MIGRATING TO IMS AND PACKETCABLE 2.0: HOW TO TRANSITION TO NEW MULTIMEDIA AND FIXED MOBILE APPLICATIONS

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Abstract

With ever-increasing competition from telcos, "over-the-top" competitors, and direct broadcast satellite, Multiple System Operators (MSOs) must differentiate with consumer-driven, rich IP multimedia services. How can operators deliver advanced offerings like fixed mobile convergence while simultaneously improving the operational efficiency of their networks? How can MSOs deliver these services today, while ensuring a future roadmap to a next-generation infrastructure?

This paper reviews the forces that are influencing the development of relevant standards to meet these challenges. The standards include IP Multimedia Subsystem (IMS), Session Initiation Protocol (SIP), PacketCable™ 1.x, PacketCable 2.0, and PacketCable Multimedia™ (PCMM). Also included is an example of how an MSO can gracefully migrate from PacketCable 1.x voice services to IMS/SIP multimedia services and the key benefits that such a gradual transition offers.

TECHNOLOGY DRIVERS

As evidenced by the joint ventures between major cable providers and mobile carriers, MSOs are serious about adding mobile services to their cable bundles. Maintaining parity with telcos (with strong mobile offerings already) and changes in consumer media consumption patterns have brought attention to the technology alternatives for multimedia services over cable infrastructures. More and more subscribers want their mobile phones to serve as their primary phones and want the ability to access Internet, video, and other multimedia services from their handsets, PCs, or TVs.

Talk of "triple play" services – data, voice, and video – has evolved to "quadruple play" with the addition of wireless services. But it would be more accurate to describe the vision in terms of delivering "triple play on the move." With that vision comes the desire to introduce blended services such as video phone, multimedia chat, and gaming to a myriad of devices. Subscribers also want to simplify the hodge-podge of multiple phone numbers, subscriptions, passwords, buddy lists, e-mail addresses, etc. In short, they want to be able to get whatever services they want, whenever they want them, regardless of where they are.

To remain competitive, MSOs must provide a variety of new multimedia services in the near term, and in a faster, more efficient way. Examples of upcoming services include "one-number" phone service, unified messages (combining e-mail and voicemail), dual-mode cellular Wi-Fi handsets, video on demand (VoD) streaming to cell phones, and cross-device functions such as controlling electronic program guides with a cell phone, or viewing caller ID using a set-top box (STB).

Looking further out, MSOs will be asked to deliver next-generation capabilities. Examples include buddy lists that span multiple devices (mobile phones, soft phones, and dual-mode phones), content on demand to any device, content sharing (between a personal video recorder, a cell phone, or other device), and remotely programmable personal video recorders for cell phones.

To deliver services that compete in this rapidly changing market, MSOs need an infrastructure that supports a wide range of devices including soft clients, PDAs, STBs, and game consoles. Services must support presence (the ability to know if a person is available for communications) and identity management and personalized services. Furthermore, high-quality voice and video applications require built-in quality of service (QoS) capabilities in the network. Even more challenging, MSOs must ensure they also continue to provide their existing primary-line voice services without interruption.

STANDARDS

As with any technology that spans multiple vendors, multiple network architectures, and multiple media, standards must play a vital role in meeting the challenges faced by today's MSOs. In particular, there is a functionality gap between today's PacketCable 1.x specification and what is needed. In response, CableLabs® and a consortium of participating industry players have evolved the Network-based Call Signaling (NCS) standard and developed PacketCable 2.0.

Comparing the old and the new, PacketCable 1.x defines a centralized architecture based on a variant of the Media Gateway Control Protocol (MGCP), called Network Call Signaling (NCS). Call management servers (CMSs, or softswitches), media gateways, and Media Terminal Adapter (MTA) endpoints are used to mimic the functionality of the PSTN. This standard supports only MTA endpoints (for connecting legacy phones and facsimile machines), and does not go beyond POTS over IP at the application and service levels.

