



**New Directions
in Media Gateway Design**

Vocallo Multi-Core DSP Solution

White Paper

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Table of Contents

Introduction	1
Overview of DSPs	1
Key Challenges Facing OEMs	4
Vocallo – Nextgen DSP Solution for Media Gateway OEMs	5
Customizing media gateway designs	6
Ease of expanding and upgrading existing deployments	7
New business models to reach a broader customer base	8
Conclusions	9



Introduction

Service providers of all types are under constant pressure to remain competitive, especially for providing telephony. As networks continue their transition from TDM to IP, the dynamics of the voice business are changing, with new challenges coming from both subscribers and competitors. With subscribers demanding new services and competition driving prices down, service providers must be more agile than ever. Media gateways are at the heart of all nextgen networks, and are critical in helping service providers address these challenges.

This White Paper examines the central role that DSPs play in media gateway design and their impact on the value gateways deliver to service providers. For OEMs, this is particularly important, as no two service providers have exactly the same media gateway requirements, and their needs are constantly evolving. In this regard, the Vocallo multi-core DSP solution from Octasic Inc. is discussed, and its merits considered for bringing a distinct, new design to market for OEMs. Vocallo will be considered not just for having an innovative approach for media gateway design, but also for possible new business models attractive for OEMs.

Overview of DSPs

DSPs – Digital Signal Processors – provide the horsepower for media gateways, and impact their performance more than any other design component. Not only do DSPs drive functionality, but they are the single most important cost factor for gateways. As such, both the economics and quality of VoIP rely heavily on DSPs.

VoIP is only now reaching mainstream adoption, and DSPs have evolved to reflect how service providers have integrated voice into their data networks. In order for voice to traverse a data network it must first pass through a media gateway. In the early days of IP, generic DSPs provided the signal processing functions, primarily echo cancellation, compression and RTP packetization. Separately, network processors provided network layer (IP/UDP) processing. This design, whereby both network processors and generic DSPs were required for VoIP, may not have been the ideal voice processing solution, but it was sufficient given the minuscule volumes of VoIP traffic being run over carrier networks.

As all forms of network and computer technology progressed, first generation media gateways evolved to keep up with changing needs. The use of generic DSPs for signal processing became supplanted by customized DSPs that were built around the specific needs of VoIP and real time communications. However, network processing was still handled separately by network processors. With VoIP adoption growing, and nextgen networks maturing, the next step was towards an integrated design, with the packetization and signal processing being housed in a single processor. The end result is the System on a Chip – SoC – design, which is emerging as the solution of choice for today's media gateways.

SoC is emerging as the solution of choice for today's media gateways.

Overview of DSPs

Aside from advancements in technology, the impetus for an integrated SoC solution came from changing market conditions. During this time, carriers were experiencing exponential growth in VoIP traffic, especially in the U.S., where the telecom market became hyper-competitive in the early 2000s. IP made it possible for almost any type of service provider to offer voice services, with consumers and businesses alike being faced with unprecedented choice from both traditional and non-traditional sources.

On the demand side, there was the parallel rise of the Internet and broadband, which created new challenges for carrier networks. Carriers faced enormous pressures to reduce Opex, and transitioning traffic from expensive TDM networks to lower cost IP networks was a key way to do so. As such, early media gateway deployments were focused on toll-bypass and Internet offload in order to optimize usage of their TDM networks and to reduce operating costs.

In today's telecom climate, the inherent value of VoIP to both carriers and enterprises lies more in new services and applications than in reducing Opex and even Capex. Of course, both are still important, but to remain competitive, carriers must also develop new revenues. They need to do this not just to offset declining TDM services, but to attract new customers who see value in VoIP and the broader possibilities of all flavours of IP communications.

Looking forward, the advent of IMS will give rise to a host of new possibilities, not just for voice services, but in how they are integrated with data and video applications. Layered on top of this is FMC – Fixed Mobile Convergence – which will support the seamless adoption of services across wireline and wireless networks. Taking the current and future outlook for VoIP into account, our view is that existing media gateway designs do not provide enough scalability and upgradability to allow carriers to benefit from all these opportunities.

