Building the Next-Generation End-to-End IP Communications Architecture

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As communications networks migrate to voice and video over IP, and as mobile networks upgrade to 4G, we're moving toward the day when IP is deployed ubiquitously as the native protocol for all communications, public and private, wireline and wireless. Having a common underlying protocol allows for an explosion of new services, devices, and applications that enterprises will be able to leverage (and even invent themselves) to drive a transformation in their business. And of course many if not most of these new transformative services will be driven by enterprise workers from their roles as consumers.

That's the good news. The bad news is that this IP layer is about all that the enterprise networks, services, and devices will have in common. Transformational services and applications will be delivered by a plethora of different service providers, equipment vendors, device manufacturers, and application developers. Enterprise network decision-makers will have to orchestrate and integrate these widely divergent elements; this bridging of diverse networks and functions represents true federation.

It should be noted that many in the industry use the term "federation" to refer to something less than this complete, seamless connection. Some describe federation as nothing more than their own technologies talking to one another across enterprise domains. But to have any real meaning in the industry, federation must provide a truly complete bridging across any two network domains, so that the widely divergent networks and platforms can function as a single system, transparent to the end user.

This federation will be provided by an open, vendor-agnostic, extensible architecture that ensures the three basic functions that all communications must provide if it is to be enterprise-grade:

- Connectivity
- Security
- Control

Communications professionals know that in previous generations, the PBX was very good at providing these characteristics. And PBXs themselves will be around for years to come, continuing to deliver these essential qualities for some segment of enterprise organizations. But of course the PBX is no longer the center of gravity for many enterprises. Mobility is increasingly the largest single cost in enterprise communications, and is often completely beyond the control of the PBX and those who manage it. Likewise, the legacy architecture of PBXs hardwired to desktop telephone sets delivers only a fraction of the value that real-time communications promises in an era when voice and video can be integrated into business applications that users "live in" as their main tools to get their jobs done.

What many enterprise decision-makers would like is to be able to carry forward the essential qualities of the PBX—connectivity, security, and control--into the new world where communications systems are so diffuse and under the control of such a wide range of stakeholders, from the end user to the datacenter organization to the application developers, and more. This will require not just technology but organizational initiatives—building bridges to the teams responsible for the enterprise datacenter, cloud services, application development and deployment, network infrastructure, and security.

To make this orchestration of diverse elements a reality, enterprises need a new architecture where, even as the PBX itself plays a more peripheral role, its function as a secure point of control and connectivity can be taken up by new network elements and processes. Unlike the PBX, this will not be a single "box" or type of box; rather it will be a set of functions that ties together the many elements of a modern communications architecture.

Not every enterprise will need every element of this architecture, but enterprises will share a common goal: To move from "call control," where one or more PBXs managed the routing and handling of telephone calls, to the use of a core communications controller that performs session management, database-driven policy control, user registration, and application integration.

