High density voice and video processing is increasingly in demand for applications such as session border controllers, media gateways/servers or media resource functions, video or content optimization, video communications servers, and interactive voice and video response systems. This white paper outlines the trends driving the need for network media processing and offers an alternative to the conventional Host Media Processing (HMP) solution. Using a PCI Express media acceleration card and embedded voice/video firmware offers dramatically improved performance while taking up less space, consuming less power and costing less. Specific application examples demonstrate that this is a much simpler upgrade and deployment experience.
As the communications networks transition to an all-IP environment, service providers and network operators are finding a need for IP media servers and new advanced flow management devices such as session border controllers, QOS analytic engines and intelligent flow optimizers.

Many of these are developed and deployed on 1U or 2U standard rack mounted server (RMS) architectures for simplicity.

The role of IP media gateways and media servers is clear but as the developers and users of border flow management devices consider where to go next, one obvious step is to build some advanced media stream processing into the platform.

One key concern is scalability.

According to most analysts, mobile data and especially mobile video is expected to grow exponentially over the next three to five years so the pressure is on to find cost and power-efficient ways to scale media processing to suit.

Some of the issues that confront equipment developers are as follows.

**Adding Voice Transcoding to a Session Border Controller**

A good example of a flow management application is the session border controller (SBC), an often-quoted example of a class of equipment known as network security gateways.

These are characteristic of “bump in the wire” devices that form a bridge between trusted and untrusted networks or enterprises. Their job is to analyze and characterize incoming IP traffic, block undesirable or unauthorized flows, and let through approved traffic. In communications networks, a lot of this traffic is media streams.

As this is a gateway point, many SBC users are also interested in providing additional media format translation in addition to the stream management. Even simple requirements like DTMF tone monitoring require that the media streams are decoded and analyzed.

The ability to have voice transcoding within the box helps simplify the communications flow for an operator, hence provides a competitive advantage for the equipment vendor.

Unfortunately, voice and especially video stream processing in real time at high channel counts is a strenuous task, so adding this function can impose a significant reduction on the processing power available to the main service leading to a reduction in capacity.

**Adding HD Video to a Media Server**

Another example is media servers, which come in many shapes and sizes. Their role in a communications network is to offer a rich multimedia experience as part of a service application. Many servers are used to offer voice announcements, message recording and playback, and conferencing services.

Increasingly, the desired multimedia experience includes video, and with high resolution user terminals and smart TVs growing in popularity, high definition video support is a key product requirement.

In order to facilitate communications to and between different video-enabled endpoints, a
media server must be able to decode and encode compressed video streams using a variety of compression schemes.

The problem with adding HD video to an existing processing array is one of processing complexity. For any given compression scheme, the processing complexity scales broadly with the number of pixels per second in the stream.

Compared to an older communication channel using the Common Intermediate Format (CIF) resolution of 352 x 288 x 15 frames per second (fps), a 720p30 stream of 1280 x 720 x 30fps requires nearly 20 times more processing for both decode and encode, and a 1080p30 stream of 1920 x 1080 x 30fps is another two times worse.

Possible Solutions

Adding media processing functionality to an application can be done in a number of ways:

- An additional system or device linked to the original appliance
- An internal software solution, adding functionality to existing software
- An internal media processing accelerator offering hardware-accelerated transcoding

In the SBC plus voice transcoding example above, using an external media gateway is perhaps the simplest to envisage. The border gateway terminates principal traffic streams, and redirects media to the external gateway for transcoding via external ports. Media can come back into the border gateway for egress filtering.

The disadvantage is that this is costly, uses rack space and extra power, takes up valuable physical network interfaces off the border gateway, and still requires application development that controls and configures media stream handling on a stream by stream basis.

Taking the media server plus HD video example above, using an external HD conferencing device will be complex to manage, will take up additional rack space and power, and could be high cost. The service application would need to be able to manage both systems in parallel, potentially increasing complexity, management overhead, and OPEX costs. Upgrade paths to newer compression schemes such as H.265 may be limited.

The other two solutions allow for this function to be taken inside the box.

An internal software solution, for instance using commercially available “Host Media Processing” software, necessarily makes use of internal processing resources.

In the case of voice transcoding, this may be a great solution for a moderate number of simultaneous channels, however it does not scale effectively. At upwards of 1200 simultaneous channels of G.729 encoding, the software solution approaches 50% utilization of a typical server, starving the original application of processing resource.

Effectively this means that additional servers would be required to offer higher densities of voice transcoding, and the cost of the commercial software that is usually charged on a per-channel basis soon mounts up.

Back to our video example - when enabling HD video within a media server environment, the processing complexity soon takes a heavy toll on
the processing resource available to the original application - with the result that overall performance is degraded. This could hardly be viewed as adding functionality. The end result is that much more processing resource would be required.

