Edge Services Result in New Revenue Opportunities

In early 2000, it was common for organizations to over provision their data center to run at peak load. This meant that organizations were only utilizing 10% of their available capacity. Virtualization enabled organizations to share computing resources between different services. The efficient use of computing resources enabled many organizations to not only survive but to prosper following the dot.com era. By the mid-2000s, the potential for cloud computing was being recognized as a technology for delivering services over the Internet.

Similar to the experience in the data center, the initial excitement regarding the smart cell was focused on the efficient usage of computing resources across base stations. Today, service providers are looking to go beyond the cost efficiency benefits, to exploit smart cell as a platform for delivering services to their end customer, the mobile subscriber.

Delivering services at the edge of the network enables service providers to offer services and a user experience that cannot be surpassed in terms of responsiveness and performance. Transitioning the base station functionality to run on an open Intel® architecture is enabling an ecosystem of software developers to develop innovative solutions that can be implemented at the network edge. This paper looks at how this open ecosystem is evolving and provides real-life examples of the innovation that is revolutionizing how service providers deliver services to their mobile subscribers.

Intel’s Smart Cell Platform Triggers Service Innovation

Historically base stations are specialized nodes in the network that include the transceiver and the baseband processes. Running the base station functionality as an application in a virtual environment is extremely challenging due to the stringent low latency and high data rate required by 4G baseband processes. Intel® Virtualization Technology (Intel® VT) for IA-32, Intel® 64, Intel® Architecture (Intel® VT-x) and Intel® Virtualization Technology (Intel® VT) for Directed I/O (Intel® VT-d) provide the hardware assists essential for a real-time hypervisor to meet these performance and latency requirements.

Running the base station functionality in a virtual environment on general purpose processors enables new development scenarios to be implemented. For example, multiple base station applications can be running on the same Intel® platform and sharing computing resources.
However, the area that is creating a high level of innovation and revenue potential is the ability to run other services and applications on the same general purpose platform. For example, Figure 1 shows a video streaming and caching application running on the same platform as the base station applications.

Today, there are thousands of software companies that develop software on Intel architecture. These developers utilize the extensive libraries and APIs that are included in the Intel® Data Plane Development Kit (Intel® DPDK) to develop high performance software on Intel architecture. The ability to leverage the Intel development ecosystem is causing the greatest excitement among service providers. Cloud technology and applications that have been proven in the data center can now run on the Intel architecture based smart cell platform. Some of the services being implemented on the smart cell are shown in Table 1.

Deploying content and services on the smart cell opens up new revenue opportunities for service providers. Three companies that are showcasing how service providers can monetize smart cells are Cygnus Broadband*, Edge Datacoms*, and Saguna Networks*.

### Cygnus Broadband* Enables Application Aware Smart Cells

The type of data that is going over the mobile networks is changing, with 60 to 70% of content expected to be video. This makes managing network congestion and minimizing the impact of real time and delay sensitive content a top priority for service providers worldwide.

Cygnus Broadband's eQoE technology looks at the content traversing the network and optimizes buffer usage to ensure a constant quality when subscribers watch video.¹

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<tr>
<th>Application Category</th>
<th>Service</th>
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<tbody>
<tr>
<td>Network Optimizations</td>
<td>Cache</td>
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<td>Proxy services</td>
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<td>Analytics and User Experience</td>
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<td>User-content</td>
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<td>Geo-Location services</td>
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**Table 1. Smart cell applications and services**
Figure 2 shows the results of lab trials using the Cygnus eQoE technology. The gray dotted line represents the minimum level of acceptable quality. Cygnus saw an increase in network utilization of up to 15%. In other words, the service provider was able to run their networks at high levels of utilization before congestion impacts the user’s quality of experience.

Ken Stanwood, CEO of Cygnus Broadband explained that “historically there was not enough spare processing power on a base station to enable a deep packet inspection of network traffic. Today, the Intel’s smart cell platform provides the high performance and scalability required to analyze traffic content and make intelligent decisions.”

Edge Datacoms* Shows the Advantages of Content Distribution

Edge Datacoms have deployed their Content Server on the Intel architecture based smart cell platform. Their solution combines advanced content deployment, edge caching, and content control mechanisms. In particular, Edge Datacoms are showcasing the value of integrating cloud applications in the smart cell to enhance the user experience and manage network backhaul.

Figure 3 shows the value of content deployment by storing a video on a smart cell. The red line shows that without preloading, the video took 2.5 minutes to download a 3 minute video. During this time, the video stalled twice to allow the application buffers to fill up. This would cause many users to cease watching the video, resulting in a lost revenue opportunity. The blue line shows the Edge Datacoms content distribution solution where same video was pre-loaded during off peak demand and then sent to the user’s handset in just 6 seconds. This results in a much better user experience, significant savings in handset battery consumption, and increased radio utilization.