PacketCable 2.0, by contrast, will include SIP, a protocol standardized by the IETF, to achieve a distributed multimedia signaling architecture with presence and identity capabilities. A broad range of SIP endpoints are supported within a PacketCable 2.0 environment, including SIP MTAs, SIP phones and soft phones, STBs, video phones, PCs and game consoles, and dual-mode cellular Wi-Fi handsets. SIP also enables enhanced services including videoconferencing, presence-based messaging, and IP Centrex functions.

SIP, however, is a protocol, and not a network architecture. A consortium of players in the mobile market, the 3rd Generation Partnership Project (3GPP), developed the IP Multimedia Subsystem (IMS) specification. IMS is a standardized network architecture for SIP-based services. It has been adopted by other standards bodies, major carriers, and equipment vendors alike.

While IMS originated in the mobile market, it uses SIP to support services across virtually any access technology.

IMS has evolved so that multiple access technologies can be blended: Wi-Fi, Worldwide Interoperability for Microwave Access (WiMAX), DSL, broadband cable access, and even enterprise-level T1. The IMS architecture includes an agnostic control plane that can work over cable or over mobile networks, and serves to bridge packet, circuit, wired, and wireless worlds. A layered approach decouples the network infrastructure from services with a standardized, horizontal approach (compared to traditional vertical silo service approaches), and enables a flexible platform for integrated IP multimedia service delivery. The profitability appeal of IMS for service providers lies in its ability to provide a standard platform to respond rapidly to marketplace dynamics (i.e., new service requirements) and the need to better address service personalization (e.g., self-subscription, buddy lists, etc.) and control (e.g., QoS, class of service, charging, security, content filtering, etc.). Essentially, IMS is an application-centric concept appealing to all types of service providers.

Because of the momentum of SIP (already accepted by wireline and mobile carriers, Internet service providers, and many PC and CPE product vendors) and IMS, it is logical that MSOs and CableLabs would decide to adopt SIP and IMS as a foundation for next-generation networking services as specified in the evolving PacketCable 2.0 standard. Note that PacketCable Multimedia (PCMM) will be the mechanism for implementing QoS for SIP services as part of PacketCable 2.0. Outside of PacketCable 2.0, PCMM can also provide QoS for non-SIP or non-IMS multimedia applications such as gaming or IPTV. PacketCable 2.0 brings IMS and SIP together to help ensure a high-quality experience for all subscribers.

MIGRATING TO IMS/SIP MULTIMEDIA SERVICES

Protecting current investments and leveraging lessons already learned with PacketCable 1.x requires a gradual, evolutionary path to get to a PacketCable 2.0 infrastructure. Such a path can be realized by using current business needs to define and drive the addition of incremental capabilities to existing networks. Each incremental capability can bring a carrier one step closer to an IMS architecture.

This type of graceful transition toward IMS offers several advantages for cable operators:

- A transparent path for subscribers. Incremental capabilities can be introduced while protecting the subscriber experience and shielding them from underlying architectural changes.

- Reduced deployment times. For many operators, the introduction of PacketCable 1.x required the integration of the CMS, media gateway, and MTAs with their provisioning, billing, auditing, operations, and other systems. If these existing interfaces can be taken advantage of during the introduction of PacketCable 2.0 capabilities, deployment times can be reduced.

- Reduced operating costs. Packetcable 1.x also required operators to train operations staff in an entirely new set of skills. Leveraging that skillset can help reduce the costs of deploying PacketCable 2.0.

- Increased revenue. Incremental services can generate revenue during the migration to IMS.

The evolution to an IMS architecture will involve the incorporation of the three core IMS control functions (see Figure 1). The Serving Call Session Control Function (S-CSCF), also referred to as the home proxy or subscriber proxy function, manages access to the subscriber database and uses the information stored in that database to invoke features and applications in response to subscriber requests.

