Tec

Tech Brief |

Enterprise

Aruba’s Mobile Voice Continuity Solution

ARUBA®

networks
Introduction
There is much evidence that Enterprises are ready for a dual-mode Wi-Fi – Cellular mobility solution: this is clear from the technical press, analysts and from Aruba’s own customers. This interest has prompted Aruba to look at the state of the art in dual-mode handsets, IP PBXs and the different forms of FMC (fixed-mobile convergence) solution available in the market.

We segment the market into three categories of service provider or vendor:

- Services from large SPs (service providers). These organizations are looking from the start for a network and service that will scale to millions of subscribers. In FMC many of these vendors have an existing cellular network, and in general their vision is to extend the reach and feature set of their cellular offering (migrating over time to IMS) to all forms of network access. Applied to Wi-Fi – Cellular dual-mode, this means that these SPs stress the cellular feature set and seamless transitions (handovers for voice calls) as the user moves between the different access networks. Aruba is active in these areas, as our architecture and features offer many advantages whether used in a UMA, MobileIGNITE, IMS/VCC or other network model.

- Services provided by PBXs. PBX vendors started in FMC somewhat later than the SPs, but they can move faster and we expect FMC announcements from all the major PBX vendors over the next two quarters. The PBX vendors stress the power of their significant feature sets – far greater than the cellular operators can match. Their aim is to enable the user to access all these features at all times, whether in Wi-Fi or cellular coverage. They are less concerned about seamless handover, often preferring to give the user the option to select the access network. These FMC solutions are ‘operator un-aware’ in that they do not depend on co-operation from the cellular operator, and the basic architecture involves using the PBX as an anchor point for all calls, so it can forward them to the cellular network if the phone is out of Wi-Fi coverage. Aruba works with several PBX vendors, in particular our OEM partner Alcatel, and Avaya where we are Premier members of the DevConnect partner program. Aruba is working on a number of features for tighter integration between the WLAN and the PBX or SIP communication server in such architectures, and particularly in FMC.

- This leaves a gap in the market for those Enterprises who want to move quickly to a dual-mode FMC solution, but for whom a basic feature set (e.g. cellular service features) is sufficient. There are a number of new entries into this market, generally adding an appliance as an adjunct to the PBX. This appliance handles call forwarding to the cellular network to achieve seamless mobility independent of the cellular operator, but represents an extra product and vendor in the network. After evaluating the needs of this market segment, we believe Aruba’s architecture offers some unique advantages; the remainder of this article explains this new set of features, known as Aruba’s Mobile Voice Continuity.

Aruba’s Mobile Voice Continuity Architecture
This architecture depends on one new product; the dual-mode phone client, and one new feature; the Mobile Voice Continuity license on the Aruba (MC) Mobility Controller.

Working together with an existing SIP PBX or softswitch, these allow seamless transition of voice calls from Wi-Fi to cellular coverage. Further, Mobile Voice Continuity for a multi-site Enterprise enables the dual-mode phone to act as a PBX extension wherever it accesses the network, whether at the corporate headquarters, a regional, branch or international site or in an employee’s home office. At all these locations, the phone will act as an extension on the corporate PBX and the call will not incur any cellular access or calling charges.
The diagram above shows the basic architectural model for a single-site MVC network, illustrating the handover function. Consider a call between a dual-mode phone in Wi-Fi coverage and a destination: for this example the destination is a POTS phone on the public phone network (PSTN – public switched telephony network), but it could be another extension on the PBX, wired or Wi-Fi, or any other dialed destination.

This call is a VoIP (voice over IP) call from the phone, carried across the Wi-Fi access network and the corporate LAN until it reaches a telephony gateway which adapts it to the public telephone network. The call is controlled by the PBX acting as a SIP server.

This is where Aruba’s architecture becomes important. The MC (Mobility Controller) is an aggregation point through which all Wi-Fi traffic must pass. It is also built on dedicated network processor and encryption hardware, allowing it to monitor all packets in real-time: this is the underlying functionality that has enabled Aruba to build a stateful firewall fully-integrated into the architecture. In this case, the MC monitors the signaling and media streams to and from the Wi-Fi phone, allowing it to determine the destination and characteristics of the call, as well as the phone number (PBX extension) of the Wi-Fi phone. All this is automatically learned without any configuration: the only remaining information needed in the MC is the cellular number of the phone, which must be entered manually or derived from a corporate directory server.
At this point, the Aruba MC has knowledge of the originator and destination of every call involving a Wi-Fi client, and can identify the media stream carrying that call.

Most calls will begin and end while the phone is within Wi-Fi coverage, and no further action will be necessary. However, if a user is moving out of Wi-Fi coverage, the network must find a way to handover the call to the cellular network. There is an important time dimension to this handover: there may be only a few seconds between an indication of falling Wi-Fi signal strength and the point where coverage is lost, so the decision to handover and then the execution of the handover must be very fast and accurate.