Recently Edge Datacoms launched a smart cell proxy upload for cloud applications. Smart cell proxy upload allows user generated content, such as photos and videos, to be uploaded to the smart cell and then uploaded to cloud or social media hosting web sites when the backhaul network has available capacity. This revolutionizes the use of personal cloud services like Ubuntu* One. Side loading

Figure 3. Impact of smart cell on user experience
gives users a high speed service, while minimizing handset battery consumption and reducing the peak load on the operator’s backhaul network.

“Anyone who has watched OTT content on a mobile device or uploads videos and pictures will immediately notice the startling difference in user experience,” commented CEO of Edge Datacoms, Andrew Hurdle. “This allows network operators to differentiate their service offerings from their competitors.”

**IneoQuest* Enables Real-Time Video Analytics for Smart Cells**

The explosive growth of video in mobile networks is creating an essential need for analytics by service providers looking to monetization mobile video services. Of particular interest is data that provides insights into the end user viewing experience and behavior, as this provides invaluable insights into how to reduce churn, validate policy control, and increase advertising revenue.

IneoQuest has deployed its video analytics solution on the Intel Smart Cell platform, providing operators with extensive real-time behavioral and quality analytics for live and video-on-demand content. Figure 4 shows how the data is captured by the IneoQuest analytics engine deployed on the Smart Cell. The IneoQuest solution provides service providers with the ability to analyze mobile video usage behavior both real-time and historically.

Deployments of the IneoQuest monitoring solution have produced impressive improvements in over-all subscriber experience for video service providers. Operationally, these video service providers were able to reduce truck rolls required to troubleshoot issues by over 50 percent and solve problems faster with a reduction of over 40 percent in the mean-time to repair (MTTR). This results in substantial savings for them in operational expenses and an increase in viewer satisfaction.

![Figure 4. Real-time analysis of the video performance and user behavior](image-url)
“By placing IneoQuest* technology directly in the Smart Cell, the analytics gathered at the edge of the mobile network provide an incredibly accurate and in-depth view of how well the infrastructure is delivering the video and advertising” said Eric Norton, VP of Marketing & Product Management at IneoQuest. “It shows in real-time how the delivery network, client devices and video players are performing across the different adaptive video delivery protocols such as Adobe* HDS, Apple* HLS, Microsoft* Smooth Streaming, or MPEG* DASH.”

Saguna Networks* Monetize OTT Applications with Smart Cells

Slow network responsiveness causes users to abandon web transactions, do less browser searches, and view fewer pages. Slow network responsiveness can be directly linked to reduced sales and advertising revenue. To improve the user experience and revenue opportunities, content delivery networks have moved content and applications physically closer to the end user.

Saguna Networks specializes in content caching in the Radio Access Network (RAN).* Both FibroLAN* and Ubiquisys* have integrated Saguna Networks’ software into gateways that are physically collocated at the base station. The Saguna Networks solution is shown in Figure 5.

In live deployments, the Saguna Networks’ solution has reduced the time taken to start a video by 30 percent and the time to download a web page by one to two seconds. This represents a significant reduction in the latency from requesting a service to the delivery of “true mobile broad band experience”.

In addition to improving the user experience, the Saguna Networks’ solution also resulted in almost a 35 percent reduction in peak traffic over the backhaul network, and a fifteen percent increase in the availability of radio bandwidth. These levels of improved network performance can have a dramatic impact in increasing the service provider’s profitability.

Saguna Networks’ Founder and CEO Lior Fite explained: “The global move into 4G networks is designed to satisfy the demand for more bandwidth. More bandwidth at the radio does not necessarily mean more revenues, better user experience or lower operational cost. The Intel* architecture based smart cell platform will allow mobile operators to sell IT real-estate at the Radio Access Network and to monetize their most valuable assets without compromising any of the network features.”

![Saguna Networks* Content Delivery Optimized System](image-url)
Smart Cell Revolutionizes Service Delivery

Running applications and storing data on the edge of the network gives content providers a distinct advantage. It has been shown to reduce latency and deliver the always-on service delivery that smartphone and tablet users are starting to demand.

Service providers own and manage the premium real estate for delivering services with the quality of experience being demanded by mobile subscribers. The Intel architecture based smart cell platform is enabling these service providers to offer their infrastructure as a service (IaaS) and become part of the Over the Top (OTT) content delivery model.

The Intel architecture based smart cell provides a virtualization platform that meets the stringent 4G data rate and latency requirements. It enables applications and services that today run in the data center to run at the network edge, creating revenue opportunities for the service provider. The Intel architecture based smart cell platform allows service providers to leverage the rich and extensive software ecosystem built around Intel architecture that are already driving the cloud and datacenter growth.

For further information about the Intel architecture based smart cell platform and other Intel initiatives in this area, go to www.intel.com/go/commsinfrastructure
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