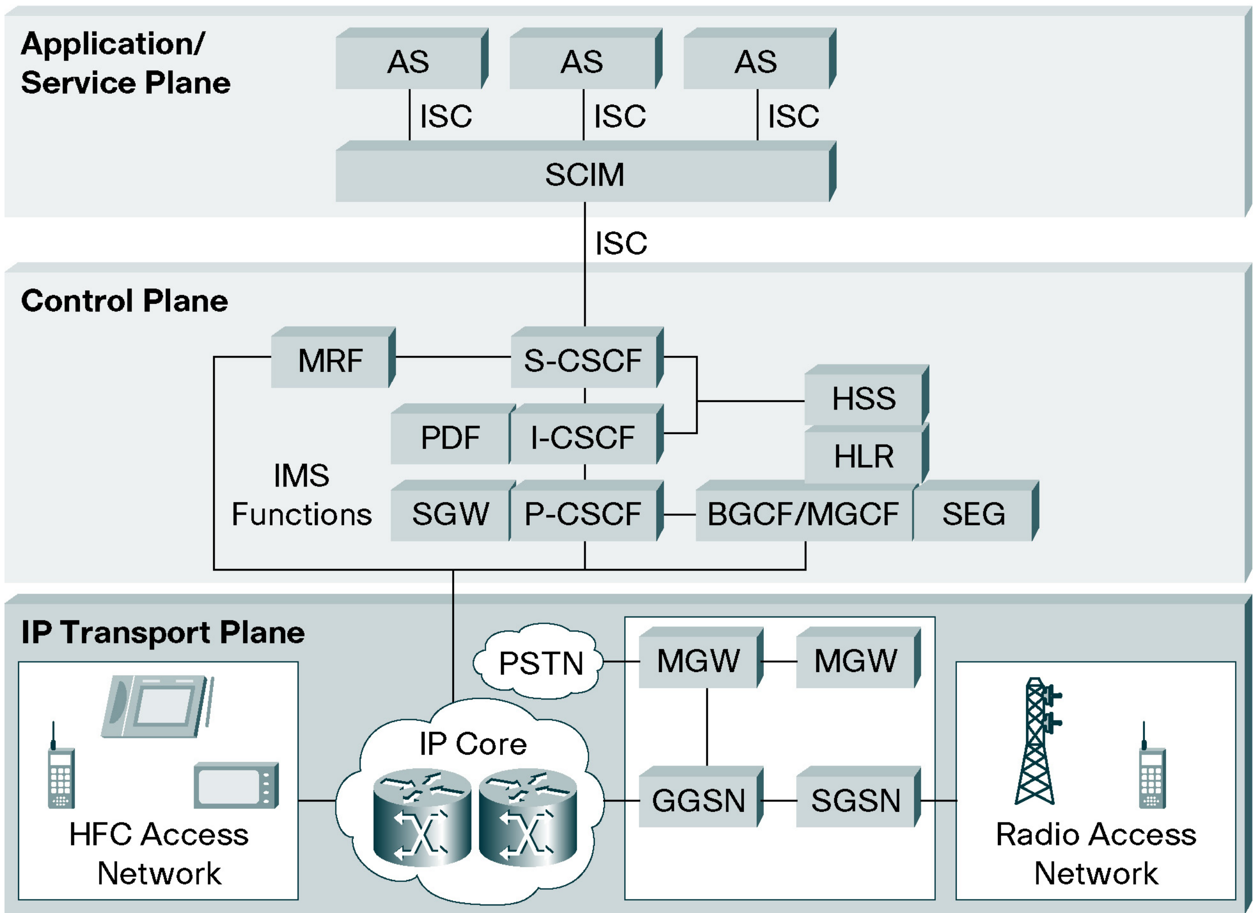

Figure 1. IMS for PocketCable 2.0

The second control function, the Interrogating Call Session Control Function (I-CSCF), controls the boundary to the network and is responsible for routing requests to the right S-CSCF. The third control function, the Proxy Call Session Control Function (P-CSCF), acts as an interface to clients , secures the link to the client, and facilitates roaming.