Logical Layers and Edges

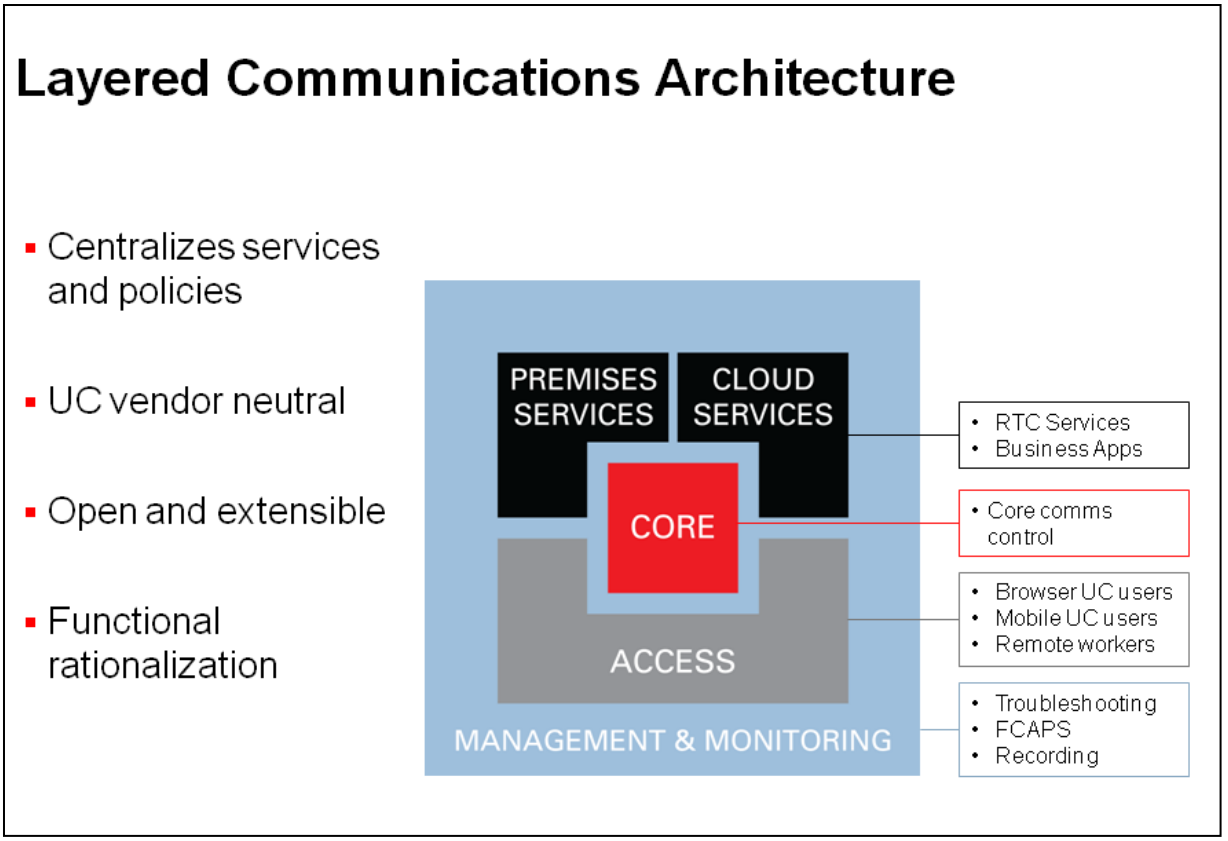
We'll start with a high-level view of the architecture, and then zoom in to take a closer look at more of the specific elements.

From a high level, the architecture is composed of layers as shown in the schematic below. Key to understanding this view is the notion of multiple network edges—the places where different networks come together and usually require some kind of border element to serve as a media and signaling gateway, and security point. Network edges have always required border elements; the most common such element today is the Enterprise Session Border Controller or E-SBC. The E-SBC remains the most common of these border elements in the new architecture, but it's not the only one; for example, a Branch Office may use nothing more than a legacy Media Gateway to connect it to the legacy PSTN.

These network-layer border elements are critical to fulfilling one of the most important requirements of enterprise networking as we go forward into the era of BYOD and anytime/anywhere access: They ensure that the end user can securely connect into the enterprise and securely derive any and all communications services to which that end user is entitled (and that his or her device will support).

But there's another kind of edge, another point where different services come together and which the enterprise must mediate if it is to deliver next-generation services to its users anytime, anywhere. This is what Rob Popovic of Oracle calls the "new border" or the "application edge." It's where two types of applications come together. This could be applications using the same type of service but controlling it differently—e.g., where Microsoft Lync and Cisco telephony come together and must be brokered. Or it could be where two different applications need to be combined into a single multimedia service, such as when an Application Server needs to access communications resources to deliver a communications-enabled business process.

Here is where the architecture breaks new ground, by introducing a new element: The Enterprise Communications Broker, which sits at the logical core of the layered architecture, shown in red in the schematic below. The ECB is the key to moving communications across these logical borders between applications.

