

Recharging Your Network with the Cisco ASR 9000

Brochure



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The ASR 9000 Recharge

What does this brochure include?

In this brochure you'll find details on the many technology features in Cisco ASR 9000 Series routers and third-generation line cards that make recharging your network for cloud-scale possible. Also included are specific use cases that benefit from the move to cloud-scale. You'll read about new capabilities enabled by IOS XR and our third-generation line cards when they are deployed to support business VPN services at the edge, residential services, mobile backhaul, Data Center Interconnect (DCI), and Internet transit/peering.

Audience

Written for both business and technical professionals, this brochure provides service providers with compelling reasons why it's vital to recharge your service infrastructure to meet the new demands of government, business, consumers, and operational realities.

The effects of digitization

Digitization has sent network traffic volumes on an exponentially growing trajectory. Exciting offerings such as the Internet of Everything

(IoT), 4K video and 5G are coming and will tax network infrastructures with even more traffic. Legacy technologies, processes, service operations and network architectures can't handle these new services and volumes. They're too inflexible, inefficient, complex, costly and lack scale. Networks that do not retool in preparation for digitization will lose out to competitors. You need to retool your network infrastructure in preparation to meet these growing demands.

To counteract the effects of digitization, you need to operate, grow and manage your network more efficiently. To reduce time-to-market, service creation needs to be on-demand. For operational efficiency and lower TCO, the network needs to be programmable and processes need to be automated. To meet shifting demands, bandwidth needs to scale, as needed. And to control and manage services securely, visibility needs to be end-to-end across every device on the network and across every traffic flow.



Exponential growth and the effect of digitization

According to the most recent Cisco Visual Networking Index (VNI) Forecast Data, by the year 2020:

- IP traffic will reach 2.3 Zettabytes annually by 2020
- 50% of global IP traffic will come from Wi-Fi connections
- Average Wi-Fi speeds will increase to 24 Mbps, and fixed broadband speeds will increase to 47.7 Mbps
- Global IP traffic will nearly triple between 2015 and 2020 to 194 Exabytes per month
- Video will be 79% of global Internet traffic

Why moving to Cloud-Scale makes good business sense

The benefits of cloud-scale are real and quantifiable. TCO is reduced through better bandwidth utilization (price per Gbps), energy efficient hardware, and a dramatic cut in operational costs with orchestration and automation. You're able to launch new services faster and substantially improve your customer experience with a real-time, hyper-scalable platform that is easier to control and manage. Built-in security, across all layers of your service delivery architecture, helps you mitigate risk. And with SDN, you have the agility and control you need for applications to determine their resource needs, rather than being limited by infrastructure constraints. Your cloud-scale network is ready to deliver any service, anywhere, and at any time.

Why Cisco for Cloud-Scale?

The Cisco ASR9000 Series with IOS XR third generation line cards is a carrier class platform that is used worldwide as the foundation for delivering services such as 4G mobile Internet, business-class Ethernet, and residential video and broadband. With more integrated capabilities, such as DDOS, MACSEC, EVPN, segment routing, NETCONF/YANG, and streaming telemetry Cisco offers new innovative ways to help networks get simpler, faster, smarter and more secure.

Industry leading platform

As an industry leader in innovative technologies including segment routing and SDN automation, Cisco provides a cloud-scale platform designed for scale and operational efficiency. With the Cisco ASR 9000 and third-generation line cards, you can:

- Simplify multilayer network operations with less complex, automated workflows (around 80% reduction in operational complexity according to some Cisco studies)
- Significantly shorten the service creation lifecycle, moving services from concept to revenue in weeks instead of years
- Gain visibility, control, and multilayer optimization of the network through computing and control functions that use open APIs across all network layers, allowing for the delivery of application-driven network services

Read on to find out how the Cisco ASR 9000 with third-generation line cards can enable your move to cloud-scale.

Business requirements: Cloud-Scale networking

No industry category is changing more dramatically and quickly today than network service. Never has the need for more, better and faster been greater than in your operations. We know the pressures and challenges you're under and we've devoted global resources to address them. Cloud-scale networking is focused on meeting many key service provider and mission-critical Enterprise and government business requirements that have arisen in response to today's trends, including:

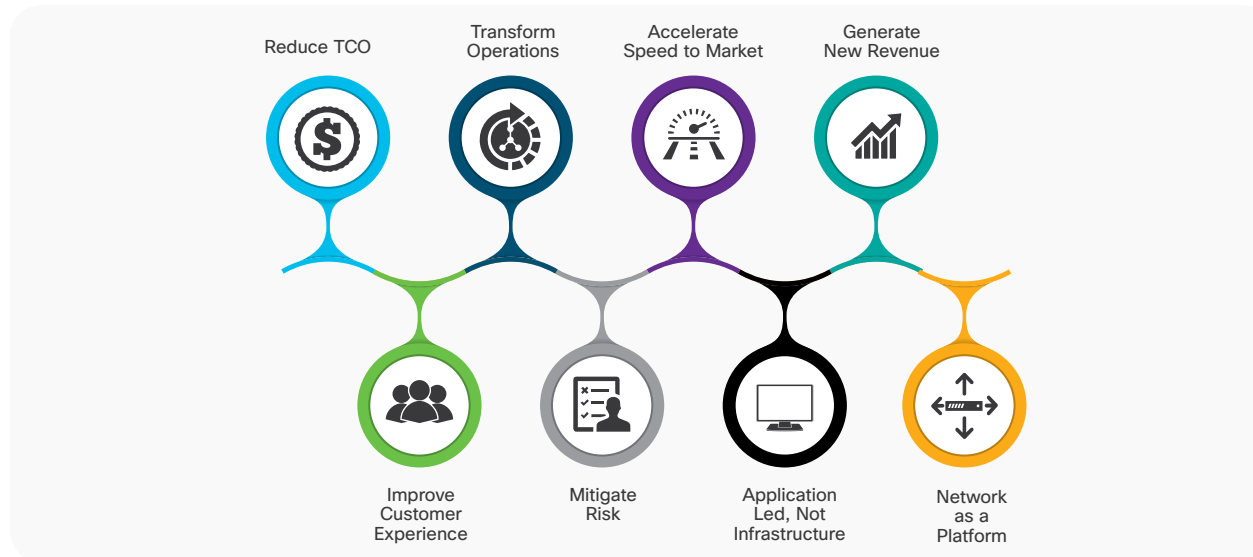
- Network scalability in real-time
- Lower TCO from reduced operational and transport costs and greater efficiency
- Automation for onboarding, Day 1 provisioning and Day 2 management
- Greater agility with SDN programmability
- End-to-end visibility for more control and better management of services
- Traffic steering with flexibility for different application requirements
- Openness of the networking stack to integrate third-party applications and containers

