Cisco ASR 1000 Series Broadband Integrated Services

This paper gives an overview of the Cisco ASR 1000 Series Broadband Integrated Services solution to meet service providers' new challenges in offering their customers more sophisticated quadruple-play (data, voice, video, and mobility) services. The solution is delivered on the latest Cisco® innovation platform: the Cisco ASR 1000 Series Aggregation Services Routers.

The Cisco ASR 1000 Series Router and the applications delivered with this platform fit into the overall Cisco IP next-generation network (NGN) vision. The vision and the role of the Cisco ASR 1000 Series Router is explained in both standards-based and non-standards-based NGN networks.

The Challenge

As wireline providers actively pursue IP NGN solutions, they are evaluating technologies that support their transition from traditional flat-fee services to more sophisticated quadruple-play services. These services must be device- and transport-agnostic so that they can be delivered over a wide range of devices over multiple network transport technologies. To achieve true access independence, service providers must achieve better understanding, visibility, and control of their networks by understanding who their subscribers are and what services they are authorized to access. Providers must be able to dynamically control network access through policies and gain a better understanding of the services subscribers use in real time. With this greater granular visibility and control, service providers can achieve new levels of insight into customer activity while simultaneously delivering differentiated and value-added new services more securely, efficiently, and profitably.

Bundling, tiering, and price discounting remain near-term priorities for broadband service providers as they strive to maintain strong new subscriber growth and increase the average revenue per user (ARPU) they receive from broadband services. Bundling enables broadband service providers to lock in customers to their product offerings, reduce customer turnover, and maximize ARPU. Tiering helps accelerate adoption and market-share gains by expanding the bandwidth and pricing options available to a wider segment of the market.

Service providers that compete for market share in next-generation consumer entertainment and communications services must move beyond “bundling” and offer personalized media and interactive IPTV services that blend entertainment, communications, voice over IP (VoIP), and the Internet. Existing network infrastructures will be pushed to their limits, however, with the deployment of these new services. To accommodate the needs of the new services, networks must be able to scale to millions of customers, maximize bandwidth resources, and provide quality of service (QoS) and security from end to end. For these and other reasons, network intelligence is critical when deploying these new services over broadband connections, DSL, fiber to the home (FTTH), cable, and wireless.

The Solution

To address this challenge, Cisco has developed the Cisco IP NGN vision, which encompasses an architecture, technologies, and products. Broadband service providers, with nearly unanimous consensus, have determined that IP will be the foundation technology to make the next-generation network a reality. The Cisco IP NGN is a sweeping transformation of both a service provider's entire network and business that takes full advantage of this evolving IP environment by aligning technology and network resources with business and subscriber requirements. By capitalizing on the power of intelligent IP-based Cisco networking solutions, service providers can build a better, longer-lasting, and economical infrastructure that supports traditional services and scales to deliver new manageable, controllable, and richer premium services over time.