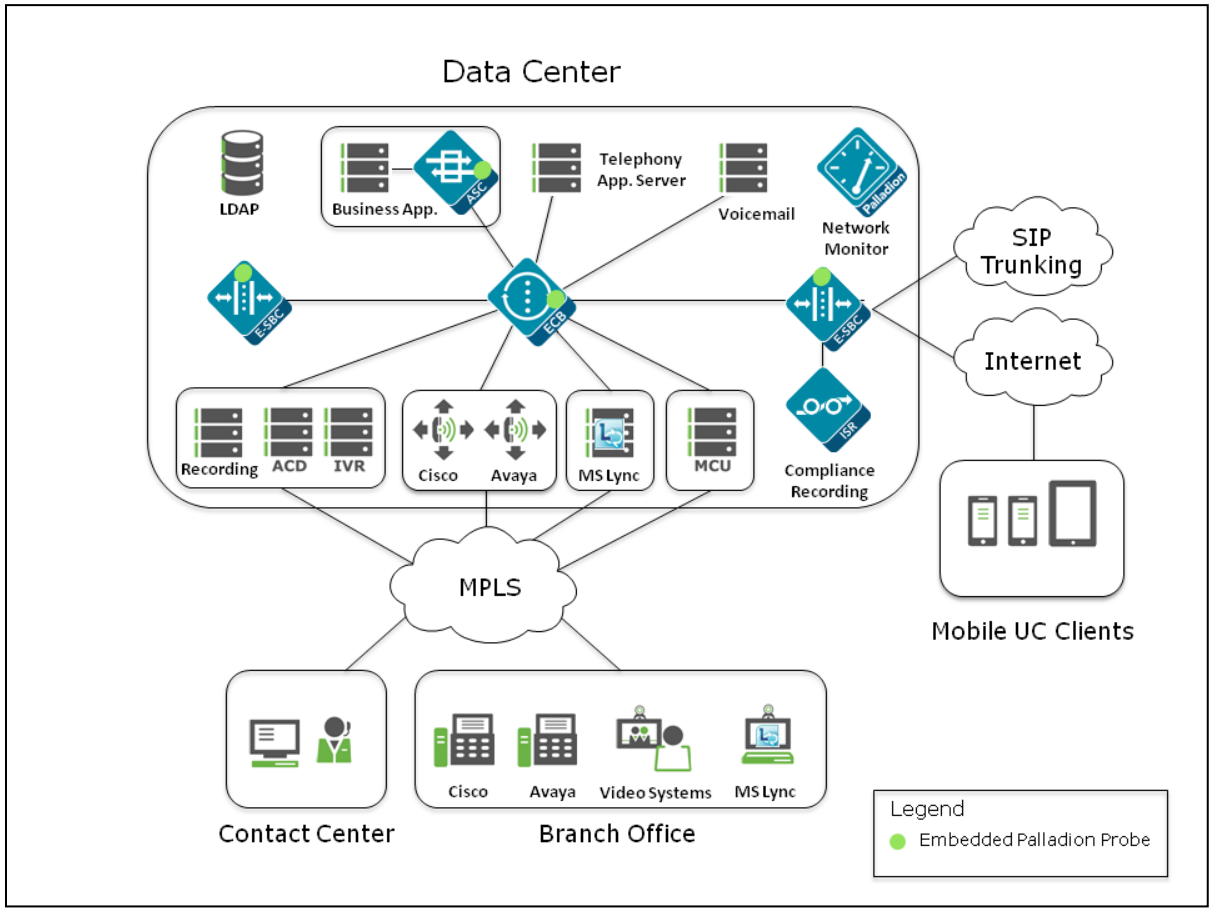


The ECB is a logical function; it need not be a dedicated appliance. The ECB function represents the heart of the new architecture; it serves as the hub for the SIP signaling that drives setup and manipulation of all communications sessions. It has the ability to communicate, either directly or indirectly, with all of the clients and client systems that access the communications assets of the enterprise (the end users, in other words, who are connecting over every conceivable type of network infrastructure, using every conceivable type of media).

The architectural vision uses two basic mechanisms for endpoints to connect, register with, gain credentials from, and find other users within the architecture. These two mechanisms are WebRTC and secure tunnels, both of which can be used to achieve any-to-any endpoint communications over any media and network within the architecture. WebRTC, the emerging standard for communications-enabling Web browsers, will allow a user on any public client to participate in the network via the Web—which will eventually become the default public communications network for all media, replacing the PSTN. Secure tunnels can be enterprise VPNs or direct connectivity into the E-SBC, and will be the connection method of choice for dedicated, enterprise-specific clients.