These IMS control functions sit on top of the IP transport plane. For GSM mobile communications, the IP layer includes the Gateway GPRS Support Node (GGSN) and Serving GPRS Support Node (SGSN) mobile access routers. On the cable side, this layer includes the HFC access network components.

In the application/service layer of the network, an IMS architecture introduces the IMS Service Control (ISC) interface for connecting the S-CSCF to a Service Capability Interaction Manager (SCIM). The SCIM performs feature interaction management, and connects to application servers using the same ISC interface.

The IMS is an important part of a service provider's network, providing a control plane for SIP-based services. However, IMS is only part of the story. As shown in Figure 2, a complete IP-based next-generation network (NGN) is composed of three distinct layers. These are the network layer, which includes the

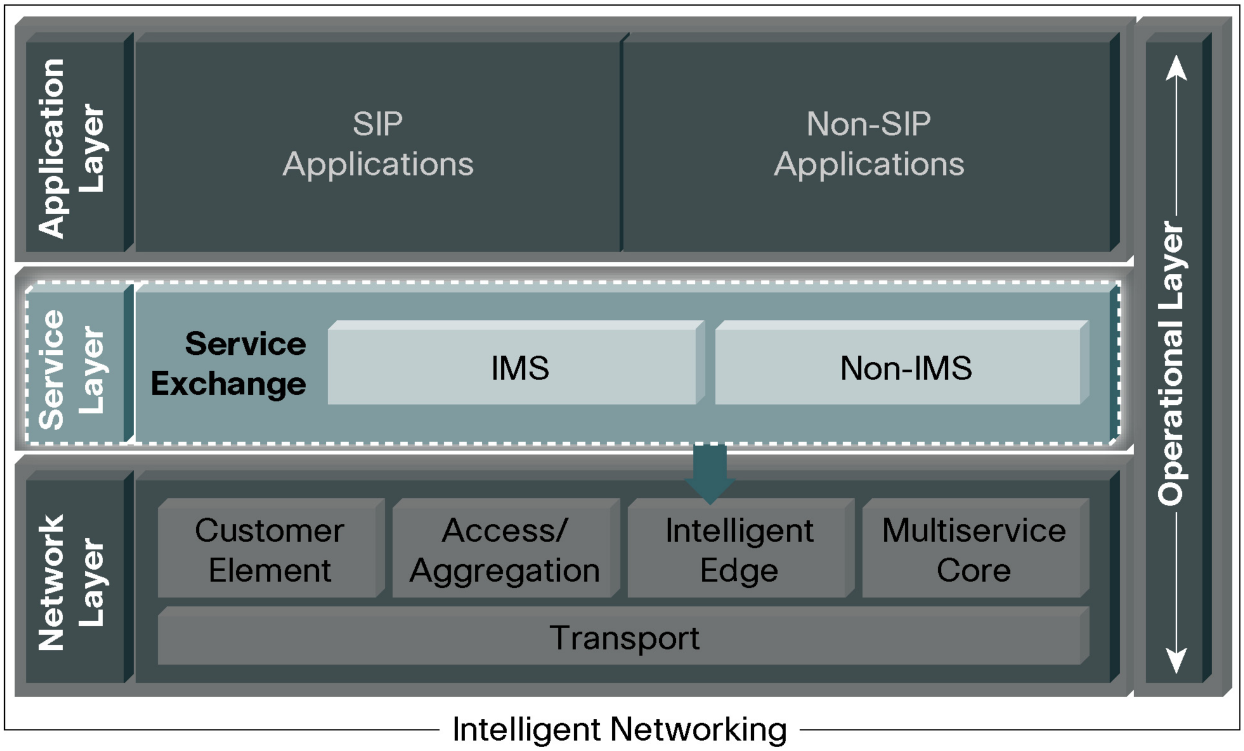

Figure 2. Next-generation network

entirety of the IP network, the control layer (of which IMS is a part), and the applications that reside on top. The control layer needs to provide a link between the applications and the underlying IP network for both SIP applications and for non-SIP applications. Indeed, the vast majority of IP-based applications today are not SIP-based, and a layer of service control is needed for these, too.