The WLAN is ideally situated to make this decision, as it has complete knowledge of the RF aspects of the network and of every client: no other entity on the LAN has this information. MVC software on the MC detects that the client is about to lose Wi-Fi coverage, and initiates the handover to the cellular network.
Handover is accomplished in a make-before-break manner. First, the MC originates a call via a telephony gateway to the cellular side of the dual-mode phone. This call is terminated, and depending on preference the user may be informed by a tone that the cellular leg of the call is complete. Now, the MC bridges the far end of the original call to the new call leg to the phone over cellular, and the call continues uninterrupted. The phone switches to the new call leg simultaneously, and the old Wi-Fi leg of the call is dropped.
MVC in multi-site networks

Aruba’s Mobile Edge architecture allows headquarters, branch offices, international offices and home offices to operate as a single Wi-Fi network.

- Single point of configuration and control for Wi-Fi
- IP PBX at central location or distributed locations
- No re-configuration of clients for different locations

This offers many benefits, chiefly the ability for any client to appear at any location, successfully authenticate and receive uniform services without any re-configuration.

As the dual-mode phone enters the Enterprise Mobile Edge of Wi-Fi coverage, it detects and connects to the voice (or voice & data) SSID and authenticates, using the same method no matter which location. It then registers with its home SIP registrar, using the corporate data network. In telephony terms, it accesses corporate dial-tone without using any resources from the cellular network. Incoming and outgoing calls are routed by the corporate SIP server, so outgoing calls are routed to the optimum telephony gateway using existing software functions in the IP PBX.

Similarly, incoming calls are routed using the existing IP PBX dialing plan. Calls to a user’s phone are automatically re-directed to wherever the user moves across the Mobile Edge, whether in a headquarters, regional, branch or home office. If the user has a Remote AP (a personal Access Point), this can be set up anywhere with Internet access, and will offer secure telephony service to the Wi-Fi phone.

Internal calls will use the corporate 4-digit dialing plan, while calls from the public and cellular telephone networks dial the user’s DID (direct inward dialing) number in the same way as for a desk phone. Mobile Voice Continuity allows this DID number to become the user’s single number when used with a dual-mode phone.

International Roaming

While national roaming to corporate sites saves cell phone minutes (and sometimes long-distance and international calling charges); users who travel to international corporate locations will enjoy significant savings in their communications budgets. International cellular roaming fees constitute a significant telecom expense for many Enterprises, and while MVC cannot mitigate the cost of calling when the user is in cellular coverage, it eliminates these fees whenever the user is within the Enterprise Mobile Edge.
For example, if the user visits the London office and connects to the corporate Mobile Edge, all incoming and outgoing calls will connect without incurring any international cellular roaming fees. Further, the far-end of the call can be handled using the IP PBX’s least cost routing capabilities.

For example, if a user with a home office in Atlanta travels to London and calls a number in London, the SIP signalling packets will initially use the SIP server – in New York in this case – but the media stream will travel directly to the telephony gateway in London. In this way there is no cellular roaming charge for originating the call in London, and the IP PBX’s least cost routing feature (and the existence of the gateway in London, either via an IP trunking service or as part of the corporate voice network) ensures that the far-end of the call to the destination in London is charged only as a local call from the telephony gateway. Knowing the physical location of the roaming subscriber, and the local SIM card type[ O2 or T-Mobile] used, policies provisioned in the MC will trigger the trunk selection algorithm to select the least expensive route to continue the call segment.

Similarly, incoming calls to the user’s DID number will be routed to the usual incoming telephony gateway – perhaps in New York in this case – and complete over the corporate data network, so the caller experiences nothing unusual.

One interesting consequence of the MVC solution is that as a user on-call walks out of a corporate building, the call hands over to cellular. If the user is in London, with cellular service from the US, this could be an expensive call, and the user or telecom administrator might prefer not to incur the cost. The MVC solution accommodates this in two ways. First, it is possible to set up the phone so there is audible warning of an impending handover to cellular, so the user may choose not to accept the call. Second, MVC software allows the administrator to restrict international calling: either of these features will control such costs.
Other Considerations

Benefits to the user

- Single device
- Single number (although the phone’s cellular number is present, the user can be reached at all times via the PBX DID number)
- Always reachable from the PBX via the internal extension number (4- or 5-digit number)
- Single voice mailbox, i.e., enterprise voice mail

