Cisco 4000 Series Integrated Services Routers: Architecture for Branch-Office Agility

The Cisco® 4000 Series Integrated Services Routers (ISRs) are designed for distributed organizations with multiple branch offices and remote sites. Today's branch offices offer full services through the cloud, mobile, and multimedia applications, and require increased direct communication with both private data centers and public clouds across VPNs and the Internet. They also need a low total cost of ownership (TCO) for their networking hardware.

The Cisco 4000 Series ISRs extend the capabilities of previous-generation Cisco branch-office routers by offering increased bandwidth with fewer and physically smaller boxes, WAN traffic management to deal with new applications and use patterns, performance-on-demand capability, and consolidation of servers.

Challenges of the Branch Office

In the past, branch offices and remote sites provided static connectivity sites to local or data center–hosted applications. Because branch offices serve up to 80 percent of customers and employees, organizations now are providing full-service branch offices with dynamic connectivity to support a mobile workforce and cloud applications. Today's trends are also introducing a new class of immersive applications to promote employee productivity and customer engagement. Businesses are innovating with high-definition (HD) video, location services, and other data-heavy applications.

However, resources of all kinds have not increased in proportion to demand, so branch offices must handle increased network traffic with a relatively small number of IT staff; little rack space for hardware; and fixed budgets for hardware, energy usage, and cooling. These limitations make it difficult for them to operate multiple appliances for routing, security, and WAN optimization.

Branch-Office Challenges

Offering full services:
- HD video
- Location services
- Cloud-based services
- Mobile users

Limiting factors:
- Rack space
- Budget
- IT staff

Increasing network demand and new traffic patterns:
- WAN optimization and intelligent caching
- Deep packet inspection
- Traffic management
- Hosting virtual servers

Mobile users, cloud services, and multimedia applications have increased the demands on networks in both higher network loads and new traffic patterns. Branch offices must support heavy downstream and upstream traffic using WAN optimization, deep packet inspection, and traffic-management techniques. In addition, branch offices find that in using cloud-based applications, they are now seeing significant cost savings by sending traffic directly over the Internet rather than hairpinning traffic through the data center. Branch offices also may need to run virtual servers to protect office functions such as printing and email messaging from WAN outages.

Introducing the New Integrated Services Router Architecture from Cisco

The Cisco 4000 Series ISRs build on 20 years of branch-office routers, adding services and horsepower for the needs of modern branch offices and allowing businesses to:

- Quickly open new remote offices or easily add additional services
- Operate an entire branch office with a single box
- Give IT departments more time for innovation by automating repetitive tasks and orchestrating security and application services

The new architecture addresses the problems that modern branch offices face, without giving up any of the existing services of previous-generation Cisco branch-office routers. It also brings virtualization to networking so that IT can adopt services faster and repurpose resources as needs change. And it delivers additional computing power for local application survivability, data backup, and local analytics processing.

The new architecture of the Cisco 4000 Series ISRs delivers up to 2 Gbps in a converged platform, typically 4 to 10 times faster than the previous-generation ISRs. The WAN and application optimization services of the 4000 Series ISRs include Cisco Application Visibility and Control (AVC), allowing IT to assess capacity planning; and Cisco Performance Routing Version 3 (PfR v3), which automatically sends traffic across the best connection for current network conditions. Not only does this architecture allow a branch office to run the network with a single box, it also allows use of that box to converge network, computing, and storage resources in the same platform. The virtualization technology available both within the Cisco 4000 Series and through additional data center–class server modules offers new levels of converged capability.

Key Features of the New Architecture

The Cisco 4000 Series ISRs include several important features that make it a perfect choice for today's branch offices:

- **Price for performance:** The Cisco 4000 Series allows branch offices to handle increased bandwidth using a single box without the need for security and optimization appliances, helping control costs. The platform is manageable for a small IT staff. The platforms run concurrent Intelligent WAN (IWAN) services, including security, application optimization, AVC, and intelligent path selection. The price for performance extends to the physical design: The 4000 Series ISRs use more compact boxes than previous-generation Cisco branch-office routers; and they include an industry-first altitude sensor, which helps ensure that the fans spin at the optimal speed, thereby reducing noise pollution in the office.

