EVOLVING SYSTEMS

White Paper

Using Intelligent M2M Controller™ - Scenarios

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Introduction

"50 billion connected devices by 2020" – Hans Vestberg, Ericsson

While one may debate the forecast number of connected devices, there is no doubt that wireless operators around the World are conceiving and executing on connected device strategies. Just look at the number of operators starting to report connected device numbers in their financial reports as evidence.

It is the intersection of a number of technological and market development trends that are fueling the interest in connected devices. Both connected consumer electronics and industrial machine-to-machine (M2M) modules will create billions of new wireless-enabled devices. But the growth of these markets poses real challenges to operators due to significantly different distribution and provisioning requirements amongst other issues.

In a white paper from Evolving Systems, "Using Intelligent M2M Controller", February 2010, we set out the case for using the IMC solution as an important tool for cost minimization and operational efficiency in connected device and M2M applications.

That earlier white paper introduced some of the issues and challenges of connected device and M2M applications – also called telematics or telemetry – and provided an overview of how dynamic provisioning can help operators avoid costs, through **minimizing the cost of inventory**, by provisioning devices at the time of first use. And, for intermittent transmitters, **avoid provisioning costs altogether** by allowing devices to attach temporarily to the wireless network.

This paper explores in more detail the various scenarios. In doing so, it presents a framework to help think about the type of connected device and what kind of wireless connectivity each type of device needs.

Issues and Challenges

In our earlier white paper, we noted that, while connected device and M2M applications can drive traffic over operators' existing infrastructure and generate incremental revenue, they also introduce new challenges. The issue presented included the inefficient and costly use of network database capacity and number ranges, and was mostly concerned with distribution and provisioning challenges.

Here, we present a broader set of issues, covering more of the supply chain, before moving on to describe a framework for thinking about the different connectivity requirements of connected devices. At a high level, there are four aspects to the supply chain:

- Commercial model and pricing
- Production and testing
- Distribution and provisioning
- Connectivity and support

Starting with the commercial model, operators must deal with the impact of ARPU dilution – M2M applications such as smart metering are estimated to generate $7 revenue per year compared to contract ARPUs as high as $60 per month in developed markets. This is possibly one reason operators are going to market with specialist M2M service providers or MVNOs in addition to leveraging the specialists' domain knowledge and lead generation capability.

However, M2M applications can have higher profitability since the operator does not have the marketing, acquisition and support costs normally associated with mobile devices. (There are also some M2M applications, such as remote cardiac monitoring, that can have very high ARPUs but clearly are much lower in volume.)

Another issue is supporting "comes with data" pricing models where the cost of the device includes an amount of mobile data – whether time-limited ("first year's service included"), transactional ("includes the synchronization of the first 1,000 digital photos"), or volume-based ("first 10 GB of data included"). The relevant tariff type is often device-specific.

For example, mobile data for a notebook or laptop may be better understood by consumers as a time-limited plan especially when compared to home broadband tariffs that are priced at $X per month (even though they may also have volume-based usage caps). For smartphone data plans, however, a volume-based tariff may be more acceptable since phones are always-on – few people think about having their phone switched on for only a couple of hours per day.

The pricing model for connected devices also requires operators to think about moving away from contract billing models and towards pre-paid subscriptions – few, if any, consumer electronics manufacturers or retailers have the experience or desire to deal with contract paperwork at the point-of-sale. For example, valued-added services for personal navigation devices, such as traffic alerts, gasoline / petrol prices, and speed camera locations, are typically offered as an annual subscription paid for in advance by credit card. High-end devices often include the first year's subscription in the retail price.

The next two phases of the supply chain are interlinked. For the production and testing phase, operators need to deal with potentially complex production and assembly processes. A wireless module could be first put into a sub-assembly and tested in one country before being shipped to another country for final production and testing. The tests may involve validating the module can connect to the wireless network.

However, operators must also recognize the longer supply chain and “shelf life” of these devices, as well as the lack of control and insight into retailing or installation. This means that provisioning a device, and/or paying for it to be present in the network databases, from the moment it is assembled and tested onwards means that many months could pass where a cost is incurred before revenue is generated. It also means that numbers are allocated to a device a long time before it is ever sold or installed, and any wastage in the supply chain, as well as a large inventory, lowers the utilization of numbers, potentially increasing costs and attracting penalties from numbering authorities.