The Enterprise Federation Architecture: A Closer Look

Now let's zoom in and take a closer look at the specific elements that make up the architecture. The following schematic may seem a bit overwhelming, but very little of it should be unfamiliar to today's enterprise communications decision-makers. The elements of this architectural vision represent continuity with the piece-parts that enterprises already deal with; the schematic shows a vision in which the enterprise has built a platform that ties these currently-disparate elements together under enterprise control:



In this large-enterprise vision, the critical elements that run the communication system reside in the enterprise datacenter, which hosts the legacy IP-PBX ("Cisco" and "Avaya" in the schematic) as well as communications applications such as IVR and conference bridging. Also residing in the datacenter is the aforementioned Enterprise Communications Broker, labeled "ECB" on this schematic.

This core controller function—the ECB-- is critical to creating a software-defined environment that can federate all of the legacy and new

communications systems, and expose these systems to enterprise applications, according to Rob Popovic of Oracle. The ECB answers a critical need, he said: “Enterprises need an architecture that embraces investments that they’ve made, and gives them a platform to innovate.”

The ECB abstracts and centralizes key services such as session routing control, directory services integration, policy control and enforcement, and dial plan, in addition to others. (For the rest of this paper, we’ll use the term “session” as the modern-day evolution of the previous idea of a “call,” i.e., any communication established between two or more endpoints, using any media.) A session is much more than a call; it includes voice and video, but also communications such as chat/IM between two or more parties. The ECB also connects service provider networks and the Internet to applications, with security and gateway functions provided by Enterprise Session Border Controllers (E-SBCs); and it provides native SIP session control over the enterprise’s internal MPLS network.

Speaking of the E-SBC, the schematic also shows the continuing importance of this element. In fact, the E-SBC will expand its role in the new architecture. In addition to the edge function shown at the right-hand side of the Datacenter, there may be a second E-SBC residing in the enterprise core (shown here at the left-hand side of the Datacenter), when transcoding and other media handling functions are needed to handle traffic from diverse networks.

A word here about investment protection: As the schematic shows, the IP-PBX remains in place to control the legacy telephony environment at a layer that’s logically below the ECB layer. If the IP-PBX in the drawing is, say, a Cisco device, it can handle Cisco-to-Cisco IP telephony across the network without involving the ECB. However, just by adding the ECB function, an enterprise with a multi-vendor telephony environment (i.e., virtually all enterprises) can extend the life of all of its IP-PBXs—because the ECB now can provide a centralized dial plan across disparate vendor systems, something that has been mostly impossible due to the lack of direct vendor-to-vendor federation. Likewise, the ECB also normalizes the different vendors’ differing implementations of the SIP signaling standard, so that multi-vendor telephony networks can now communicate with each other and these networks can be easily accessed by third party applications. Thus, for the subset of the enterprise that continues to rely on basic telephony as its main or only communications medium, the ECB actually adds value to the legacy systems.

We should also note here that many of these functions that relate to federation of disparate telephony systems can be performed already today, in E-SBCs. The migration of this abstracted telephony control function to the Enterprise Communications Broker is a microcosm of the enterprise-wide migration to an abstracted core that will eventually reach beyond voice telephony to all communications.

So, stepping back to a high-level vision, the architecture links all of the critical elements in the communications network fulfill the three requirements of enterprise communications:

- **Connect:** All IP devices, business applications, and communications systems/applications are linked through the signaling that the ECB provides or normalizes.
- **Secure:** All borders—between network/application and between user/network edge—are protected at the network layer by E-SBCs, with policy brokered through the Enterprise Communications Broker.
- **Control:** The ECB controls the user experience by controlling the signaling that sets up and routes sessions, provides media services as requested by the end device, and (where required) embeds the communication in other business applications.

These 3 qualities are what define communications as enterprise-grade, and the architecture ensures that these requirements are met.

Drawing upon the resources of its constituent elements, the architecture delivers the following key services:

- **Security**—Security is both an attribute of enterprise-grade networks, and a service that must be provided over those networks, via specific devices enacting specific policies. The policies may reside in the ECB, but they are carried out by the E-SBCs and other border elements.
- **Media**—Media either reside on servers or, more commonly, are generated by the end users themselves (who transmit audio and/or video streams of themselves).
- **Interoperability**—Many enterprise decision-makers consider interoperability to be an attribute of an enterprise-grade network, but really it's a service provided within a network, to further the goal of connecting disparate elements. In the architecture, interoperability service is provided by the ECB in conjunction with other elements.
- **Compliance**—The ECB brokers policy elements that ensure the enterprise complies with relevant regulations and best practices in its industry. The

obvious example in the drawing here is Call Recording. The E-SBC within the datacenter communicates with the Call Recording Servers via a protocol called SIPREC, enforcing the policies that reside in the ECB.