The importance of IMS for future services, and the importance of growing and protecting existing PacketCable 1.x services, calls for a phased introduction of IMS. Consider the following example as one path an operator might take.

Phase 1 – PSTN Bypass

Focusing on a reduced dependency on the PSTN addresses a relevant business need for today's MSOs. By making better use of Media Gateway Controllers (MGCs), MSOs can move more of their long-distance voice service off the PSTN and onto the IP network. This reduces the dependencies on competing carriers and reduces costs simultaneously.

To accomplish this first step, the soft switch is decomposed into two logical components – a subscriber-facing CMS and a PSTN-facing MGC. (See Figure 3.) By separating the soft switch into these component parts, the network can be more easily scaled for better overall network efficiencies.

Once PSTN and subscriber control functions are separated, MSOs can then introduce the first IMS element: a combined I-CSCF and Breakout Gateway Control Function (BGCF) function. (BGCF is the

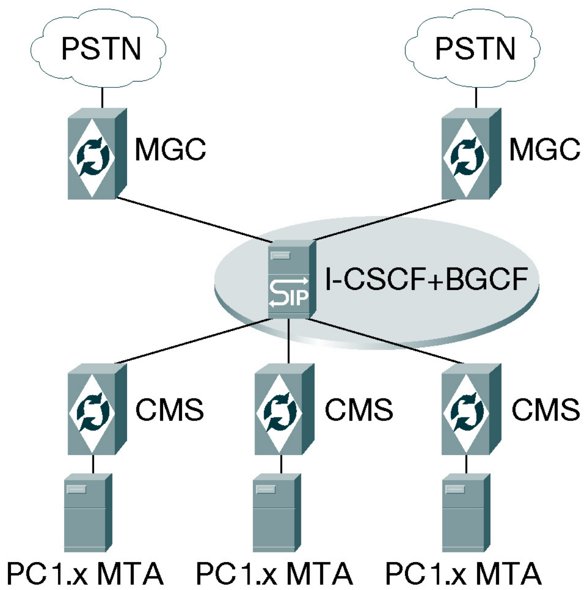

Figure 3. Inserting I-CSCF + BGCF (Bypassing the PSTN)

interface for interconnecting IMS with legacy networks.) This element serves multiple roles. First, it allows PSTN interconnects to be shared by multiple CMSs. CMSs can be added as needed, allowing the network to scale with increases in subscribers. Similarly, PSTN interconnects can be added as traffic requires. Calls between subscribers can stay on-net, routed to the correct terminating CMS by the I-CSCF function.

This configuration offloads calls from the PSTN. By keeping voice traffic on the IP core network, instead of requiring high-cost hand-offs to the PSTN, MSOs can not only reduce costs, but also increase call quality, reduce latencies, and allow the use of high-rate, wide-band codecs for improving speech quality. These features add up to improved differentiation and service quality.

Phase 2 – Add SIP-Based Services

The addition of the first IMS component in Phase 1 offers many benefits, but does not result in increased revenue. Phase 2 introduces new revenue streams for IMS-enabled services.

The introduction of SIP-based services maintains the previously mentioned focus on business needs. Specifically, MSOs need to introduce new services to provide feature differentiation from telcos and incumbent telephone providers that are competing in the same markets. Retaining customers can be more successfully accomplished by introducing SIP-based services that are not available from these competitors. Revenues are also increased from the monthly charges associated with the new services, which can include capabilities such as voice dialing, caller ID on a set-top box (STB), and click to dial.