Cisco IOS XR Software: Cloud-Scale innovations

Cisco IOS XR Software provides an array of features representing over 15 years of use and development, including cloud-scale capabilities. Cisco IOS XR cloud-scale features include integration with structured, data model-driven, high-performance APIs so you can move beyond CLIs. A comprehensive set of YANG-based configuration and operational data models let you control the rich feature set of the OS. There is support for native, OpenConfig and IETF models. The YANG modeling language is optimized for network devices with many tools and utilities. Encoding is decoupled from the model so you can deploy with data encoded in JSON, XML or Google Protocol Buffers (GPB) format. Transport is also decoupled from the choice of encoding for further flexibility. You have the flexibility to use NETCONF, RESTCONF or Google RPC (gRPC) for encoding. Additionally, the Yang Development Kit (YDK) is provided, letting your developers auto-generate model-driven APIs from any Yang model for Python and C++.

Cisco IOS XR is modular. Major features are available as independent packages. Just get the code you need and put it to work faster. Industry-standard RPMs align update and upgrade procedures with those used in the data center. The RPM package format provides the transparency and automation required of cloud-scale.

Figure 2. Business value for Cloud-Scale: Cisco ASR 9000 and third-generation line cards



New device on-boarding is automated for boot and day-zero provisioning. Say goodbye to manual processes. Bring devices online in minutes instead of hours. Automation for Day 2 management is also provided.

Cisco innovation: Network Services Orchestrator

Cisco Network Services Orchestrator (NSO) lets you deliver services faster and more easily to your customers through network automation.

What can NSO help you do?

- Drastically reduce the time to on-board new services in the network using model-driven orchestration
- Accelerate revenue-generating services with automated, self-service, on-demand provisioning that reduces activation times from months to minutes
- Increase business agility with the capability to create, reconfigure, and repurpose services in real time
- Simplify your network operations by automating the end-to-end service lifecycle and reducing manual configuration steps by up to 70 percent, according to Cisco estimates
- Differentiate the services you offer with automated advanced device features, bundled network services, and real-time assurance
- Dramatically reduce downtime with exceptional control over network changes and the ability to reconfigure devices and services during live production

Cloud-Scale features: Cisco ASR 9000 and third-generation line cards

The following is a sampling of the cloud-scale features—and their associated benefits—that are available with the Cisco ASR 9000, our third-generation line cards and Cisco IOS XR. Together, they deliver many benefits including reduced TCO, faster time-to-market, improved customer experience, increased revenues, and much more.

Some of the features you'll want to take advantage of immediately. Others may apply to your future plans. Either way, we think you'll be impressed with all of the ways the ASR 9000 can help transform your network to meet the growing demands of digitization.

Increased bandwidth and density

ASR 9000 third-generation line cards provide up to 12 ports of 100GE. The 8x100GE and 4x100GE line cards can be configured in 10/40/100GE mode. Thanks to Anyport technology exclusively available with CPAK optics, each port can be configured as 10x10GE or 2x40GE or consolidated into a single link for unprecedented density and scale. The high-density Cisco NCS 5000 Series satellite port extender solution is also supported to further increase port density.

- Reduce TCO
- Accelerate Speed to Market

Application hosting

The Cisco IOS XR 64 Bit architecture on the ASR 9000 supports third-party off-the-shelf operational applications built with Linux tool chains. You can run custom applications built with the Software Development Kit (SDK) that Cisco provides. Application hosting gives you a platform for experimenting with your tools and utilities. Use apps to monitor the state of your network.

- Reduce TCO
- Transform Operations
- Accelerate Speed to Market
- Generate New Revenue
- Application-Led, Not Infrastructure
- Network as a Platform

Scalable media transport

With the cloud-scale capabilities of the ASR 9000, you can scale up media transport to 512K per subscriber per ASR 9000 chassis. Coupled with the high-density third-generation line cards, this provides enough bandwidth to address customer needs into the foreseeable future.

- Reduce TCO
- Improve Customer Experience



Multiservice edge

The ASR 9000 with IOS-XR is a highly resilient, scalable, and feature-rich networking platform. It supports edge services such as: Layer 2 VPN (L2VPN), Layer 3 VPN (L3VPN), Broadband Network Gateway (BNG), Internet Protocol Television (IPTV), and Content-Delivery Networks (CDNs). You can deploy the ASR 9000 as common networking infrastructure to manage multiple edge services.

- Reduce TCO
- Accelerate Speed to Market

Ethernet VPN

EVPN is the next-generation all-in-one VPN technology that provides a wide range of services such as Ethernet Virtual Private LAN (E-LAN), Ethernet Virtual Private Line (E-Line), Ethernet Virtual Private Tree (E-TREE), Layer 3 VPN (L3VPN), Data Center Interconnect (DCI), Data Center Overlay, and Integrated Routing and Bridging (IRB). These services were previously provided by different, disjointed technologies. EVPN uses Multi-Protocol extensions to Border Gateway Protocol (MP-BGP) to distribute Layer 2 MAC or IP information. Therefore, EVPN can control Layer 2 or Layer 3 overlays and can be used to deliver Ethernet and IP VPN services removing some complexity at the control level.

EVPN provides some significant enhancements over existing technologies. It optimizes traffic load sharing with all active multi-homing, so that devices or servers can be dual homed with both paths active with per-flow load sharing. Multi-homing all active capability is native to EVPN, so there is no need for complex Multi Chassis Link Aggregations (LAGs) configurations. EVPN also limits flooding for unknown unicast. With EVPN, learning takes place in the control plane, allowing for more control and policy enforcement. EVPN also performs Address Resolution Protocol (ARP) suppression, another optimization that reduces unnecessary traffic flooding in the network.

- Reduce TCO
- Transform Operations
- Accelerate Speed to Market
- Generate New Revenue

Geo-Redundancy

Geo-redundancy provides seamless failover across geographies. For example, if you have two or more BNGs in different locations when one goes down, subscribers are moved seamlessly—thanks to the stateful redundancy feature—to an available BNG at another location.