- **Routing**—The E-SBC at the Datacenter edge as shown at right in the diagram routes communications between the enterprise and those outside the enterprise; the ECB located in the heart of the datacenter at left works with the IP-PBXs ("Cisco" and "Avaya") to route internal sessions; those sessions that can be handled as simple PBX calls may not need the ECB's involvement, but multimedia sessions or those that require federation between multi-vendor IP-PBXs, UC systems and other applications will utilize capabilities of the ECB.
- **Directory Services Integration**—The ECB connects the Active Directory/LDAP directory which stores policy information used in call routing and compliance.
- **Endpoint Management/User Registration**—The ECB brokers endpoint management to ensure that clients are registered with the network and provided the resources and permissions to which the devices and their users are entitled.

The Need to Begin the Transition

The discussion so far has been about the opportunity that the new architecture offers, for enterprises that need to bring all their communications together in a way that lets them provide connectivity, security, and control at the level that businesses require. The biggest challenge is that most enterprises are already behind the curve on this effort.

Consider that much of the enterprise has already transitioned to BYOD mobility for many key communications tasks; that next-generation Unified Communications systems, most notably Microsoft Lync, are already spreading through the enterprise like wildfire; and that video is finding its way into more and more enterprise communications sessions. If you haven't already been thinking about crafting a new, more comprehensive architecture for your enterprise's communications, you're already in danger of putting core communications capabilities and enterprise assets at risk—from the perspective of security, productivity, and business process modernization.

It's likely that as an enterprise communications decision-maker, you have already been seeing these issues emerge. Carl Blume, Director of Enterprise Solutions Marketing at Oracle, puts it this way:

"The heat is being turned up on enterprise IT organizations to respond, to provide enterprise-class communications capabilities that are as flexible, as adaptive, and cost effective as users can get in their consumer roles—their consumer lives."

Indeed, while your colleagues and managers within enterprise IT are evaluating your efforts based on efficiencies of management and service delivery, your end users have an entirely new set of expectations--determined by what they are able to do with their consumer devices, which too often are functions that they aren't able to replicate with their work-based systems. To satisfy both of these constituencies, you need to start planning now.

The most important thing that communications professionals can do is to begin building bridges within the larger technology organization in their enterprise. We've seen from the proposed architectures that communications will be woven into the fabric of the datacenter and the applications that run there. That's one organization from which communications has traditionally been separate, with which you now must align yourself more closely. Also, finding those within your enterprise who make decisions on device and service selection for mobile BYOD is crucial—and this is a role that is not clearly defined in most organizations. It may be someone within the current communications structure—or it may be someone from the overall procurement or business units.

Conclusion

Enterprise communications, once the exclusive domain of the PBX, has already fragmented, and many of the pieces today are beyond the reach of the technical managers who once were able to guarantee the connectivity, security and control of the communications environment. If enterprises simply allow this control to slip out of their grasp, they are putting the business at risk—by opening up security issues, losing control over enterprise assets, and failing to optimize the new technologies that users have come to take for granted in their personal lives.

The time is right for enterprise decision-makers to re-assert control over the total communications environment. Innovation—which recently had been almost exclusively the province of the consumer world—is beginning to experience a renaissance within the enterprise communications industry. New players are entering the market with new technologies, and even traditional providers are beginning to understand that they cling at their own peril to the silo-ed, proprietary systems of the past.

This environment of budding innovation is the perfect climate for enterprises to begin crafting a new communications architecture, leveraging an abstracted, software-driven core that can tie together the myriad elements that make up modern communications, and do so in a way that ensures enterprise-grade communications can be provided flexibly, in a scalable manner, and in a way that makes it easy to incorporate cutting-edge innovations almost as soon as they emerge. This new architecture protects legacy investments while equipping the enterprise to move aggressively into the future.

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