Benefits to the telecom manager

- Provide users with single-number, single-device capability for productivity and convenience
- Cost savings (see detailed listing below): For example, calls from Enterprise Wi-Fi coverage do not use the cellular network, and since more than 30% of business calls over cellular are made from the office, cellular calling plans can be reduced by this amount.
- Cost savings: calls originated from Enterprise Wi-Fi coverage make use of the PBX’s least cost routing capabilities, particularly important for international calls.
- Cost savings: all corporate sites (and home offices with corporate Wi-Fi) support corporate phones, no matter where they were originally registered (a feature of Aruba’s Mobile Edge). This is particularly important for international roaming, where calls from Enterprise Wi-Fi coverage will not touch the cellular network.
- Minimally invasive. There is nothing the telecom manager needs to reconfigure when adding this feature to an existing Aruba WLAN: existing Wi-Fi phones still function as before, and the system learns internal extension numbers automatically. There are two additional items to configure: the MC requires a number of dummy extensions on the PBX to originate calls for handover, and each dual-mode phone’s cellular number must be added to the database.

Notes on handset selection

Phones are the key to customer acceptance of any telephony service. With our new MVC architecture, Aruba will initially offer two options:

- A phone designed especially for this service. This ‘candy bar’ form-factor handset has state-of-the-art GSM and Wi-Fi calling features. It is an inexpensive phone aimed at users who value simplicity, low cost and small form-factor. As it is based on the Linux operating system, Aruba has designed a custom client for this handset that will become a reference design for such clients. As the client is designed for use with the MVC solution, it will feature completely seamless handover operation as one of the user options.
- Off-the-shelf dual-mode phones. Most cell phone vendors are now introducing dual-mode devices, and these will all work within Aruba’s solution. Because Aruba does not control the user interface, it is likely that handover will depend on user intervention – when moving out of Wi-Fi coverage, it will appear that a new cellular call is arriving: when the user presses the button to receive the call, he will be connected to the previous call extended to cellular.

Notes on Cellular technology

Although the initial handsets qualified with this service will be GSM – Wi-Fi dual-mode handsets, the architecture supports other cellular technologies such as CDMA and UMTS from the beginning – there is no dependence on the cellular protocol.
Notes on scalability
A number of aspects of Aruba’s Mobile Edge architecture lead to spectacular scalability for MVC compared to any other dual-mode architecture:

- Aruba markets a range of Mobility Controllers, scaling to 500+ dependent APs and 4000+ simultaneously-associated clients. Furthermore, MCs can be configured in master-slave hierarchical networks including 100+ MCs, each with dependent APs and clients.
- Each MC is based on network processor and encryption hardware. This provides significant scalability, with an encrypted throughput per MC in excess of 5Gbps.
- The MVC architecture does not require the MC to maintain SIP sessions for ‘normal’ Wi-Fi calls: calls that never move out of Wi-Fi coverage impose no extra processing burden on the MC.
- It is only when active clients start to move out of Enterprise Wi-Fi coverage that the MC has to originate calls to cellular, and join the media streams of the different call legs. Since the media stream is always processed in hardware, this is still not a significant processing burden on the MC.
- Compare this to other architectures, where all processing is in software and every call requires a complete session termination: while these architectures struggle to support even a hundred Wi-Fi calls, Aruba’s MVC solution immediately scales two orders of magnitude further.

Notes on financial analysis
Detailed analysis of the sources and scale of savings depends on many Enterprise-specific factors, and pro-forma analysis is necessarily superficial. The following should be taken as a checklist or guide for tailoring to the individual circumstances of a corporation.

- Purchasing phones.
  - Each user of MVC services requires a dual-mode phone. The cost will vary: Aruba’s initial customized phone is expected to retail in the order of US$200-300, while off-the-shelf dual-mode phones currently range from US$350 to US$500+ for a full-featured ‘smart phone’.
  - However, cellular SPs in most countries subsidize the cost of phones sold with service plans, and as they add dual-mode phones to their menu we expect to see a subsidy of US$50-150 per phone.
  - Also, if the user receives a dual-mode mobile phone in place of a desk phone, the cost of the desk phone (a wired VoIP phone in this case) can be defrayed: this could be US$100-400 depending on the model.
  - Note that IP PBXs often include a per-seat software license for each SIP extension: this would be the same regardless of whether MVC or a desk phone is used, but if a user has both, then two licenses may be necessary, at US$50-100 each.
- Domestic (national) service.
  - Most business users today subscribe to cellular calling planes with buckets of minutes. The financial advantage of MVC in this case is to reduce the number of minutes used each month, allowing a reduction in the calling plan. Analysts consistently estimate that 30% and more of business calls are placed or received from within a corporate building, so it will be possible to reduce calling plans to 50-70% of prior levels, resulting in measurable monthly savings.
  - Most cellular calling plans include unlimited national long-distance calling. However, for those that do not, MVC presents savings by switching outgoing calls (when the user is in corporate buildings) from the cellular network to the IP PBXs least cost routing network. Most corporations have negotiated rates in the order of US$0.02 per minute, compared with per-minute rates in the order of US$0.05 to US$0.30 for cellular calling plans.
  - When the user makes international calls, considerable savings are realized. As above, calls are now routed by the corporate IP PBX and enjoy the bulk rates negotiated by the corporate telecoms department. For instance, a call placed from the New York office to a London number might be charged at US$50 per minute by the cellular SP, but only US$10 per minute using the Enterprise tariff.
• International roaming charges.
  o International roaming constitutes a significant part (around 10%) of cellular SPs’ revenues (it is an even more significant contributor to their profits). It represents a greater proportion of corporate telecoms expenses. The fraction of international roaming fees incurred when a user is at a corporate location (placing or receiving calls) can be completely eliminated through the use of MVC.