- **Performance on demand (pay as you grow):** Branch offices can upgrade to a higher level of bandwidth without having to buy a new box. Each model in the Cisco 4000 Series offers additional performance and services that you can activate remotely with a license. For example, a branch office can implement a Cisco 4351 with a baseline performance of 200 Mbps. But when a new application rollout increases the need for bandwidth, you can boost the performance (up to 400 Mbps for the Cisco 4351) with no additional hardware, at a fraction of the cost of buying a new router, and no expensive upgrades are required.

- **Services on demand:** Service containers allow virtual machines to run within the Cisco 4000 Series. Essential branch-office services that the branch office is already running, such as WAN optimization and energy management, can run natively on the router. Thus the branch office can consolidate servers and appliances, reducing its hardware footprint and power usage.

- **Scalable services:** The Cisco 4000 Series routers support Cisco Unified Computing System™ (Cisco UCS®) E-Series Blade servers, which are comparable to a full-size server. The blades use the power supply and chassis of the router, but are managed separately from the router; resetting a blade will not reset the router and the network team members don't have to give their passwords to the server team. This setup gives an IT department all the benefits of a separate data center–class server without the need for maintaining another box. In addition, a separate server virtual-machine license is not required, and troubleshooting involves only one point of contact instead of multiple vendors, resulting in better uptime and reliability. As an added bonus, hardware support costs through Cisco SMARTnet® support are bundled into the router support cost. Any Cisco UCS E-Series servers hosted in an ISR are covered at no additional fee. This is beneficial because those support fees can really add up when dealing with potential hard-drive failures in a server.

Cisco 4000 Series: Technical Highlights and Comparison

The Cisco 4000 Series uses a new Linux-based OS, Cisco IOS® XE Software, which retains the same design user interface of the Cisco IOS Operating System used by previous-generation Cisco routers yet allows the use of multicore CPUs. This setup facilitates separation of the data and control planes, and uses dedicated CPUs for services.

Because the services plane is separate from the data and control planes, the router can handle more services on a single platform, allowing an office to consolidate devices. Solutions such as Cisco Unified Border Element (Cisco UBE) with Survivable Remote Site Telephony (SRST) or with routing can now be deployed more easily and efficiently on a single ISR. Also, for many of the services, such as Cisco UBE, the scalability is significantly greater without added costs per port. Performance also remains solid across most typical branch-office deployments, giving branch offices application-specific integrated circuit (ASIC)-like performance and a highly reliable platform.