With the changes already made in Phase 1, new SIP-based services can now be rapidly introduced and delivered by connecting new application servers to the CMSs. IMS introduces the 3GPP-specified ISC interface, a SIP-based interface for interfacing to application servers. Using these constructs, multiple application servers from multiple vendors can all interconnect to CMSs over the IMS ISC interface. Here, a true blending has occurred. The SIP-based ISC interface from IMS and PacketCable 2.0 is used, but to provide features to existing PacketCable 1.x endpoints. This allows a minimally disruptive transition with no forklift upgrades and no replacement of endpoints. Application servers can be added without changes in the CMS, allowing for faster rollout of services.

Phase 3 – Business/Commercial Voice

For the next phase of the transition to IMS, an MSO might focus on the business needs related to the expansion of the commercial

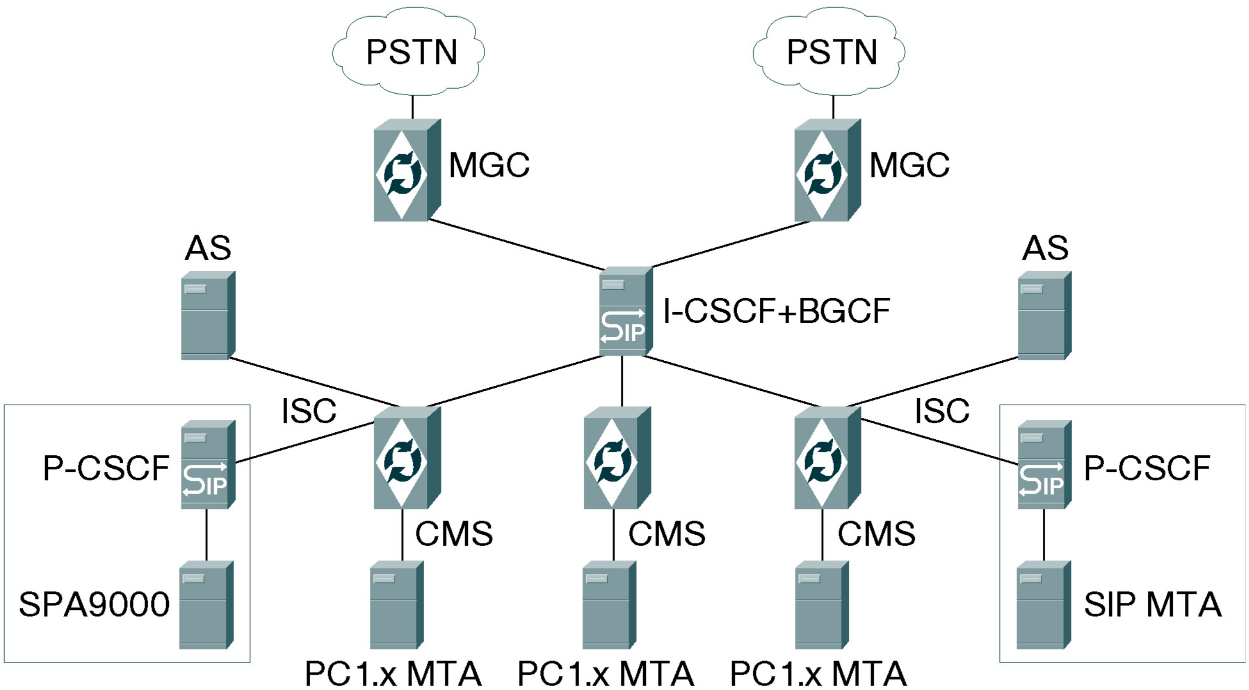

Figure 4. Insert P-CSCF (enable business voice)

subscriber base. These customers require a high-quality, business-grade experience and an expanded feature set with capabilities such as conference calling, call forwarding, and integrated voicemail and messaging.