Connectivity Scenarios

There are three main aspects of the connectivity and support phase:

- Connectivity requirements
- Device behavior
- Device management and diagnostics

In this section, we present a framework for describing the connectivity requirements of connected devices.

First, we have to consider whether the device will require periodic or permanent access to the wireless network. Note that periodic access does not imply infrequent access – a device may report its status every few minutes and this would still be periodic access.

Next, we differentiate between devices where the access to the wireless network – the sending of a message or data packet – only originates from the device, or where messages can be sent to, or terminate on, the device. The latter case implies that some central monitoring station can, either as a matter of course or just in emergency situations, try and send a message to a remote device at any time.

Note that the ability to terminate a message on a device at any time requires the device to have permanent access to the wireless network – it must always be connected, “listening” for the paging attempt from the network to find it.

Finally, there is a distinction to be drawn in the case of permanent access – is the device moving or does it remain in one place? The following table summarizes the options with example applications.

	Messages originate from the remote device only	Messages can also terminate on the remote device
Periodic access	In industrial monitoring and security or metering applications, the remote device may only report data periodically. During the reporting session, data communications is two-way, so the device can receive data such as new reporting schedules.	Not applicable.
Permanent access – device static	In video surveillance or monitoring applications, there may be a requirement for one-way streaming of data from the device. Control signals, to move a camera, would not be supported in this scenario. Possibly other types of monitoring application too – for example, telemetry from vending machines or medical devices as long as they are fixed in location. Again, control signals would not be supported.	Similar to the “periodic access” applications above left, but the central monitoring station requires immediate access, at any time, to a remote device. For example, this could be for diagnostics and remote administration, or for turning supply on or off. Also for video surveillance and other kinds of monitoring where control signals have to be sent. Wireless-enabled display signs or billboards would also fall into this category.
Permanent access – device mobile	Certain types of monitoring application – for example, automatic tracking for insurance purposes or security.	The most flexible scenario where the remote device can send or receive information at any time.

The behavior of a device towards the network can be thought of as how well the device’s radio implements the specifications for signaling on the network – whether they are *de jure* standards or *de facto* characteristics. Some devices can behave very aggressively towards the network, issuing far more messages than normal mobile phones. It is very important to mitigate the effect of these devices since the signaling bandwidth on the network is limited and the aggressive behavior of devices can result in the experience of other users being affected negatively.

Finally, devices have to be managed, both in terms of diagnostics and fault finding, and also concerning the life cycle of a device which is eventually decommissioned or retired. Just as the integration of asset management and provisioning helps manage the early stages of the life cycle during production and testing, the provisioning platform must also support management and diagnostics.

Scenarios and Benefits

Looking at the connectivity requirements framework from the previous section, we can propose three scenarios.

	Messages originate from the remote device only	Messages can also terminate on the remote device
Periodic access	Intermittent Transmitters	
Permanent access – device static	Always-on, Static Connections	
Permanent access – device mobile	Normal Connections	

They are:

- Intermittent Transmitters – The remote device only temporarily attaches to the wireless network to periodically send and receive data. Messages cannot be terminated on the device unless during the temporary session.
- Always-on, Static Connections – The remote device has a permanent connection to the wireless network and can originate and receive messages at any time. However, because the devices are static and not moving between cell sites, the utilization of MSISDNs can be optimized by sharing MSISDNs between devices in different locations.
- Normal Connections – The remote device has a permanent connection to the wireless network and has its own unique MSISDN. The device can be fully mobile.

Each scenario is described in more detail below.

Intermittent Transmitters

The remote device temporarily attaches to the wireless network according to a schedule, in response to a detected condition, or when instructed to by the user of the device. When attached, the remote device can receive messages from a centralized system to, say, modify the future schedule of reporting.

In this scenario, the permanent allocation of a MSISDN and the provisioning of the MSISDN / IMSI pair into the network databases would be wasteful. For large periods of time, those resources would be unused, as the device is not connected to the wireless network. Also note that the majority of energy used by the device's radio would be wasted if it was permanently attached to the network.