While TDM is still the dominant mode of voice for most carriers, VoIP volumes are rapidly increasing, and with it, the workload on media gateways. In an all-IP world, there is little need for media gateways in their current form, since no conversion of traffic is required. However, that world is many years away, and for the foreseeable future, carriers will increasingly rely on media gateways for reliable voice processing.

With these increasing volumes and requirements in mind, our research indicates a number of key trends that are impacting design decisions for media gateways and the performance needs of DSPs.

- **Greater integration with other functions.**
VoIP may be the core application for DSPs in media gateways, but increasingly they must support and interact with other communications modes, such as video and wireless.
- **System on Chip architecture.**
To support this level of integration, media gateways need a programmable SoC design with a multi-core DSP. The role of gateways has expanded well beyond voice processing, and multi-core DSPs allows OEMs to efficiently address all these functions with a single design. On-chip memory is a key cost factor here, and OEMs must anticipate the right amount for the need of their customers.
- **Carrier-grade reliability.**
The more central VoIP becomes to the core competence of a service provider, the more important reliability becomes. Paying subscribers expect service that is on par with PSTN or better, and to support SLAs, media gateways need to deliver Five 9s uptime. This is how service providers define high availability for VoIP, and OEMs cannot afford to compromise here. In addition to service reliability, media gateways need to enable carrier-grade voice quality that makes VoIP calls just as good as PSTN.

- **Support for standards.**
As gateways expand to integrate more functions, the need to support multiple standards increases. Many standards must be supported by licensed codecs, which adds cost for DSPs. Licensed codecs will be with this market for years to come, and IP's success is largely due to being standards-based. As such, OEMs need to strike a careful balance in supporting enough standards and the right standards without making their gateways prohibitively expensive.
- **Low power consumption.**
DSPs are used across a wide variety of industries, but for telecom, this is a particularly important issue. Network environments consume a great deal of power and constantly generate heat, both of which cause concern for service providers. The higher capacity the media gateway, the less floor space is required, hence reducing real estate costs. Furthermore, reducing power consumption leads to lower cooling costs, which is another cost factor. An intangible benefit of reduced power consumption is the green factor, making the carrier more eco-friendly.

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Key Challenges Facing OEMs

Our analysis to this point leads us to conclude there are five key challenges that OEMs must address to remain competitive in the media gateway market. Although each challenge has its own distinct set of issues, there are also mutual incompatibilities among them, making it even more difficult to meet the needs of service providers.

Challenge for OEMs	Issues and Implications for DSPs
Scalability	To date, most carriers have only deployed VoIP on a small scale. The market is now seeing larger scale ramp-ups, and to achieve this, media gateways must support the growth. Nextgen DSPs are key here, as they can cost-effectively allow existing gateways to support higher densities. This is far more economical and practical than having carriers scale by buying additional gateways as volumes grow.
Reducing costs	DSPs are expensive, and while carriers need them to offer more functionality, they face ongoing cost pressures. VoIP is becoming a commodity, and the core function of gateways is supporting an application with a declining perceived value. Voice will always be a key offering, though, and carriers need to maximize their margins now while there is still a demand to pay for it. Silicon economics have led to steady and dramatic cost reductions for elements such as memory or CPU, but less so for DSPs. This means that OEMs should not expect major DSP cost reductions any time soon, and should focus elsewhere for savings.
Adding features and Capabilities	Most media gateway applications are for basic voice processing, but that will change as IP proliferates. Not only will voice applications become more complex, but newer and additional applications such as video are far more processing-intensive. This trend will only continue, and to remain cost-competitive, OEMs will need higher performing DSPs, especially if this remains their largest cost component.
Flexibility and Adaptability	Long term success for carriers with VoIP will depend on features and innovation, and not pricing. To provide this differentiation, carriers need gateway designs that can easily adapt to changing customer demands. These demands can be highly varied, and a key way for DSPs to address this is to allow OEMs to develop their own software that can be supported by the gateways.
Responsiveness and Time to market	With IP, new services come to market much faster than they did with PSTN. Time to market is just as important as the ability to develop new services, and media gateways need to be properly designed to support this. Traditional hardware-based designs make it difficult to respond quickly, especially if the new feature is not natively supported. More advanced designs that include hardware and software components give carriers greater ability to do this.