To address this business goal, MSOs can build on the IMS environment by adding SIP endpoints (e.g., the Linksys SPA9000, a residential standalone box that provides a small, integrated IT PBX solution with support for up to 16 lines, or SIP MTAs).

To interface to these SIP endpoints, the operator introduces another IMS component during this phase: the P-CSCF (see Figure 4). This proxy control component provides PCMM QoS features that ensure business-grade voice services. The P-CSCF component will be connected to the underlying CMTSs and policy servers to provide QoS and security functions such as Network Address Translation (NAT) traversal and secure access – features that help ensure the protection of the new smarter endpoints.

As in the previous phase, this phase uses the in-place CMSs, allowing them to control the SIP endpoints. Through the ISC interface, the SIP endpoints also gain access to the new applications deployed from the previous step..

With the completion of Phase 3, an MSO has actually introduced a significant portion of an overall IMS architecture. The CMS has taken on much of the role of the S-CSCF, the P-CSCF was introduced to talk to SIP endpoints, and the I-CSCF was introduced for enhanced routing functionality. A big part of making this migration graceful was the blending of S-CSCF functions with the CMS.This phase also increases the revenue flow from new services.

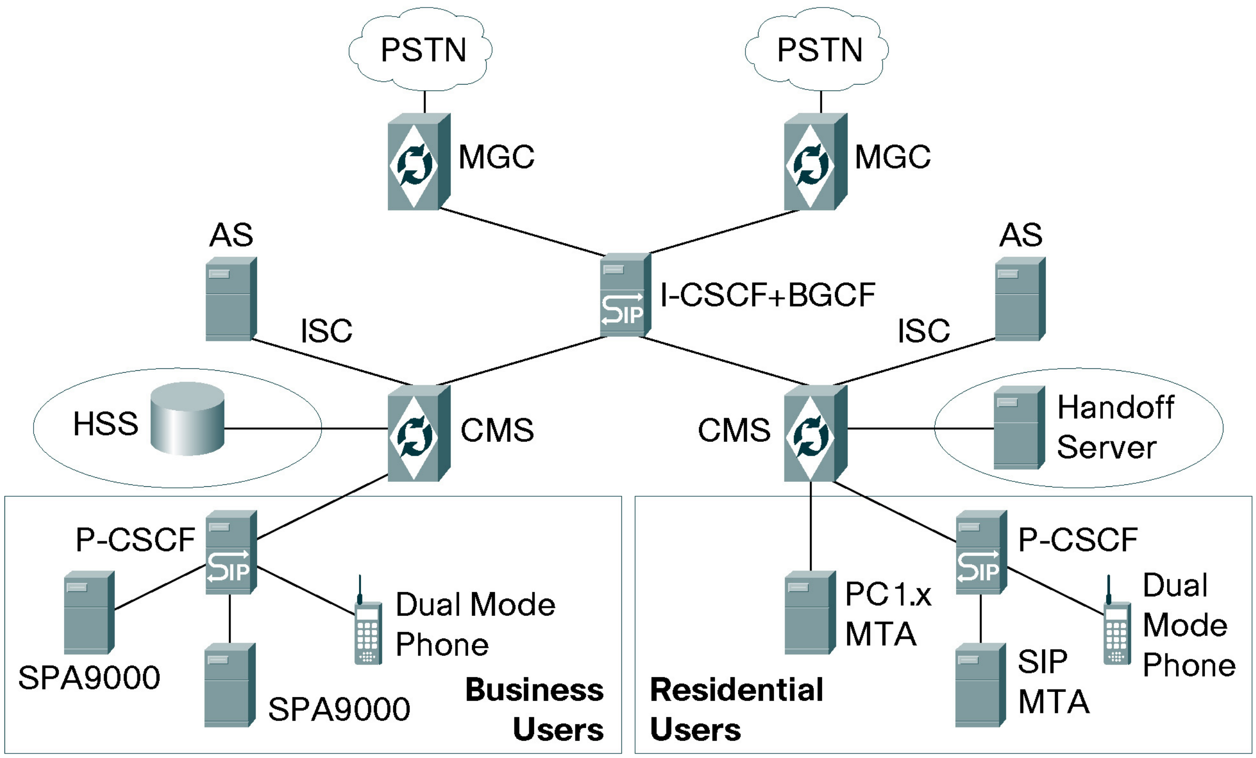

Figure 5. Add handoff server (FTC)