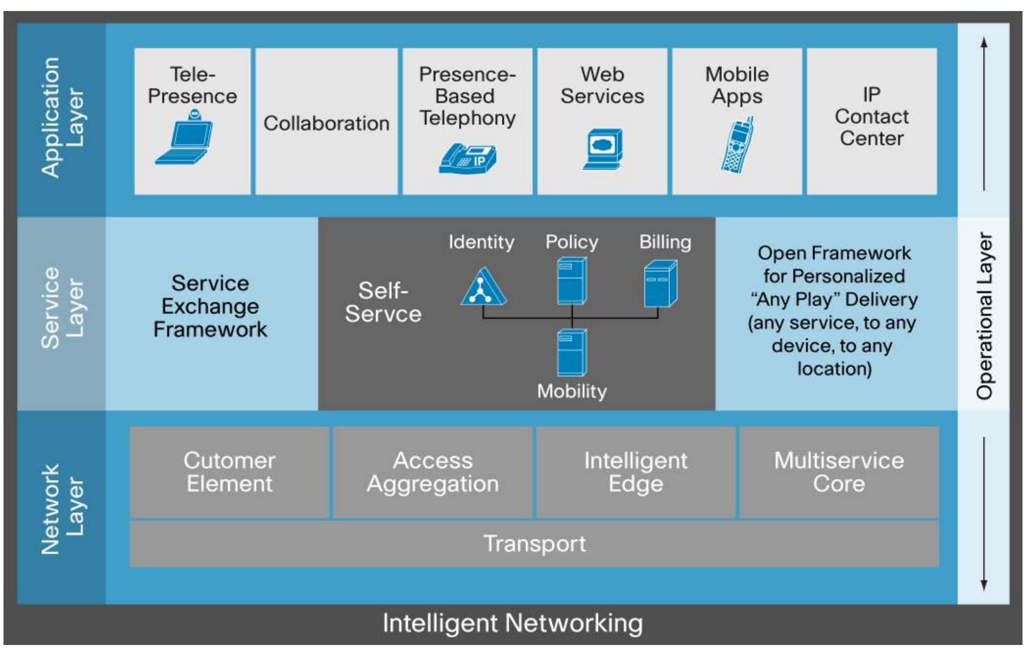
Cisco IP NGN Overview

In order to meet the challenges that service providers face, Cisco has developed a converged network architecture called the Cisco IP NGN for integrated offerings of data, voice, and video. This architecture combines all the features you and your customers demand most from your network, including true mobility, abundant bandwidth, network management ease, and security. Just as importantly, the IP NGN is characterized by embedded intelligence throughout to make it service-aware, highly flexible, adaptable, and scalable enough to provide the foundation for your business for decades to come.

To achieve this foundation, Cisco believes that “convergence” in service-provider networks must occur, not in a generalized fashion, but in several different and distinct ways: convergence of applications, of services, and of networks. Finally, each of these three convergence layers must work together intelligently for the benefit of the end customer and provider alike.

The Cisco IP NGN architecture was created with the close involvement of customers, standards bodies, and technology partners worldwide. The results include many new IP technologies and processes, innovative multiservice solutions, a convergence strategy, and embedded intelligence and security throughout all layers.

Figure 1. Cisco IP NGN Architecture



As depicted in Figure 1, central to an IP NGN are three fundamental areas of convergence that service providers are already enabling today:

- Application convergence: As customers adopt devices with multiple functions, such as phones that can switch between wired and wireless subnets, service providers are no longer confined to offering a single service to that device. Now you can offer new services that integrate different voice, video, and data elements with mobility, such as video teleconferencing, peer-to-peer gaming, and other converged applications. Although these new service possibilities can bring substantial revenue opportunities, they also require greater scalability and availability, application and subscriber awareness, and the adaptability to adjust to changing requirements rapidly and cost-effectively.
- Service convergence: In the digital era, multiple services must reach consumers wherever they are, on various devices, through one converged network. The Cisco IP NGN makes the deployment of integrated data, voice, video, and mobile services possible at the service control layer through the Cisco Service Exchange Framework (SEF). Cisco helps control these diverse services with a converged, integrated platform where multidimensional subscriber identity is maintained, policies and sessions are managed, and quality and classes of services are administered. From integrated billing to content filtering, the Cisco SEF provides a rich array of control functions that let you manage, scale, and customize services to meet the needs of individual subscribers and more broadly defined service offerings. The Cisco SEF controls customer access and the use of services without limiting deployable applications. It also allows for new types of consumer and business services, such as intrusion prevention, parental controls, and distributed-denial-of-service (DDoS) protection, which can be layered on top of existing services, and offers new ways for packaging these services, such as per-use, prepaid, or unlimited use.
- Network convergence: Convergence at the network layer combines disparate networks ─ whether fixed or mobile, ATM, Frame Relay, time-division multiplexing (TDM), or IP ─ onto a single IP Multiprotocol Label Switching (IP/MPLS) platform that is flexible enough to support older IP data as well as newer services, such as voice and video, that require special features such as QoS and heightened security. Another significant benefit of a converged network is lower capital and operating expenses (CapEx and OpEx), because a single converged network costs less to build, manage, and maintain than multiple networks, especially over the long term.