- Improve Customer Experience
- Mitigate Risk
- Network as a Platform

Cisco innovation: WAN Automation Engine (WAE)

WAE is a powerful and flexible SDN platform that automates the engineering and operations of multivendor physical and virtual WAN infrastructures. You can use WAE to deploy new services, including global load balancing, bandwidth on demand, and premium/latency based network routing. It helps you optimize your network infrastructure through continual monitoring and analysis of network elements and applications

What can WAE help you do?

- Perform accurate traffic and topology simulations as often as needed
- Optimize traffic load-balance over core MPLS/SR links
- Minimize service down-time through worst case failure analysis
- Reduces both OPEX and CAPEX costs through efficient asset utilization
- Innovate and assure service deployment with easy-to-use automation capabilities

Real-Time telemetry

End-to-end visibility into network infrastructure is a required feature of cloud-scale networking. Until now, visibility has been limited to sections of network topologies, relying on SNMP which limited scalability. And visibility hasn't been available to administrators in real-time. But with the demands of a quickly digitizing world, you need to see what is going on in all facets of your network at all times. Visibility must be continual and automated to support the scale and agility required today and increasing in the future.

Cisco model-driven telemetry, available with Cisco IOS XR Software, is a new and improved approach to network monitoring. Data is streamed and captured continuously from devices with efficient, incremental updates. Model-driven telemetry is fully configurable using telemetry YANG models. You can precisely specify what data to stream, to where, and with what encoding and transport using just the models—no Command Line Interface (CLI) required. With model-driven telemetry, you simply specify the YANG model that contains the data you want.

Model-driven telemetry opens up your entire operational space for fine-grained control and operational efficiencies. For example, the increased visibility provided by streaming telemetry supports the highly efficient techniques of segment routing for near real-time network optimization.

- Transform Operations
- Mitigate Risk

Analytics

In the future, with the streaming data from Cisco's model-driven telemetry, you will be able to save data to a server and then run analytics on a variety of network, application, subscriber and other use cases. This capability provides visibility into the network state, traffic patterns, and applications, which can be used to monetize and optimize the network.

- Transform Operations
- Mitigate Risk

4G/5G scalable architecture

The cloud-scale networking architecture is backward compatible with 2G to 4G mobile network architectures and is 5G ready.

- Reduce TCO
- Transform Operations
- Generate New Revenue
- Improve Customer Experience
- Application-Led, Not Infrastructure
- Network as a Platform



Bandwidth flexibility

Third-generation line cards provide support for a very high density of 100G/40G/10G/1G interfaces with fixed and modular options along with support for dense 10G/1G nV with our satellite solution. The same third-generation line card can, therefore, be used to support both current and future bandwidth demands at a given site.

- Reduce TCO
- Transform Operations

Timing support

The Cisco ASR 9000 Series features a fully-integrated timing infrastructure, allowing the routers to take in timing inputs (for example, SyncE, Building Integrated Timing Supply [BITS], and DOCSIS® Timing Interface [DTI]) and distribute them over the backplane to each slot. This capability allows extensive support for transparent mobile convergence, mobile Radio Access Network (RAN) backhaul, and Time-Division Multiplexing (TDM) circuit emulation— without sacrificing performance or scale. These timing protocols are supported on third-generation line cards, for example, for mobile backhaul:

- IEEE 1588 G.8275.1
- IEEE 1588 G.8265.1
- IEEE 1588 G.8275.2
- SyncE
- IEEE 1588 G.8273.2
- PTP Hop-by-hop

- Generate New Revenue
- Application-Led, Not Infrastructure

Low latency

Segment routing can route your critical traffic, which requires stringent SLAs, over a path where latency below a certain threshold is guaranteed.

- Improve Customer Experience
- Application-Led, Not Infrastructure

Cisco innovation: Evolved Programmable Network Manager

Cisco Evolved Programmable Network Manager (EPN Manager) provides simplified, converged, end-to-end lifecycle management for carrier-grade networks of all sizes.

What can EPN manager help you?

- Increase operational scale and efficiency through simplified, integrated, and automated device operations, network provisioning, and network assurance
- Proactively assure service performance and minimize future service disruption through real-time fault management
- Increased service agility through integrated lifecycle management and standards-based Northbound Interfaces (NBIs) to third-party Operations Support Systems (OSSs)
- Service provisioning, monitoring, and change and compliance management to accelerate device and services deployment and to rapidly resolve problems that can affect the end-user experience

100 GE/10 GE density MACSec

MACSec is the IEEE 802.1AE standard for authenticating and encrypting packets between two MACSec-capable devices. MACSec is a new third-generation line card feature. IPsec is CPU-intensive, requiring a lot of memory to handle the encryption. But the MACSec chip in third-generation line cards allows encryption and authentication in hardware, saving CPU resources and providing higher throughput. MACSec is available both on 100GE and 10GE links. This is a critical feature for DCI as service provider, Enterprise, and government links from different data centers going to public areas need to be encrypted faster to handle massive scale without overwhelming CPUs.

- Generate New Revenue
- Improve Customer Experience
- Mitigate Risk

Service chaining

Network service chaining uses SDN capabilities to create a chain of connected network services and connects them virtually. You can use this cloud-scale capability to set up groups of connected services (e.g., Layer 4-7 firewalls, intrusion protection, Network Address Translation [NAT]) that use a single network connection. This approach automates the setup of VNFs and traffic steering for the various services. With this you can offer new-revenue generating services on-demand in your network infrastructure.

- Reduce TCO
- Transform Operations
- Improve Customer Experience
- Network as a Platform

Integrated DDoS

The virtual DDoS (vDDoS) solution powered by Arbor Networks technology on the Cisco ASR 9000 detects and blocks DDoS attacks in seconds without impacting legitimate traffic. The solution can detect potential outages from DDoS attack traffic, network “hot spots”, BGP hijacks or even network misconfigurations. And it provides root cause analysis tools to quickly diagnose and resolve the issue. With this solution deployed as a Virtual Network Function (VNF), you don’t have to buy and power a separate threat management system device.

- Reduce TCO
- Improve Customer Experience
- Mitigate Risk



Routing table scale

Certain use cases such as Internet Transit/Peering include very large routing tables. So routing table scale is an important attribute as traffic volumes grow. With third-generation line cards and 64-bit IOS XR, the ASR 9000 can support 10 million IPv4 routes and 5 million IPv6 routes.