Phase 4 – Fixed/Mobile Convergence

Moving toward fixed/mobile convergence (FMC), an MSO can address several business needs relating to the introduction of "triple play on the move." MSOs can provide a superior user experience with better at-home coverage, begin to converge the fixed and wireless experience, and unify broadband VoIP and wireless with single-number access. Users gain access to new applications that can only be delivered over high-speed networks, and MSOs make progress toward the goal of all three services (data, voice, and video) on all three devices (TV, PCs, and handsets).

Accomplishing this phase involves the support for dual-mode handsets, and the introduction of two servers (see Figure 5). The dual-mode devices can communicate over the cellular network, or act as a new endpoint on the IP network. The Home Subscriber Server (HSS), the last missing piece of the IMS architecture, is introduced. It is needed to manage subscriber data uniformly between the cellular and IP worlds. The Handoff Server is also introduced in this phase. It runs on top of the ISC interface, and provides a seamless experience when subscribers move from the cellular network to a Wi-Fi network.. The CMS remains the functional center of the network, but with the introduction of the HSS, has added the Cx and Sh interfaces defined by the IMS, taking it a step further to becoming a complete S-CSCF. By continuing to take advantage of the CMS in each phase, MSOs accomplish a truly evolutionary move to IMS.

SUMMARY

By introducing a common suscriber data model and standardized interfaces for application servers, the IMS promise is to create a flexible platform for quickly launching new services. IMS also allows MSOs to take full advantage of their existing IP core network, and avoid overloading the cable infrastructure because very few applications need to extend beyond the IP network.

The IMS component of PacketCable 2.0 provides many opportunities for cost savings including bypassing the PSTN, more flexibly scaling the network, and more quickly integrating new application servers. The resulting new services can greatly enhance revenues while differentiating an MSO from competing telcos.

MSOs require a Service Exchange Framework (SEF) that supports a transparent migration to IMS, with full support for both IMS and non-IMS endpoints. This framework must allow service providers to deliver today's voice, video, and data services efficiently while also creating a foundation for new rich multimedia services. With a robust service exchange solution for IMS, cable MSOs will be able to support multiple applications on a common infrastructure that supports both SIP and PacketCable 1.x, while offering subscribers a customized service experience based on real-time state information and profile preferences.

The Service Exchange Framework eliminates dependence on a single application vendor, and allows cable providers to reuse solution components across multiple applications and even other access networks for full subscriber mobility. This framework will also enable cable operators to generate revenue by offering FMC services to their subscribers, thereby providing access over any network to a complete array of real-time, multimedia business and consumer services such as VoIP, video content sharing, presence-based services, and video telephony.

ABOUT THE AUTHOR

Dr. Jonathan Rosenberg is a Cisco Fellow in the Routing and Service Provider Technology Group at Cisco Systems. There, he is responsible for guiding the technology directions for their service provider VoIP products. Jonathan is active in the IETF; he is the lead author of the Session Initiation Protocol (SIP), the inventor of SIP for presence and IM, known as SIMPLE, in addition to other Internet technologies, such as STUN, XCAP and TRIP. Jonathan is also a member of the Internet Architecture Board. Jonathan received his PhD from Columbia University, and his Bachelors and Masters from MIT. Jonathan has been awarded the Voice on the Net Pioneer Award by pulver.com, and was named one of the one hundred most innovative young technologists in the world by Technology Review Magazine.

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