To address the need for more services that can help you boost revenue, gain competitive advantage, and increase customer loyalty, the Cisco SEF ─ the service control layer of the Cisco IP NGN architecture ─ supports both IP Multimedia Subsystem (IMS) and non-IMS applications. This approach maximizes your flexibility to quickly deploy the broadest possible portfolio of integrated data, voice, video, and mobility services to customers.

Cisco ASR 1000 Series Router Role in the IP NGN

The Cisco ASR 1000 Series Router plays a key role in the secure network layer of the Cisco IP NGN vision as the Layer 2 and Layer 3 termination point for access and aggregation networks where service awareness, service enablement, and service integration become realities for broadband subscribers with the new and innovative modular Cisco IOS XE Software.

The Cisco ASR 1000 Series Routers offer high performance, high scalability, rich feature sets, and carrier-class high availability with Cisco's latest innovative hardware and software. They set a high technological industry standard in the midrange segment by achieving a quantum leap in performance and resiliency.

The Cisco ASR 1000 Series Broadband Integrated Services Solution consolidates the edge network and simplifies the aggregation network. With this solution you can:

- Offer applications that are both secure and easy to use:
  - VoIP and Video conferencing
  - Video-delivery services such as voice on demand (VoD) and broadcast TV
  - High Speed Internet (HSI)
- Offer a successful rollout of these applications:
  - Change the network paradigm to provide both horizontal network connectivity and a standards-based vertical interface(s) that directly links the service edge to your policy, management, and application layers.
  - Deliver a consistent and aligned set of network use cases that allow you to use generic infrastructure of network features that work together to provide secure and open applications for end customers.

The consolidation of the service edge in the integrated services solution does imply that all services need to be available on the service edge, meaning that you must pay particular attention to providing the entire service-control infrastructure such as H.248 and RADIUS.

One differentiator in the integrated services approach is that the emphasis is placed upon delivering interactive session-based services such as Session Initiation Protocol (SIP)-based VoIP in addition to video and more typical Internet service provider (ISP) access. In addition, the control interface necessary for voice services is also used for other applications such as the VoD. Applications ask for network resources and status through the service exchange layer, which in turn instructs the secure network layer to make the necessary move, add, or change. The integrated services model seeks to combine services into the same service node in the network and provide one service edge on which all subscriber access depends. Cisco ASR 1000 Series Router was engineered and developed with this integrated services model as a target solution.

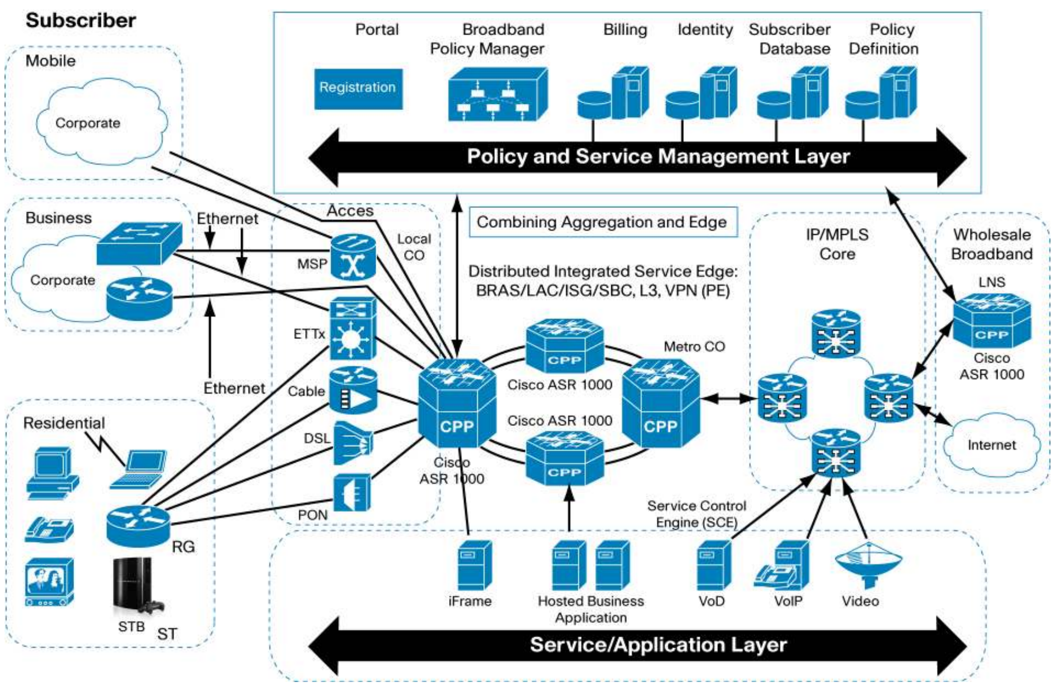
Integrated Services Solution in Distributed Architecture