- Reduce TCO

Path engineering

With data from streaming telemetry features available with Cisco cloud-scale, analytics can provide intelligence for solutions such as segment routing and real-time traffic engineering to help engineer optimal paths for traffic. These paths can be communicated to the network and implemented as needed. The end benefits are higher utilization rates with more efficient application-based routing and a great customer experience.

- Improve Customer Experience
- Mitigate Risk
- Application-Led, Not Infrastructure
- Network as a Platform

Cisco innovation: segment routing

Make your cloud-scale infrastructure SDN-ready with segment routing. This innovative architecture delivers a unified, end-to-end, policy-aware network infrastructure that also provides unmatched simplicity and scalability.

Why use segment routing now?

- You can reduce the number of protocols required, and still have complete control over application transport
- Scalability is enhanced because path signaling is not required. And per-flow states are encoded in the packet header instead of the network fabric
- It runs natively on a MPLS data plane, and only requires a simple upgrade to get started. Migration is painless, as it can coexist with your MPLS infrastructure
- It can set up end-to-end policies across your independent Metro, WAN and data center domains, making a unified forwarding plane possible
- New, innovative network services can be offered with features like low latency, disjoint paths and loop avoidance

Segment routing provides many benefits. A stateless and scalable network fabric. Higher link utilization. Ease of configuration. A better end user experience. Enhanced network resiliency. And application traffic steering.

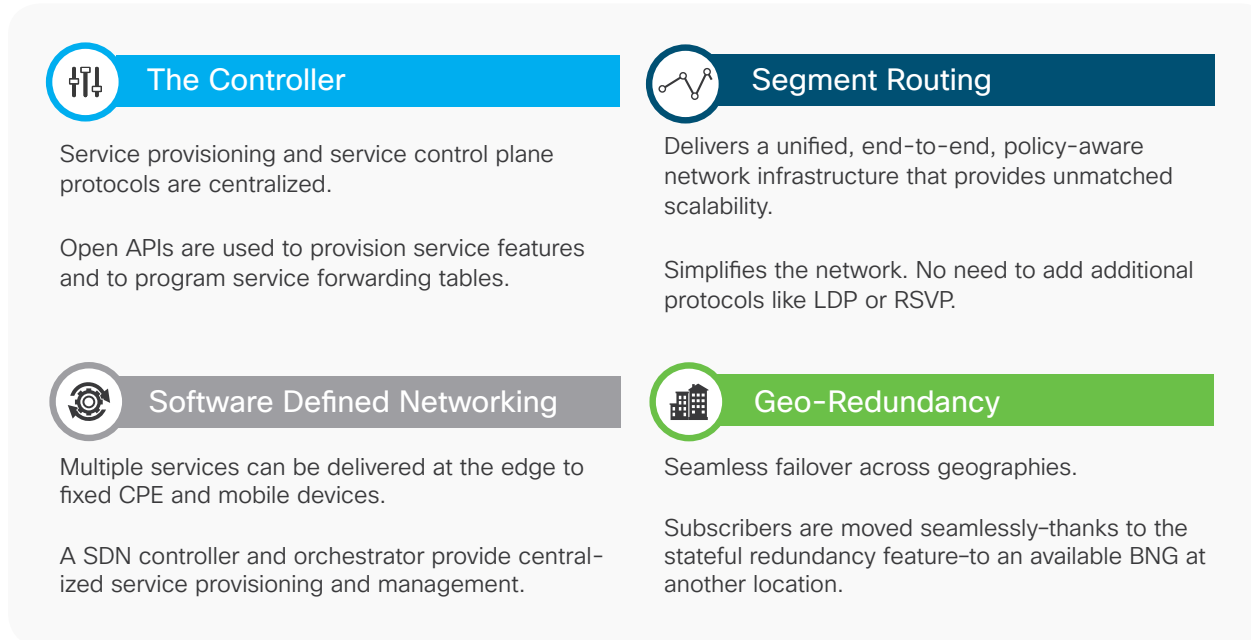
Use cases: Enhancing service provider services

Cisco cloud-scale, available with the Cisco ASR 9000, Cisco IOS XR and third-generation line cards solves many existing challenges and opens up exciting new possibilities. You benefit from the flexibility and elasticity of using physical and virtual solutions that can be quickly deployed, modified or taken down. You increase session scale with lower TCO, thanks to the 64-bit IOS XR. With Cisco's third-generation line cards, you're adding 4x more bandwidth than the previous generation line cards. SDN controllers like the Cisco NSO offload control plane functions for greater efficiency. Many other features provide additional benefits.

Business and residential services

For business VPN and residential services, the ASR 9000 maintains minimal software features and protocols locally to build an optimized and self-protected IP/MPLS transport solution. Service provisioning and service control plane protocols are centralized in the controller. The controller uses open APIs to provision the service features and to program service forwarding tables.

Figure 3. ASR 9000: Business VPN and residential services



Room for improvement: Residential services

Slow failover is a fact of life today among your residential subscribers. They notice when their service goes down. They have to re-authenticate and re-establish their sessions. It's a hassle that reflects poorly on your company. And network failures can wreak havoc on the service provider's back end, too. When a Broadband Network Gateway (BNG) goes down, accounting records stop. Hundreds, thousands or perhaps tens of thousands of disconnected subscriber machines start requesting IP addresses and authentication at the same time to a different node. Your network becomes tremendously stressed. Your call center is swamped. It's hard to offer service level agreements that you can guarantee.

Aside from not being able to provide fast, seamless failover, the infrastructure providing your residential services is under pressure. More bandwidth is needed for more subscriber devices and traffic flows. You have to scale but it's complex and expensive to both add capacity and manage everything.

Business specific

An EVPN deployed for Layer 2 or Layer 3 business VPN services uses a centralized BGP control plane. A SDN controller and orchestrator provide centralized service provisioning and management. They also serve as a centralized service control plan and inter-domain segment routing facilitator.

Residential specific

For residential services, the ASR 9000 with cloud-scale features is a next-generation BNG. With its massive data plane and control plane scale and support for geo-redundancy, BNG provides you with the most reliable and cost effective platform to host millions of subscribers.

The ASR 9000 router keeps minimal software features locally to build the optimized and self-protected IP/MPLS transport. The controller uses open APIs to provision the service features and programs the service forwarding tables. For IP/MPLS transport, the network nodes run a distributed Interior Gateway Protocol (IGP) such as Intermediate System-to-Intermediate System (ISIS) or Open Shortest Path First (OSPF) with required extensions for MPLS segment routing locally.