Although it is possible to add more servers to address this issue, accepting a reduction in capacity even for an improvement in functionality is often difficult to manage from a product line perspective. It results in a downgrade of capacity within the same product offering, so cannot really be viewed as adding functionality.

Matters get even worse when considering field upgrades since a customer must accept that a given installation would no longer be able to carry the same traffic.

The Solution
A more elegant solution to the problem is to use a plug-in media processing accelerator to offload both audio and video processing from the server host.

This keeps the function internal to the network element AND avoids the loss of central processing resource that would otherwise be required to run a fully software solution. Ideally this would be able to take account of new voice and video compression schemes as they emerge.

In this case, using a plug-in media processing accelerator offers a true upgrade path, and Emerson’s PCIE-8120 addresses just such a need.

Introducing PCIE-8120
Emerson Network Power’s PCIE-8120 is a PCI Express media processing board that offers high performance voice and video transcoding based on digital signal processing (DSP) technology.

Each board features an array of low power DSP devices running optimized voice and video processing firmware. Application developers interact with the board via a simple object-oriented application programmers interface (API).

Media streams can be delivered to the board either via the PCIE interface or via a pair of dedicated on-board Gigabit Ethernet interfaces.

The transcoding performance scales linearly according to the number of DSPs that are fitted – options from 4 DSPs to 12 DSPs are available.

But even with 4 DSPs and consuming less than 25W of power, Emerson’s PCIE-8120 delivers a voice transcoding performance comparable to a typical server consuming 300W or more.

An Example Application
An example may help illustrate the value of using acceleration.

Consider a packet processing application that, in a server based on dual Intel® Xeon® processors, can support 4000 concurrent sessions or streams. The market now demands to add voice transcoding capability.

As outlined above, one option is to use a commercial Host Media Processing solution.
This requires approximately 50% of a dual Intel Xeon server capacity for 2000 transcode streams.

As a consequence, adding this capability reduces the available processing power for the original application by 50%.

The resulting solution is now only a 2000 stream processing device. To get back to the 4000 stream capacity, a customer must buy two units, so power consumption and rack space is doubled.

The alternative is to add an Emerson PCIE-8120 accelerator board. This takes care of the processing-intensive workload, thus maintaining the original performance.

In fact, compared to a host media processing solution that is limited to approximately 2000 sessions per server, a single PCIE-8120 is capable of transcoding over 7500 bidirectional voice streams or over 300 mobile video streams in hardware, and multiple boards can be fitted to a single server.

**Voice Capability**
PCIE-8120 supports the following 3GPP, ITU-T, IETF and other voice codecs:
- Uncompressed telephony: G.711 μ-law/A-law with Appendices I and II
- Narrowband compression: G.729AB, G.729.1, G.723.1A, G.726, G.727
- Wideband compression: G.722, G.722.1
- Wireless network: GSM EFR, AMR and AMR-Wideband; EVRC and EVRC-B
- Internet voice: iLBC, SILK (Skype), Opus [roadmap]

In addition, each voice channel can support echo cancellation, announcements, conferencing, mixing, and a full range of tone detection and relay functions.

**Video Capability**
HD (or other) video streams can be redirected within an appliance to Emerson’s PCIE-8120 and transcoding and conferencing can happen without making any use of existing processing resource.

A single PCIE-8120 can handle up to six 4-party video conference bridges where each participant...
uses H.264 720p at 30fps. It can also handle resizing to and from 1080p. PCIE-8120 is based on software programmable DSP technology so it is easily upgradeable as newer compression schemes emerge.

PCIE-8120 supports the most common video compression schemes used in communications: H.263 (legacy) and MPEG-4 for CIF, and H.264 at resolutions up to 1080p. Once streams are decoded, the software also offers full scaling between resolutions and adaptation between frame rates, and the ability to mix streams and graphics together to create different layouts for output.

Within the same software package, PCIE-8120 also offers a full suite of voice processing capability including a wide range of voice codecs, tone detection, and voice conferencing functions.