One network design decision that needs to be made is where to place the Layer2/Layer 3 edge. One approach is to distribute the Layer2/Layer3 edge of the network as close as possible to the subscriber access. Cisco's experience with this variant of access and aggregation network is that customers choose this model when they want to implement services quickly but also want to minimize and compartmentalize the scope of service delivery to their customers. In other words, they want to be first to use new technologies, but with an architecture that is easy to replicate and easy to manage. In such networks, often the benefits of an easy-to-operate network far outweigh any perceived potential network scalability concerns. And often what happens in any network is that services offered today need to be present in future networks too, meaning that any transformation to NGN services such as voice and video need to also incorporate designs for the existing customer base.

On the contrary, in the centralized aggregation model, the emphasis is placed on providing access on a service-by-service basis back to a centralized set of dedicated network servers responsible for individual services in the network. The aggregation network uses a fairly complex array of both Layer 2 and Layer 3 technologies such as Virtual Private LAN Services (VPLS), IEEE 802.1Q (QinQ), IP, Layer 2 VPN (L2VPN) Pseudowire, MPLS VPN, and MPLS Traffic Engineering (MPLS-TE) in order to backhaul subscriber traffic in a very reliable and very scalable fashion back to aggregation devices (broadband network gateway [BNG] ─ as defined in DSL Forum TR-101) and network services operating in the network.

Cisco ASR 1000 Series Router is uniquely positioned for the distributed integrated services model. This solution could also be be thought of as the local model, where service access is determined at a fairly local level such as a neighborhood. Because the service intelligence is being offered closer to the subscriber, it makes more sense to use an integrated approach.

Figure 2. Cisco ASR 1000 Series Router Broadband Integrated Services Solution



Positioning the Cisco ASR 1000 Series Router closer to the subscribers makes service-edge operation fairly straightforward from a provisioning point of view.

Solution Benefits

The benefits of this solution follow:

- It creates a clear defining point in the network on which services are offered.
- It limits exposure to and from problems arising in common points of the network.
- It allows for local content to be fine-grained down to the neighborhood level.
- It is better suited to distributed access networks where the carrier has already invested in a distributed physical plant:
    - The solution could also be used effectively in various locales too, in a rural setting or high-density centralized approach.
- It dramatically simplifies the aggregation network and allows you to focus efforts on applications such as VoIP and not the network itself.

Cisco ASR 1000 Series Broadband Integrated Services Solution Deployment Scenario

The Cisco ASR 1000 Series Router integrated services model has already been adopted by one of the biggest service providers in the world. The solution provides a secure and reliable network platform that allows convergence of voice and video into the same service-edge device and onto the same fiber-optic connection to the home.

The goal is to deliver voice and interactive services for an easy and safe consumer experience. Services include:

- VoIP and video conferencing
- Video delivery services such as VoD and broadcast TV
- High Speed Internet (HSI)