Vocallo – Nextgen DSP Solution for Media Gateway OEMs

Octasic Inc. has a long history of innovation with DSP technology, and our view is that their latest solution – Vocallo – addresses the issues and challenges discussed in this paper. Media gateway OEMs of all size face an increasingly competitive market and Vocallo has the capability to address almost any level of need.

For example, incumbent OEMs could use Vocallo to develop cost-effective, high density designs for their core customers. Second and even third tier OEMs could use Vocallo to compete more aggressively on features to address specific carrier needs that incumbent OEMs are not well suited to serve.

To better understand the fit with these and other scenarios, we will first highlight the key features of Vocallo, and then discuss what we believe represents their distinct value proposition for media gateway OEMs.

To begin, Vocallo offers a complete DSP-based platform for media gateway design. We view it as being fully nextgen in light of its advanced support for all forms of multimedia – voice, video and wireless, and engineered for both IMS and FMC applications. In reviewing Vocallo, the key features that we feel define these capabilities are summarized below.

Key Features of Vocallo	Benefits to OEM
High performance	Industry-leading channel processing power - more cost effective for scaling
Complete SoC solution	All core voice processing functions served in a single DSP design – echo cancellation, compression and packetization
Full support for packetized voice	Can serve all voice scenarios – VoIP, VoATM, conferencing, IP trunking, FMC and 3G
Industry-leading echo cancellation	Octasic's core competence ensures OEM can deliver superior voice quality, allowing their customers to offer premium services and earn higher margins
Full range of codec support	OEMs can design gateways for all scenarios – narrowband and wideband HD voice, across the full range of ITU and GSM compression specs
Full range of video support	As the demand for video grows, OEMs will be able to support both wireline and mobile requirements, including real time transcoding, transrating and conferencing
Software-based capabilities	Programmable platform allows OEM to seamlessly integrate their own software applications with Octasic's, as well as that of other third party vendors
Flexible design for expansion and upgrading	Vocallo's unique software licensing model gives OEM's unprecedented control and opportunity for gateway design

Vocallo gives OEMs a very rich palette to work from, and allows them to compete with virtually anyone.

Building on this, we see three distinct competitive advantages that Vocallo offers to OEMs:

1. **Customizing media gateway designs**
2. **Ease of expanding and upgrading existing deployments**
3. **New business models to reach a broader customer base**

Customizing Media Gateway Designs

Several aspects of what makes Vocallo a complete DSP solution have been discussed in this paper, and when all the points are considered, this represents a compelling value-add for OEMs. It must be reiterated that service providers are under increasing competitive pressure to get beyond the commodity nature of VoIP, and will be drawn to media gateway designs that provide this capability. Vocallo supports this in a number of ways. Their SoC architecture provides OEMs a powerful toolkit from which they can design highly customized gateways for carriers.

With a user-programmable platform and support for a wide range of I/O interfaces, OEMs have a great deal of flexibility to build on Vocallo's components and design gateways that cater to the specific needs of each customer. They can choose to mix and match not just from Octasic's software and their own applications, but also from third party developers. This gives OEMs a very rich palette to work from, and allows them to compete with virtually anyone. Not only can the OEM now deliver a design with just the right mix of features and scale, but at exactly the right price.