Both business and residential

With the ASR9000's reliability, high availability, open API's and streaming telemetry, you can offer your customers guaranteed SLAs that are monitored and managed over your programmable network infrastructure.

SDN architecture

With an SDN architecture, multiple services can be delivered at the edge to fixed CPE and mobile devices. Segment routing allows for simplification of the network—no need to add additional protocols like LDP or RSVP—and simpler administration.

Next steps - Day 2

When you're ready, products like the Cisco WAN Automation Engine (WAE) can provide real-time insight into the best paths for traffic. In the future, you might also consider virtual application hosting on the ASR 9000. With 64-bit IOS XR, it's easy to deploy third-party operational apps and services – for example, iperf for network performance measurement or Puppet/Chef tools for management.

Mobile backhaul services

Overview

For mobile backhaul, third-generation line cards are invaluable as they can handle the tremendous scale of traffic being generated by mobile devices and future-proof your network for the 5G evolution. SDN controllers configure the backhaul network using automation and orchestration to greatly simplify provisioning and management.

Room for improvement: Business VPN provider edge

Your operational costs are outpacing your business VPN revenues. Service delivery infrastructure complexity is slowing down your ability to deploy and manage new business services. Using MPLS VPNs with label technologies such as Label Distribution Protocol (LDP), pseudowire tunnels and many other tools increase the potential for failure and add additional traffic. All of these technologies and the complexity they introduce slows down service agility and failover. Configuring devices individually makes it much harder to scale your network to support the increases in traffic, devices, and apps that are coming with digital business initiatives.

Ethernet and network programmability promise new and better ways of providing business services. Any new and improved solution must be able to co-exist with existing network infrastructure since forklift upgrades are too expensive and disruptive.

Simplify and optimize

Using segment routing as the transport protocol for mobile backhaul further simplifies and optimizes traffic engineering. The use of streaming telemetry combined with data analytics solutions provides, even more, information about traffic, usage, devices and subscribers. This information is useful in optimizing traffic in real-time, troubleshooting and providing granular information about subscribers that can be useful for the development of new services and pricing.

Figure 4. ASR 9000: Mobile backhaul services



Bandwidth and Density

ASR 9000 third-generation line cards provide up to 12 ports of 100GE. Ports can be configured flexibly to 10/40/100GE making it a universal line card.

Each port can be configured as separate 10 GE or 40 GE links or consolidated into a single 100 GE link.



Streaming Telemetry

Streaming telemetry combined with data analytics solutions provides information useful in:

- Optimizing traffic and real-time troubleshooting
- Monetizing the network by developing new services and pricing based on granular subscriber data



Segment Routing

Using segment routing as the transport protocol for mobile backhaul further simplifies and optimizes traffic engineering.



4G/5G Scalable Architecture

The cloud-scale networking architecture is backward compatible with 2G to 4G mobile network architectures and is 5G ready.

Cisco envisions the future unification of Ethernet backhaul and fronthaul using the same cloud-scale architecture and features.

Data Center Interconnect (DCI) Services

Overview

For Data Center Interconnect (DCI), the ASR 9000 provides more control, higher speeds and density and greater routing efficiency. For enterprises and public sector users that might not have their data centers and want to connect their offices across geographies, the ASR 9000 serves as a WAN edge device.

OTT benefits

For Over The Top (OTT) providers that require a multi-service edge device to connect to peers and to provide DCI, the ASR9000 and third generation line card are an ideal fit. They supports the scale and features required to serve as a peering router, LSR, LER or DCI device.

Room for improvement: Mobile backhaul

Mobile data and traffic volumes are growing, and they'll grow even more with 5G. Currently, disparate legacy and newer network management tools from different vendors handle various network segments within the mobile Internet. These point products are non-collaborative, limited in their scale of operations and often unable to consistently support Quality of Service (QoS) levels demanded by customers.

Mobile backhaul capacity and efficiency must increase so mobile broadband, data access, and video services can effectively support consumer usage trends and keep mobile infrastructure costs in check. As with other use cases, the complexity of the pre-aggregation and aggregation layers of the service provider network and their lack of automation and programmability are impediments to efficiency, scale, and cost-effectiveness.

An EVPN control plane

In all of these roles, EVPN provides the next-generation L2 VPN service infrastructure. It enables the ASR 9000 running multiprotocol BGP to advertise and learn MAC addresses for access topology and VPN endpoint discovery. This eliminates the need for signaling of separate point-to-point pseudowire VC labels for each remote PE, enabling tremendous scale. EVPN also brings seamless host mobility for near-instantaneous failover. If a VM in one data center goes down, another VM in a different data center is automatically created, so service isn't lost.

Figure 5. ASR 9000: Data Center Interconnect



Ethernet VPN

The EVPN was designed to meet key requirements for Data Center Interconnect (DCI) environments.

Benefits include flow-based active/active load balancing to and from multi-homed Ethernet segments and greater flexibility and control over the MAC learning process.



Segment Routing

Segment routing lets you take advantage of enhanced packet forwarding via Cisco NSO. NFV, automation and other programmable features simplify complex service deployment and management.



100 GE/10 GE Density MACSec

The IEEE 802.1AE standard for authenticating and encrypting packets between two MACSec devices.

It enables service provider links from different data centers going to public areas to be encrypted faster so they can handle massive scale without overwhelming CPUs.



Multiservice Edge

The ASR 9000 provides an array of edge services: Layer 2 VPN (L2VPN), Layer 3 VPN (L3VPN), Broadband Network Gateway (BNG), Internet Protocol Television (IPTV), and Content-Delivery Networks (CDNs).

Cisco controllers

Cisco NSO controller serves as a SDN controller for segment routing and lets you take advantage of enhanced and optimized packet forwarding. Cisco's Network Functions Virtualization Infrastructure (NFVI) and Cisco Virtual Topology Systems (VTS) provide NFV, automation and programmable features to simplify complex service deployment and management. The Cisco WAN Automation Engine (WAE) can also be used for DCI environments to bring real-time insight into establishing the best paths for traffic.

Room for improvement: Data Center Interconnect

Scale is also an issue with Data Center Interconnect (DCI) services. The need for signaling for separate point-to-point pseudowire Virtual Circuit (VC) labels in each remote provider edge device limits scale. Slow failover is also a problem with most DCI solutions. If a VM goes down in one data center, it often doesn't failover to another VM instantaneously, so service is temporarily lost.