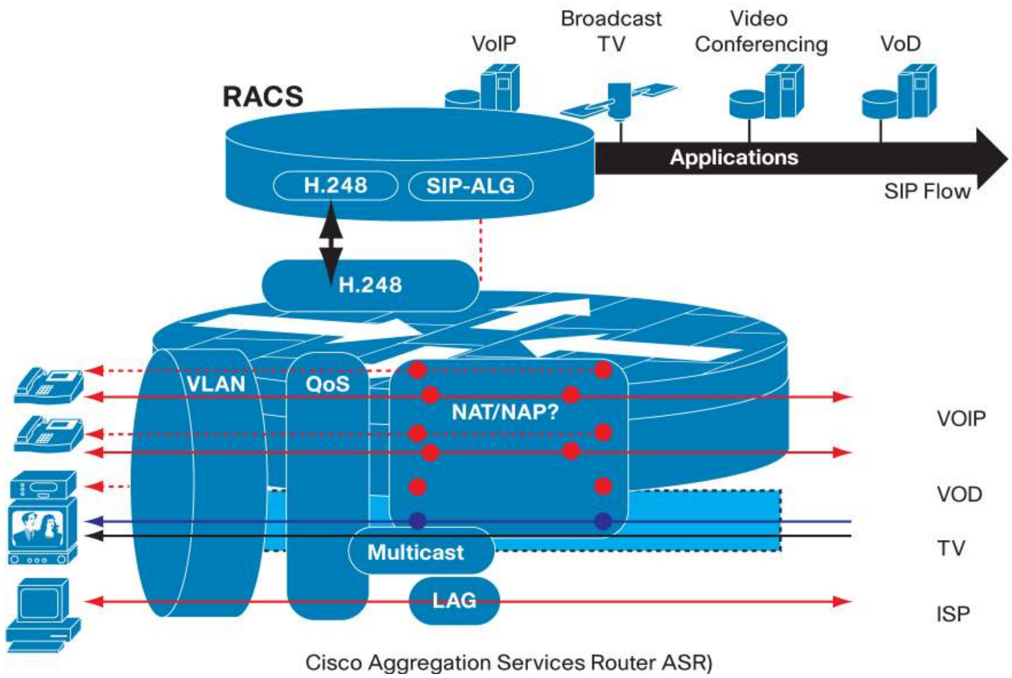
VoIP, video streaming, instant messaging, and gaming are just a few of the real-time, IP-based applications enjoying rapid growth in today's competitive communications market. The Session Border Controller (SBC) function on the Cisco ASR 1000 Series Router helps enable service providers to connect isolated islands of voice, video, and multimedia-based IP networks and helps enable end-to-end IP-based transport of these real-time applications. This SBC functionality builds on the continuous operation and service aggregation provided by the powerful and flexible Cisco ASR 1000 Series Router, which completely integrate the SBC with other Layer 2 and Layer 3 services, such as security, advanced hierarchical QoS, IP Multicast, etc., without requiring additional application-specific hardware. With this integration, the SBC eliminates the need for overlay networks and standalone appliances and provides an open and flexible architecture for all service provider deployments, whether for peering or for customer access. A key element of the Cisco SEF, which supports IMS and non-IMS services, the SBC functionality on the Cisco ASR 1000 Series Router further accelerates network convergence while providing investment protection.

In addition to the integration of SBC functions, advanced QoS capabilities on the Cisco ASR 1000 Series Router allow for fairer access to best-effort bandwidth, so subscribers can now use more of the shared fiber bandwidth than is currently possible. So, for example, if 200 Mbps is available and no other subscribers are using the service, then active subscribers can use all this available bandwidth. The carrier can, in addition, give subscribers unequal access to available bandwidth such that some subscribers can pay for and receive more best-effort bandwidth during times of congestion.

The second innovation involves allowing the carrier to set that upper limit shared by all subscribers of Internet and best-effort services; the carrier can set a defined amount of bandwidth available to best-effort Internet services, perhaps more than what is currently available today. This scenario is analogous to economy-class seating in an airplane, where passengers can use as many seats as they like if the seats are unoccupied, but even if business class is empty they cannot use this space. Thus service providers with this new capability can set a clear dividing line between higher-priority services such as voice and video and best-effort services such as Internet access.

In the Cisco ASR 1000 Series Router integrated services model, the network delivers the content in the form of unicast or multicast IP packets, as shown in Figure 3.

Figure 3. Cisco ASR 1000 Series Residential Use



This network model terminates all subscribers, each on their own single VLAN, at the service edge, a setup analogous to the 1:1 VLAN model described in the DSL Forum Technical Report TR-101 service mappings. In 1:1 service, each subscriber is assigned a VLAN and all services are offered through this VLAN.

