughput. Application ready, standards based platform gateways are now a viable option that can eliminate the headache of many months of integration work.

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