Another limitation with DCI solutions used by Tier 2 and Tier 3 providers today is the inability to do line rate Layer 2 encryption. In the past, supporting this functionality meant adding a prohibitively expensive optical line or other proprietary third-party solution. As a result, markets such as government agencies that have extensive security requirements have been out of reach for DCI providers.

MACSec encryption

Additionally, cloud-scale gives DCI providers the ability to deliver Layer 2 line rate encryption using the 100GE and 10GE MACSec feature in the new third-generation line cards. Now you can provide encryption and authentication in hardware, saving CPU resources and providing higher throughput. This capability is significant because provider links from different data centers going to public areas must be encrypted faster to handle massive scale without overwhelming CPUs.

With the MacSec feature, you can now offer protected, fully encrypted services to government agencies and other organizations that are mandated to provide line rate encryption. It's a new source of revenue based on service capabilities with a clear ROI.

Internet peering/transit services

Overview

For Internet peering/transit, the ASR 9000 with IOS XR cloud-scale features serves as a peering router in the Internet Exchange Point (IXP). It provides enhanced egress peering that includes support for a rich and highly scalable Hierarchical QoS (HQoS) stack that lets you apply service classes and policies to peering/transit traffic. Enhancements to the BGP stack help make peering even more efficient. And the new third-generation line cards provide a 100GE backbone that is needed for growing traffic volumes.

Security Access Control Lists (ACLs)

Another big advantage of cloud-scale here is third-generation line card support for scaled security Access Control Lists (ACLs). With a large volume of unknown traffic coming into peering routers, a large scale of ACLs is needed to filter out malicious traffic and ensure that the traffic is coming from trusted sources. Currently, the third-generation line cards support up to 98,000 IPv4 ACLs and 16,000 IPv6 ACLs. It also supports chaining ACLs to help manage the provisioning of large-scale ACLs on the router.

Routing table scale

The line cards also support routing table scale, with each card able to handle 10 million IPv4 routes, triple what the old cards can support. This is a key feature with peering/transit as it involves multiple providers with separate routing tables that must be maintained by the peering routers.

Room for improvement: Internet peering/transit

Capacity and scale also figure prominently as requirements in Internet transit/peering services. To ensure that bandwidth requirements are supported without excess capacity, peering routers need to provide 100GE ports and 10GE or 40GE interfaces too. Hierarchical QoS must be available to apply service classes and policies to all traffic, and that is difficult to ensure as traffic continues to grow exponentially.

Determining the best path for traffic with a plethora of endpoints and networks with thousands of nodes is complex. Application networking adds data tables sometimes containing millions of entries to traffic workflows. Multiple protocols must be maintained, and many protocol interactions require troubleshooting. What's needed is greater network programmability and efficiency in how traffic is directed. What if edge routers could steer packets onto the most optimal network paths and intelligently respond to application requirements and network conditions without requiring any state creation and maintenance?

Another area where there's room for improvement in Internet transit/peering is the capacity of routing tables. IPv4 tables are 750,000 entries alone. Peering multiple providers requires that multiples of those tables are maintained in each peering router. Older line cards can handle 4 million routes. That isn't enough going forward.

Streaming telemetry

For all of these use cases, cloud-scale streaming telemetry will provide a rich source of operational data in the future. Using BGP to obtain information about traffic paths, you'll be able to add data from your streaming telemetry solution to see what traffic patterns look like, where problems are occurring and many other operational data points. Using analytical solutions, you'll be able to run a true self-healing network where problems can be anticipated before they happen and where outages are a thing of the past.

Figure 6. ASR 9000: Internet peering/transit services



Bandwidth and Density

ASR 9000 third-generation line cards provide up to 12 ports of 100GE.

Each port can be configured as separate 10 GE or 40 GE links or consolidated into a single 100 GE link.



Streaming Telemetry

You'll be able to see what traffic patterns look like and where problems are occurring.

Analytics support a self-healing network where problems can be anticipated before they happen.



Routing Table Scale

Currently, the ASR 9000 supports 4 million IPv4 routes and 2 million IPv6 routes.

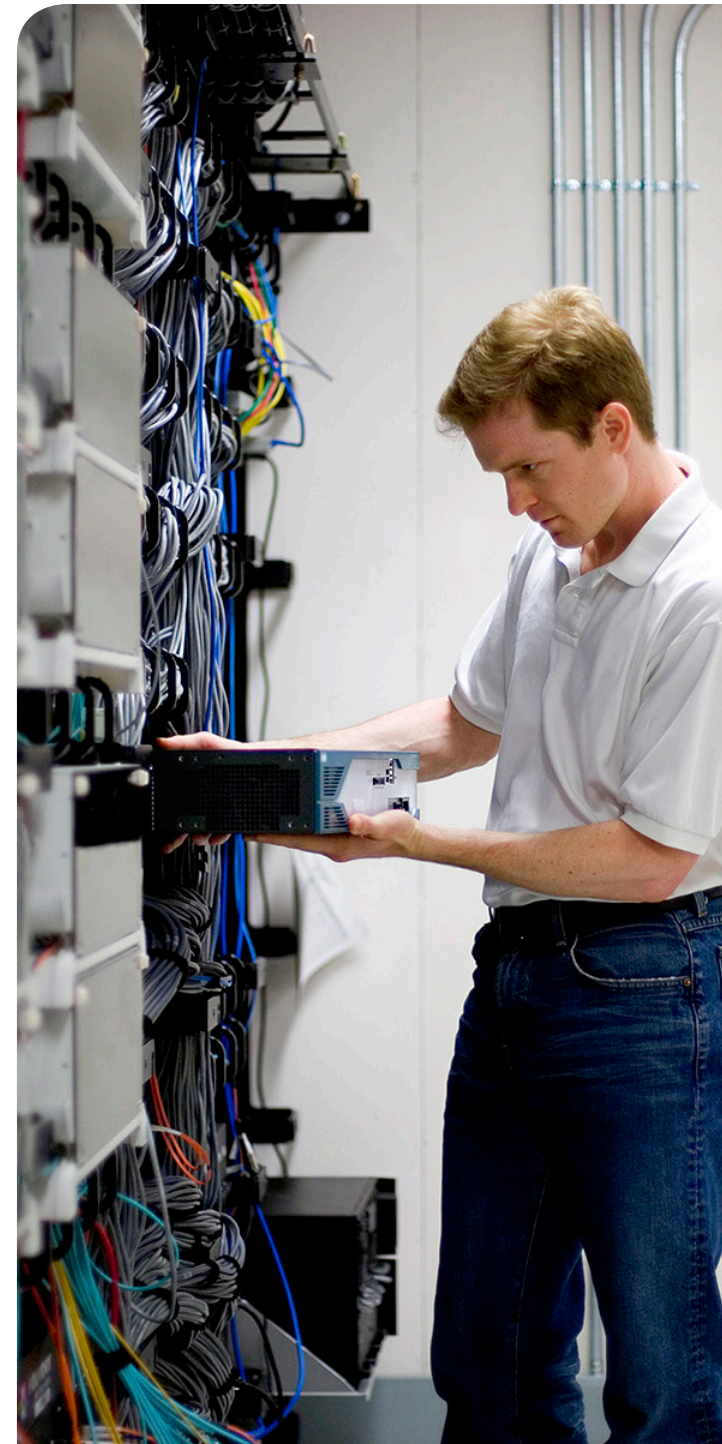
Third generation line cards and 64-bit IOS XR, can support 10 million IPv4 routes and 5 million IPv6 routes.