• Mobile Edge savings.
  o As the Enterprise moves to a fully Mobile Edge, including MVC services, it becomes unnecessary to provide wired desktop phones. In addition to the savings from not purchasing these phones, there are potential installation and administration savings in terms of moves-adds-changes (MAC) because mobile phones are self-administered by the user. As Enterprises use various internal accounting models for these costs, they are difficult to quantify without reference to a particular business.
  o A corporation moving to a new site, whether newly-constructed or previously occupied, may be able to recognize significant savings from two further areas. Wiring to cubicles is no longer necessary when data and voice devices are Wi-Fi connected, so wiring need not be installed or checked. Further, wired LAN infrastructure can be reduced, as fewer wired Ethernet ports are required: only one port per Access Point rather than one or two ports per cubicle.
Simple Financial Analysis

The following is a simplistic calculation, the discussion above provides pointers for developing a model tailored to the particular Enterprise. The user profiled below makes international calls, and is a significant international traveler.

<table>
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<tr>
<th>Fixed expense without MVC (per user)</th>
<th>Fixed expense with MVC (per user)</th>
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<tr>
<td><strong>Business mobile phone with SP subsidy</strong></td>
<td>Aruba business dual-mode phone with no SP subsidy</td>
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<tr>
<td><strong>Low-end wired VoIP desk phone</strong></td>
<td>Desk phone not required</td>
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<tr>
<td><strong>Extra hardware/software</strong></td>
<td>Mobile Edge Convergence license, per extension (*** budgetary only: dependent on installation size, etc)</td>
</tr>
<tr>
<td><strong>Setup &amp; configuration costs</strong></td>
<td>Setup &amp; configuration costs (0.1 hrs @ $100)</td>
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<tr>
<td><strong>Total fixed expense</strong></td>
<td><strong>Total fixed expense</strong></td>
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<tr>
<td><strong>Differential cost of MVC</strong></td>
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<th>International Roaming Scenario</th>
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<td><strong>Monthly Expense without MVC</strong></td>
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<tr>
<td>Calling plan with 1500 minutes</td>
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<tr>
<td>Outgoing international calls from corporate locations in home country: 30 minutes @ $0.50</td>
</tr>
<tr>
<td>International cellular roaming charges when placing &amp; receiving calls from corporate locations in foreign countries: 60 minutes @ $0.50</td>
</tr>
<tr>
<td>Cost of international calls made when in corporate locations in foreign countries: 30 minutes @ $0.50</td>
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<tr>
<td><strong>Total monthly expense</strong></td>
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<td><strong>Monthly savings</strong></td>
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<td><strong>Payback period for MVC (International roaming)</strong></td>
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<th><strong>Local Dialing Scenario</strong></th>
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<td>Calling plan with 1000 minutes</td>
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<td>Assorted overage/roaming charges (while in Mobile Edge coverage but using cellular)</td>
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<tr>
<td><strong>Total monthly expense</strong></td>
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<tr>
<td><strong>Monthly savings</strong></td>
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<tr>
<td><strong>Payback period for MVC (Local roaming)</strong></td>
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About Aruba Networks, Inc.

Aruba securely delivers the enterprise network to users, wherever they work or roam, with user-centric networks that significantly expand the reach of traditional port-centric networks. User-centric networks integrate adaptive WLANs, identity-based security, and application continuity services into a cohesive, high-performance system that can be easily deployed as an overlay on top of existing network infrastructure. Adaptive WLANs deliver high-performance, follow-me connectivity so users are always within reach of mission-critical information. Identity-based security associates access policies with users, not ports, to enable follow-me security that is enforced regardless of access method or location. Application continuity services enable follow-me applications that can be seamlessly accessed across WLAN and cellular networks. The cost, convenience, and security benefits of user-centric networks are fundamentally changing how and where we work. Listed on the NASDAQ and Russell 2000® Index, Aruba is based in Sunnyvale, California, and has operations throughout the Americas, Europe, Middle East, and Asia Pacific regions. To learn more, visit Aruba at http://www.arubanetworks.com.

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