Because all services are handled for each subscriber through one generic VLAN (both QinQ and Cisco EtherChannel® technology services are also possible), many advantages differentiate this network model:

- Critical to voice and video applications is the ability for the service edge to perform hierarchical QoS for all services for all subscribers. Subscriber traffic must be prioritized such that voice and video always enjoy the lowest latency and highest priority relative to best-effort data services.
- Multicast distribution is optimized for the service edge to handle all IP Multicast forwarding, but it could facilitate further distribution if the downstream aggregation or DSL Access Multiplexer (DSLAM) supports IP Multicast.
- The service edge can manage control-plane access on a flow-by-flow basis. With this network model the service edge can allow access to servers such as SIP for voice control and also the use of SIP for VoD control. The service edge can also provide individual pin holes for each VoD flow for each subscriber. In other words, the same billing and call detail records (CDRs) available to voice applications are also available to SIP-enabled video applications.

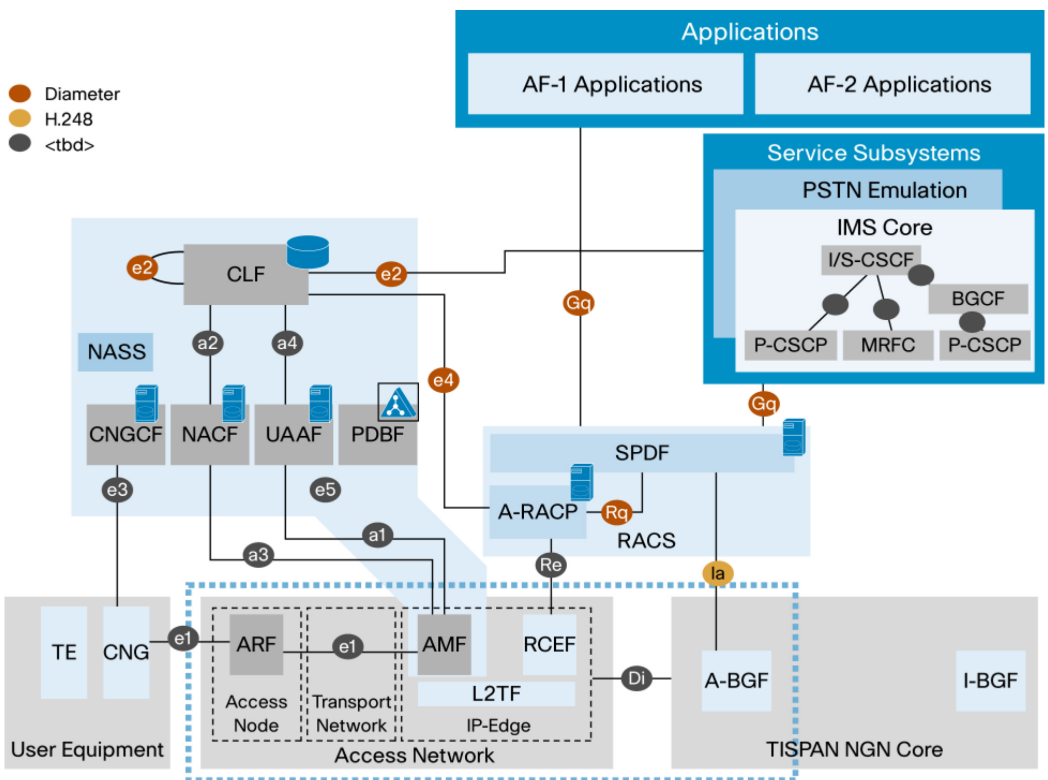
Another area of interest is the access technology required in the last mile to deliver these NGN services. It is important that the initial aggregation layer be a fairly simple aggregation scheme such as a VLAN or QinQ VLAN. Because the service edge is implemented very close to the subscriber, scalability in this setup should not be of much concern.