The ability to integrate across a wide range of software is complemented by the flexible nature of Vocallo's design. OEMs typically have two types of DSP solutions to choose from. One type is to buy the base hardware and raw silicon, and then take on the burden of integrating software with that vendor's platform. If that is not their competence, the OEM is better off with a pre-built solution where the hardware and software come together, already integrated. This may be more economical and easy to deploy, but the OEM is locked into the vendor's platform, and unable to develop any differentiated features for its customers. Vocallo offers the best of both worlds, enabling the OEM to pick and choose the software they want to use. As such, they may excel in transcoding and use their own software, but go with Octasic for echo cancellation, where Octasic is best-in-class.

Ease of expanding and upgrading existing deployments

Vocallo's architecture is by nature very scalable, and able to manage high density requirements. OEMs can order a high density device from Octasic, or simply add more capacity at a later date when needed. While other DSP vendors can do the same, Vocallo is distinct by virtue of a software-based licensing model that allows OEMs to scale on the fly without physical upgrades or downloading new modules. When OEMs order Vocallo, the system is configured precisely to their specifications, and that is what they pay for. However, the system is shipped with far greater capacity because Octasic's DSP architecture is built on power and cost efficient processors.

With Vocallo, when OEMs need to scale or upgrade, it is a simple matter of buying a new license and loading it on the Vocallo via an Ethernet connection.

This is enabled by encrypted software keys that are hard-coded into the system. Each Vocallo device comes with firmware that the OEM downloads from Octasic's website. From there, the OEM can view a key file listing all the additional features that are available once unlocked. When the new features are selected, a key file is generated that enables them. The OEM then receives a unique serial code for each feature, which will unlock them for authorized use.

This is the classic software licensing model, and allows OEMs manage the entire upgrading process. In this way, Vocallo provides a very high degree of flexibility in how OEMs execute their designs as well as in how they manage customers as their needs evolve. This model allows OEMs to be more responsive and accountable in terms of how much cost they choose to pass on to their customers.

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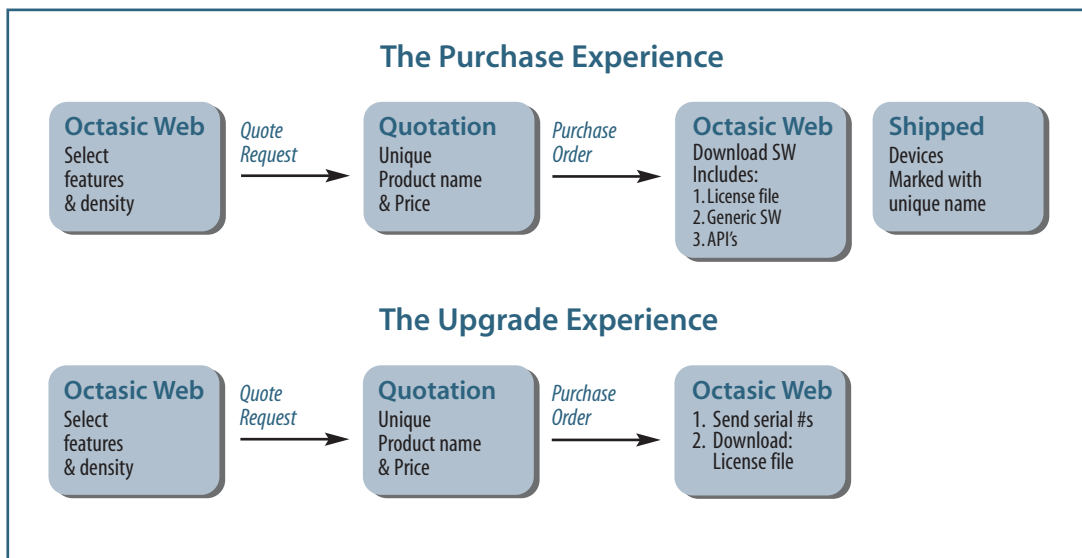


Figure 1: Illustrates the basic process for how OEMs can upgrade Vocallo.