### Adding 15,000 ports of compressed voice to an application

<table>
<thead>
<tr>
<th>Number of additional servers required</th>
<th>Using Emerson’s PCIE-8120 Using Host Media processing (HMP)</th>
</tr>
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<tbody>
<tr>
<td>Zero. Can achieve with 2X PCIE-8120</td>
<td>8 or more depending on the HMP solution</td>
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<tr>
<th>Additional power consumption</th>
<th>130W</th>
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<tr>
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<td>8x 400W average = 3200W</td>
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<tr>
<th>Additional rack space</th>
<th>1U (upgrade to a 2U server)</th>
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<td></td>
<td>8U (assuming 8X 1U servers)</td>
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<tr>
<th>Hardware &amp; software costs</th>
<th>1X</th>
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<tr>
<td></td>
<td>&gt;2X</td>
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<tr>
<th>Ready for new codecs</th>
<th>Yes</th>
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<td></td>
<td>Yes</td>
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<tr>
<th>Support mobile video</th>
<th>Yes</th>
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<td></td>
<td>Yes</td>
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<tr>
<th>Support 720p and 1080p video</th>
<th>Yes</th>
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<td></td>
<td>No</td>
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### Server Tested

Emerson Network Power has tested the PCIE-8120 in best-selling servers including the Dell PowerEdge R720 and HP ProLiant DL380p, as well as short-depth carrier grade rack mount servers (CGRMS) from third party vendors.

Emerson has published guides to simplify the installation of the PCI Express card into the Dell PowerEdge R720 and HP ProLiant DL380p servers.
Many rack mount servers are available in fully NEBS compliant, hardened versions. Emerson’s PCIE-8120 is designed for NEBS carrier grade and data center environments, depending on the server enclosure, and so offers a common solution for both enterprise and telecom environments.

In addition, since Emerson Network Power’s ATCA-8320 ATCA® media processing blade is based on the same technology, this allows OEMs to achieve even higher scalability up to multi-bladed AdvancedTCA systems while protecting software investment.

**A Better Solution**

High density voice and video processing is increasingly in demand for applications such as session border controllers, media gateways/servers or media resource functions, video or content optimization, video communications servers, and interactive voice and video response systems.

We can see that using Emerson’s PCIE-8120 rather than additional servers has a lot of benefits:

- It takes up less space
- It consumes much less power
- It can easily be retro-fitted to existing deployed systems as a true feature addition
- It costs less than a comparable server + commercial host media processing combination for the same performance

Consequently, Emerson’s PCIE-8120 offers a lower total cost of ownership and a much simpler upgrade and deployment experience.
In addition to the PCIE-8120, Emerson Network Power offers ATCA solutions for media processing applications.

At the core of the offer is the sophisticated DSP-based ATCA-83xx “gateway-on-a-blade”, but also available is the full range of support technology including x86 server blades and ATCA platform cores backed up by OEM-focused services such as long term support, revision management, and product customization.

There are two blades in the ATCA-83xx series: the ATCA-8310 based on Texas Instruments “Tomahawk” DSP technology and the ATCA-8320 based on Octasic “Vocallo” DSP technology.

Emerson’s ATCA-83xx has roots in the company’s long involvement with media processing applications including several successful CompactPCI products, but builds on the technical and thermal leadership in both ATCA blade design and ATCA platform performance to create one of the industry’s most capable single-blade solutions.

The boards support use as both scalable “gateway-on-a-blade” and “DSP farm” modes with creative build variants and mezzanine options.

At the core of each blade is a 48 port Gigabit Ethernet switch married to a Freescale™ QorIQ™ P4080 multicore processor. The Freescale™ QorIQ™ P4080 is provided with a core-based virtualized environment whereby some cores are allocated for board level and DSP control, and others can be utilized for IP packet processing and load balancing functions that make the board appear as a single IP address.

Media processing is handled by the scalable DSP array with DSPs provided both on the base board and on user-installable mezzanines. This enables the lowest cost for the entry level solution but with the ability to add more capability in the field.

The boards also features a TDM environment with a range of physical TDM interfaces including T1/E1 and STM1/STM4 and a timeslot switch to distribute channels to the DSPs.

The final component that allows true gateway-on-a-blade operation is the optional Intel® Core™ i7 processor subsystem with SSD mass storage that can be used for element or service management and call agent functions.
About Emerson Network Power

Emerson Network Power, a business of Emerson (NYSE:EMR), is the global leader in enabling Business-Critical Continuity™. The company is the trusted source for adaptive and ultra-reliable solutions that enable and protect its customers’ business-critical technology infrastructures.

The Embedded Computing business of Emerson Network Power enables original equipment manufacturers and systems integrators to develop better products quickly, cost effectively and with less risk. Emerson is a recognized leading provider of embedded computing solutions ranging from application-ready platforms, embedded computers, enclosures, motherboards, blades and modules to enabling software and professional services.

Manufacturers of equipment for telecommunications, defense, aerospace, medical and industrial automation markets can trust Emerson’s proven track record of business stability and technology innovation.

Emerson’s engineering and technical support is backed by world-class manufacturing that can significantly reduce time-to-market and help OEMs gain a clear competitive edge. And, as part of Emerson, the Embedded Computing business has strong financial credentials. Let Emerson help your business improve time-to-market and shift development efforts to the deployment of new, value-add features and services that build market share.

With Emerson behind you, anything is possible!