Security Access Control Lists

ACLs filter out malicious traffic and ensure that the traffic is coming from trusted sources.

Currently, the third-generation line cards support up to 98,000 IPv4 ACLs and 16,000 IPv6 ACLs.



Cisco ASR 9000 overview

Awarded “Best Carrier Ethernet Aggregation Product” by the Carrier Ethernet World Congress, the Cisco® ASR 9000 Series Aggregation Services Routers is one of Cisco’s best-selling products. It has consistently raised the bar for edge and core routing, with exceptional scalability, carrier-class reliability, environmentally conscious design, incredible flexibility, and an attractive price-to-performance benchmark.

Figure 7. ASR 9000 product portfolio



Product portfolio

The product portfolio ranges from the Cisco ASR 9001 (2 Rack Units [2RU]) to the Cisco ASR 9922 (44RU), with each system designed to provide true carrier-class reliability using the Cisco IOS® XR operating system. Comprehensive system redundancy and a full complement of network resiliency schemes are included. The Cisco ASR 9000 Series also offers service, and application-level intelligence focused on optimized video delivery and mobile aggregation. The ASR 9000 Series products are designed to simplify and enhance the operational and deployment aspects of service-delivery networks.



Within the ASR 9000 Series, all common components including Route Switch Processors (RSPs), Route Processors (RPs), switching fabric, fans and power supplies are redundant. The Cisco ASR 9000 Series is a critical component in optimizing service-transport infrastructure because of its service flexibility, comprehensive feature set, wide interface capability, and transparent integration of Carrier Ethernet and WAN interfaces as the foundation for services delivery. The Series provides a powerful single solution for Multiservice Edge (MSE), Ethernet-optimized MSE (E-MSE), and Carrier Ethernet needs.

The Cisco ASR 9000 Series brings increased power and simplicity to the edge, and the ASR 9000v sets the industry benchmark as a virtualized compact carrier-class converged access and aggregation platform. Using the Cisco network Virtualization (nV) technology, the Cisco ASR 9000 Series offers exceptional pay-as-you-grow scale, carrier-class reliability and simplified service provisioning.

The high-density service edge and core platforms are scalable, ultra-high density service routers, ideal for large, high-growth environments. They are upgradable to 10 GE and 100 GE ports without the need for a complete chassis replacement.

Coming enhancements will provide investment protection because they provide backward compatibility with third-generation line cards, fabric and Route Processors and Route Switch Processors (RPs/RSPs).

Smart Software Licensing for the Cisco ASR 9000

With Cisco Smart Software Licensing, you only pay for the software you need when you need it. No software installation is needed or necessary. The ASR 9000 initiates an HTTP/HTTPS call-home session and requests the licenses it uses and is configured for the licenses associated with your account.

You can un-configure the feature that is used in the current chassis and reconfigure the feature on a new chassis that needs to use the same license. A re-provisioning happens dynamically when the new device initiates an HTTP/HTTPS request via the call-home process.

License pool(s) created already in your account can be used with any ASR 9000 device in your company. Licenses are stored securely on Cisco backend servers, accessible 24x7x365. License count is per customer account, or pool and many devices can be part of the same pool.

Licenses can be moved between product instances without any software installation. You can also transfer licenses from one pool to the other easily with a Web interface.



Cisco IOS XRv 9000 Router

The Cisco IOS XRv 9000 Router is a virtual version of the ASR 9000 router. Deployed on virtualized general x86 compute platforms, it complements existing physical Cisco routers that rely on Cisco IOS XR Software, such as Cisco Network Convergence System routers, Cisco ASR 9000 Series Routers, and Cisco Carrier Routing System (CRS) platforms.

You can utilize the Cisco IOS XRv 9000 Router as an end-to-end solution with a Network Functions Virtualization (NFV) infrastructure, virtual network functions, and service orchestration and management. It can be deployed for control plane functions as a virtual route reflector. It can also be deployed as a high-performance data plane. It is based on an X86-optimized code base that uses Cisco nPower Network Processor Units (NPUs) and the Intel® Data Plane Development Kit (DPDK).

Third-generation line cards

The Cisco ASR 9000 Series supports industry-leading, ultra high-density 100 Gigabit Ethernet third-generation line cards with up to 12 ports of 100GE and Cisco IOS XR Software. These high-capacity line cards are designed to remove bandwidth bottlenecks in the network that are caused by the large increase in Video-on-Demand (VoD), IoT, 5G, IPTV, point-to-point video, Internet video, and cloud services traffic.

Feature highlights include high density and scalability; flexible interface support; the benefits of Cisco CPAK™ technology that is poised to revolutionize optical transport through Complementary Metal-Oxide Semiconductor (CMOS) photonics; inline security; and environmentally and resource-friendly power saving design.