For existing customers, there is a new business model here in the sense that OEMs can enable upgrades more quickly than before, and probably faster now than their competitors.

New business models to reach a broader customer base

Vocallo represents a departure in how DSP systems are architected, as well as the business dynamics between the DSP vendor and media gateway OEM. With Vocallo, the business relationship becomes more strategic than transactional, and the OEM becomes more empowered to create a higher value design for each customer or application space. Given the central role DSPs play in media gateway design, there is no better way for an OEM to chart their own course, especially now, as the VoIP market is about to hit its stride.

The notion of new business models stems from the fact that Vocallo can be the basis for an OEM to enter virtually any VoIP market. This singular design, based on Octasic's Multi-core DSP architecture, enables the OEM to create a multitude of media gateway designs, much like the way a single chassis design of a carmaker can support numerous different models, with each one targeted at very specific end markets. Vocallo gives OEMs more flexibility and control in the design process, making it much easier for them to manage their growth. We see this being important to OEMs in two ways: for existing customers and for targeting new customers.

For existing customers, there is a new business model here in the sense that OEMs can enable upgrades more quickly than before, and probably faster now than their competitors. In an environment where time to market is critical, Vocallo allows OEMs to command a premium by providing rapid system upgrades to their customers. Furthermore, OEMs can enable new features at little or no charge as a means to incent customers to scale their overall usage, and hence drive new revenues.

We also see new business model possibilities where OEMs are looking to grow their customer base. The flexibility of Vocallo can help OEMs target any type of new market, such as a Tier 2 vendor trying to break in with Tier 1 carriers, or a U.S. vendor trying to sell into the Asian carrier market. Vocallo provides the key components, and it is up to the OEM to identify the specific needs of the target market, as well as the right mix of features that will lead to those critical first trials. Forward-thinking OEMs will use Vocallo to sell into these markets with voice as a stepping stone, and then introduce multimedia on a trial basis. This allows OEMs to be more proactive in accelerating the adoption of a broader range of features, and managing the growth of these customers.

Conclusions

This white paper has reviewed the evolving role of DSPs in media gateway design, and how this has helped OEMs address many of their key challenges. As the adoption of VoIP continues to grow, the needs of service providers will become increasingly complex, and even more so as voice becomes integrated with data and video for multimedia applications.

The Vocallo solution from Octasic has been developed to help OEMs meet these challenges, with the core capabilities discussed herein. Their multi-core architecture shares common elements with other semiconductor vendor solutions, but Octasic has taken a forward-thinking approach by integrating hardware and software elements into a single, multi-core DSP design. This translates into greater flexibility for OEMs in their media gateway designs, which we believe can be the basis for meaningful competitive advantage.

Our view is that Vocallo has three distinct elements that will enable OEMs to achieve this outcome:

1. Ease of customizing media gateway designs. All carriers need to differentiate their services, and this capability from OEMs provides the basis for them to do so.
2. Ease of expanding and upgrading existing deployments. Many carriers are scaling up their VoIP deployments now, and time to market is critical to meet rapidly changing demands for new features.
3. Enabling new business models. Vocallo's software licensing capability provides OEMs unprecedented control over how they manage growth with their customers. This flexibility gives them more ways to upsell new capabilities, as well as to reach a broader customer base that was not possible before.

Taking these elements into account, we conclude that Vocallo represents an ideal solution for media gateway OEMs who are looking to compete more aggressively, and to take advantage of what the latest technologies have to offer. Given Vocallo's flexibility and scalability, we feel this holds equally true for large OEMs looking to protect their Tier 1 customers as it does for smaller OEMs looking to enter new markets or dominate a niche segment of the carrier market.

J Arnold & Associates, an independent telecom consultancy, produced this White Paper. The contents herein reflect the conclusions drawn based on general research about DSP technology, media gateway design trends, and Octasic's Vocallo solution. For more information please contact us by email: jon@jarnoldassociates.com.



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