Cisco ASR 1000 Series Router Compliance with Standards-Based NGN Networks

In the distributed integrated service solution, the emphasis is placed on protocol availability at the edge of the network and the ability to interact with all services that may be deployed at the subscriber site. The protocol interactions required include variables such as address management, multicast access protocols, authentication and authorization schemes, border gateway features such as security enforcement, QoS and address translation, and SBC functions. These protocol use cases and interactions become very complex and will vary from subscriber to subscriber. In order for any NGN to achieve the desired goal, these protocols will form the baseline feature set for any edge device such as the Cisco ASR 1000 Series Router.

It is clear that the service edge needs to adhere to some form of vertically aligned approach instead of the more typical horizontal approach used in providing more basic IP services. Because of the aforementioned complexities, it is almost mandatory for a prospective service provider to use a standards-based approach not just for the service edge but also for the entire NGN network. Most standards bodies such as ETSI Telecoms and Internet Converged Services and Protocols for Advanced Networks and Next-Generation Network (TISPAN) and ITU focus primarily on the NGN. A service edge that aligns with these models gains important credibility and potentially eases the complexities associated with actual NGN deployment.

Figure 4. Service-Edge Functions and Interfaces in the TISPAN Model



The Cisco ASR 1000 Series Router implements all the functions shown in the dotted blue box and clearly aligns with the TISPAN model:

- Layer 2 Termination Function (L2TF): The Layer 2 termination point is the point at which the subscriber is known from an IP point of view and also where services can first be controlled; it is also the point at which routing starts. Instead of trying to tunnel data to services in the network, IP packets are forwarded irrespective of whether they are voice, video, or data.
- Access Management Function (AMF): This function forwards requests for access, IP address, etc. on the appropriate server.
- Resource Control Enforcement Function/Access Border Gateway Function (RCEF/A-BGF): The RCEF, a subset of A-BGF, defines functions such as gating, per-session QoS, and in the case of A-BGF, advanced functions such as Network Address Translation (NAT) and accounting for particular subscriber flows (in particular, voice).

Supporting Solutions and Partners

Cisco partners are trained to manage the entire solution, from planning to deployment, through ongoing maintenance. In addition to our global network of qualified resellers, Cisco provides comprehensive design and support through Cisco CCIE® professionals and the Cisco Technical Assistance Center (TAC), both of which are recognized as excellent in the industry, with expertise in voice, video, and data communications for wired and wireless networking technology.

Why Cisco?

Cisco is a worldwide leader in networking technologies, having supported customers of all sizes around the globe for 20 years. By working with the established industry leader, you can benefit from:

- More than two decades of experience building large-scale networks
- Proven performance, reliability, and security
- A broad range of technical experts and engineers who understand the unique requirements of your customers
- Award-winning customer support services that help you get the most out of your investments and extend the life of your network assets
- Ongoing investments in R&D initiatives that can help you build the most scalable, profitable NGN network rich with most critical services
- Sustained value with upgradeable, standards-based solutions
- A phased approach to support the integration of new technologies in your network

Summary

The Cisco ASR 1000 Series Broadband Integrated Services Solution stands out as a mechanism to implement standards-based NGN for the fixed wireline segment, as well as fixed mobile convergence (FMC). It provides for a rich feature set local to the broadband subscribers and incorporates some efficiency of its own, particularly with regard to provisioning and management of the services edge. It offers a complete solution for all the available and potential interactive services that service providers can charge premium pricing.

The Cisco ASR 1000 Series Broadband Integrated Services Solution can help you to build an NGN network that facilitates technologies to support your transition from traditional flat-fee services to more sophisticated quadruple-play services.

The Cisco ASR 1000 Series Broadband Integrated Services Solution can help you to maintain strong new subscriber growth and increase the ARPU you receive from broadband services.

For More Information

For more information about the Cisco ASR 1000 Series products, visit: http://www.cisco.com/go/asr1000.

For more information about the Cisco IP NGN vision, visit: http://www.cisco.com/en/US/netsol/ns537/networking_solutions_solution_category.html.

For more information about Cisco Service Exchange Framework, visit: http://www.cisco.com/en/US/netsol/ns549/networking_solutions_solution.html.

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