IMC can, in this case, avoid the provisioning of the device into the network databases completely as IMC itself acts as the gateway between the device and the centralized systems. Essentially, IMC acts as the HLR / AUC and enables temporary sessions where the device can send and receive data. During each session, IMC allocates a temporary MSISDN from a pool that is shared between devices, helping to improve MSISDN utilization.

In summary, this approach:

- Does not use traditional HLR / AUC space, avoiding those costs completely
- Needs fewer MSISDNs, improving utilization and saving costs
- Integrates with asset management to support the device life cycle
- Enables custom mitigation strategies for devices with aggressive behavior

Always-on, Static Connections

The remote device is permanently attached to the wireless network, allowing it to send and receive messages at any time. Because it can be reached from a centralized system, there has to be way to address it with a MSISDN or similar.

However, where the remote device is static and not moving, there is the opportunity to improve the utilization of MSISDNs by sharing them amongst different devices in different locations. As long as the devices don't move, there is no chance of a conflict when trying to address them using a non-unique MSISDN.

In this scenario, IMC again acts as a gateway between the device and centralized systems. It has a new role in mapping unique device identities into the combination of MSISDN and location. But again it can completely avoid the provisioning of MSISDN / IMSI pairs into the network databases.

In summary, this approach:

- Does not use traditional HLR / AUC space, avoiding those costs completely
- Needs fewer MSISDNs, improving utilization and saving costs
- Translates from unique device identities to the correct network addresses
- Integrates with asset management to support the device life cycle
- Enables custom mitigation strategies for devices with aggressive behavior
- Has special handling for devices on the edge of location areas

Normal Connections

In this scenario, the remote device has permanent access to the wireless network and is fully mobile. That means it must be provisioned in the traditional network databases – a minimum of the HLR and AUC – and is effectively indistinguishable from any other mobile device.

However, the longer supply chain and "shelf life" of these devices, the unfamiliar retail channels, and the subsequent lack of control and insight into retailing or installation, means traditional provisioning approaches are far from optimal. Provisioning a device when it is assembled and tested, rather than when it is used for the first time, means that many months could pass where a cost is incurred before revenue is generated. It also means that numbers are allocated to a device a long time before it is ever sold or installed; any wastage in the supply chain, as well as a large inventory, lowers the utilization of numbers, potentially increasing costs and attracting penalties from numbering authorities.

Evolving System's *dynamic provisioning* solution, called Dynamic SIM Allocation™ (DSA), provides supply chain and network database cost savings in this scenario as devices are only provisioned when they are first used. As well as saving costs, and helping improve number utilization, this also results in a more flexible supply chain. For instance, wireless-enabled devices can be moved between distribution centers freely without any concern about which region of a wireless network for which they may have been provisioned.

In summary, this approach:

- Defers the provisioning of traditional HLR / AUC databases, reducing costs
- Avoids the wastage of MSISDNs, improving utilization and saving costs
- Integrates with asset management to support the device production / testing time line
- Enables custom mitigation strategies for devices with aggressive behavior

Summary

It is clear that connected device strategies are important to operators around the world. In the second quarter of 2010, for example, the two largest wireless operators in the US, AT&T and Verizon, added more connected devices than postpaid connections. For AT&T alone, connected devices account for about 7% of subscriptions. (Source: Chetan Sharma Consulting, August 2010.)

What is also clear is that there are real challenges facing operators with these new devices, ranging from commercial models through to provisioning wireless connectivity. This paper introduced a framework for thinking about the different types of connected device and the appropriate provisioning strategy for each. By looking at how and when a connected device will attach to the wireless network, and by adopting solutions such as IMC and DSA, operators can find new supply chain and network cost savings.

These savings can help drive the development of connected device and M2M markets and applications, giving operators new tools to find efficiencies, drive volumes, and scale these exciting new business segments.

About Evolving Systems

Evolving Systems, Inc. (NASDAQ-EVOL) is a provider of software and services to over 70 network operators in more than 40 countries worldwide. Its portfolio includes market-leading solutions for activation, dynamic allocation, number portability, number inventory, M2M and mediation. Founded in 1985, the Company has headquarters in Englewood, Colorado, with offices in the United States, United Kingdom, India and Malaysia. Further information can be found at www.evolving.com