Third-generation line card models include:

A9K-8X100GE-SE	8-port 100GE LAN/WAN/OTN Service Edge Optimized, LC
A9K-8x100GE-TR	8-port 100GE LAN/WAN/OTN Packet Transport Optimized, LC
A99-8x100GE-SE	8-port 100GE LAN/WAN/OTN Service Edge Optimized, LC (7-fabric support)
A99-8x100GE-TR	8-port 100GE LAN/WAN/OTN Packet Transport Optimized, LC (7-Fabric support)
A9K-4x100GE-SE	4-port 100GE LAN/WAN/OTN Service Edge Optimized, LC
A9K-4x100GE-TR	4-port 100GE LAN/WAN/OTN Packet Transport Optimized, LC
A9K-4x100GE	4-port 100GE LAN Packet Transport Optimized, LC
A9K-MOD400-SE	400GE Line Card, Service Edge Optimized, LC
A9K-MOD400-TR	400GE Line Card, Packet Transport Optimized, LC
A9K-MOD200-SE	200GE Line Card, Service Edge Optimized, LC
A9K-MOD200-TR	200GE Line Card, Packet Transport Optimized, LC
A9K-400G-DWDM-TR	400GE IPoDWDM Packet Transport Optimized, LC
A9K-MPA-20x10GE	20-port 10GE Modular Port Adapter
A9K-MPA-1x100GE	1-port 100GE Modular Port Adapter
A9K-MPA-2x100GE	2-port 100GE Modular Port Adapter
A99-12x100GE	12-port 100GE LC
A9K-48X10GE-1G-SE	ASR9000 48-port dual rate 10G/1G service edge optimized LC
A9K-48X10GE-1G-TR	ASR9000 48-port dual rate 10G/1G packet transport optimized LC
A9K-24X10GE-1G-SE	ASR9000 24-port dual rate 10G/1G service edge optimized LC
A9K-24X10GE-1G-TR	ASR9000 24-port dual rate 10G/1G packet transport optimized LC

The 8x100GE and 4x100GE third-generation line cards support the AnyPort technology thanks to CPAK optics. They support dense 100GE/40GE/10GE interfaces that you can mix and match on the same line card. IP and optical 100G interfaces can be integrated on the same ASR 9000 400G IPoDWDM TR line card.

IOS XR 64-bit is only supported on third-generation line cards. It brings the features and control plane scale that enables cloud-scale networking.



Cisco Services

Unmatched industry experience

Implementing cloud-scale networking technologies can get complex. Ensuring that you're adding them in a way that will enable the simplified, automated, programmable networks of the future—even more so. Fortunately, you don't have to go it alone.

Cisco Services has decades of professional services experience helping service providers plan, build, and manage network migration projects. We have industry-leading expertise across the full range of technologies, as well as next-generation orchestration platforms. We can help you capitalize on new cloud-scale innovations more quickly and easily, at a lower cost and with less risk.



Implementation tailored to your business

Cloud-scale networking evolution paths can be different for each service provider. We have the flexibility to understand and help you achieve your specific business goals. Our services can help you evolve your network to support new customer experiences, simpler and less expensive operations, faster time-to-market, and more profitable growth. Cisco Services uniquely deliver innovative solutions, unmatched expertise, and smart service capabilities using a collaborative partner approach.

Our intellectual capital, tools, experience and expertise set Cisco Services apart from the competition. We have delivered successful plan, build, and manage services to all types of service providers around the world. Trust the success of your network operations to the worldwide leader in networking services and solutions.



Summary

The benefits of Cisco cloud-scale networking are truly transformative. Reducing TCO, optimizing your operations and getting services to market faster will have a clear impact on your bottom line. The ability to launch new types of services and to substantially improve the customer experience will improve your revenue flow. Security throughout all layers of your service delivery architecture helps you mitigate risk. With SDN solutions, you gain tremendous agility and control, enabling applications to determine what resources they require rather than being limited by infrastructure constraints. Your network becomes a platform ready to launch all of the hottest new services.

You've seen how Cisco cloud-scale features can transform business and residential services to lower operational costs at the network edge. With mobile backhaul, you learned how third-generation line cards can handle the tremendous scale of mobile traffic and how segment routing can simplify and optimize traffic engineering to help you manage next generation 5G and IoT services. With DCI, the ASR 9000 delivers more control, higher speeds and density and much greater routing efficiency. And for Internet peering/transit, cloud-scale features in IOS XR make peering hyper-efficient, and the new line cards bring a 100GE backbone to future-proof your operations.

Cost-effective and flexible to deploy

Migration is a complex exercise that demands tremendous attention to detail, a high level of technical expertise, and time-consuming effort. It also throws up numerous challenges, ranging from availability of adequate information, managing time and cost to maintaining SLAs post migration. Cisco Advanced Services helps customers transform their cloud-scale Networking initiatives from idea to reality through a proven risk mitigating methodology. And with Cisco's Cisco Smart Software Licensing, you only pay for the software you need when you need it.

Next steps

It's all waiting for you with Cisco cloud-scale networking, available on the tried and true ASR 9000 running IOS XR with our newest third-generation line cards.

Are you ready for 5G, the IoT, M2M, virtual managed services and the other major opportunities and challenges coming from consumer and business digitization? Are you a current ASR 9000 customer or new to this product line?

Contact us today. Find out how cloud-scale networking from Cisco can make a huge difference today and tomorrow.

Attention Cisco ASR 9000 customers!

With the Cisco ASR 9000 deployed in your network, you already know about the feature richness and versatility of this best-selling Cisco product. So why make changes to what's working so well? Why risk disrupting your network and incurring additional costs?

Because with Cisco third-generation line cards, a whole new world of lucrative cloud-scale networking capabilities can be yours. And upgrading isn't disruptive at all. Here are a few more reasons why you should take a serious look at Cisco third-generation line cards today:

- They can provide investment protection and greater longevity for your ASR 9000s
- No need to swap chassis to switch out the new line cards
- Upgrade your platforms as needed, no need to do all at once

Financing your upgrade through Cisco Capital is another tremendous benefit. Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries.

Learn more

Ready to take the next step in your cloud-scale networking transformation? Contact your Cisco account representative or visit:

Cisco ASR 9000 Series Aggregation Services Routers: <https://www.cisco.com/c/en/us/products/routers/asr-9000-series-aggregation-services-routers/index.html>

Cisco ASR 9000 Series Line Cards: <https://www.cisco.com/c/en/us/support/docs/routers/asr-9000-series-aggregation-services-routers/116726-qanda-product-00.html>

Cisco IOS XRv9000 Router: <https://www.cisco.com/c/en/us/products/collateral/routers/asr-9000-series-aggregation-services-routers/datasheet-c78-734034.html>