Service containers offer dedicated virtualized computing resources that include CPU, disk storage, and memory for each service. An industry-standard hypervisor presents the underlying infrastructure to the application or service. This scenario offers better performance than a tightly coupled service, deployment with zero footprint, security through fault isolation, and the flexibility to upgrade network services independent of the router software.
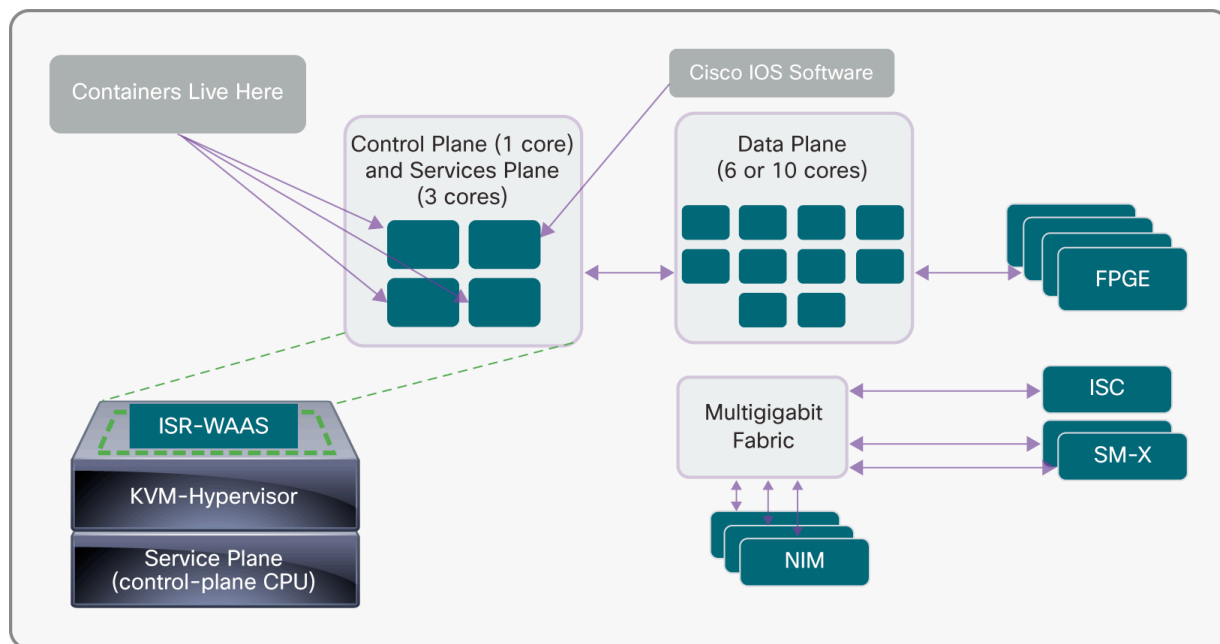
The Cisco 4400 and 4300 Series

The Cisco 4400 and 4300 Series ISRs are very similar in design user interface. The biggest difference to most users is that the Cisco 4400 Series supports dual power supplies, whereas the Cisco 4300 Series does not; this difference makes the Cisco 4451 and 4431 the preferred choices for organizations that cannot tolerate any downtime. The 4400 Series routers have a physical separation between control and data planes, and they use dedicated CPU sockets for each. The Cisco 4300 Series uses a single socket with multiple CPU cores allocated to the control plane, data plane, and services, a difference most users would never be aware of.

Figure 1 shows the Cisco 4400 Series architecture.

- FPGE: Front-Panel Gigabit Ethernet–The Ethernet interfaces on the front panel.
- ISC: Internal Services Card–An internal module used for exmanding the capabilities of the system. Commonly used for DSP modules.
- SM-X: Enhanced Service Module–A larger module type used mainly for UCS E-Series server blades and high density Ethernet switch modules.
- NIM: Network Interface Module–Half the size of an SM-X generally used for WAN, Voice and low-density Ethernet interfaces.

Figure 1.   Cisco 4400 Series Architecture

The Cisco 4400 Series uses two multicore CPU complexes for the data plane (packet processing) and control and services planes. In Cisco IOS XE Software, classic Cisco IOS Software runs as a single daemon within a Linux OS, helping ensure control-plane protocol compatibility with all other Cisco routers; this setup is indicated as "Cisco IOS Software" in the figure. Additional system functions now run as additional, separate processes in the host OS environment. "ISR-WAAS" in the figure is virtualized Cisco Wide Area Application Services (WAAS) in a Cisco IOS XE Software service container. As with previous generations of Cisco routers, a multigigabit fabric supports intercommunication among the IP Solution Center (ISC), Cisco SM-X EtherSwitch® Modules, and network interface modules (NIMs).

Figure 2 shows the Cisco 4300 Series architecture, which is similar to the 4400 model but does not include physical separation of the control and data planes. All functions are exactly the same, with identical end-user experiences and feature support.

Figure 2.   Cisco 4300 Series Architecture
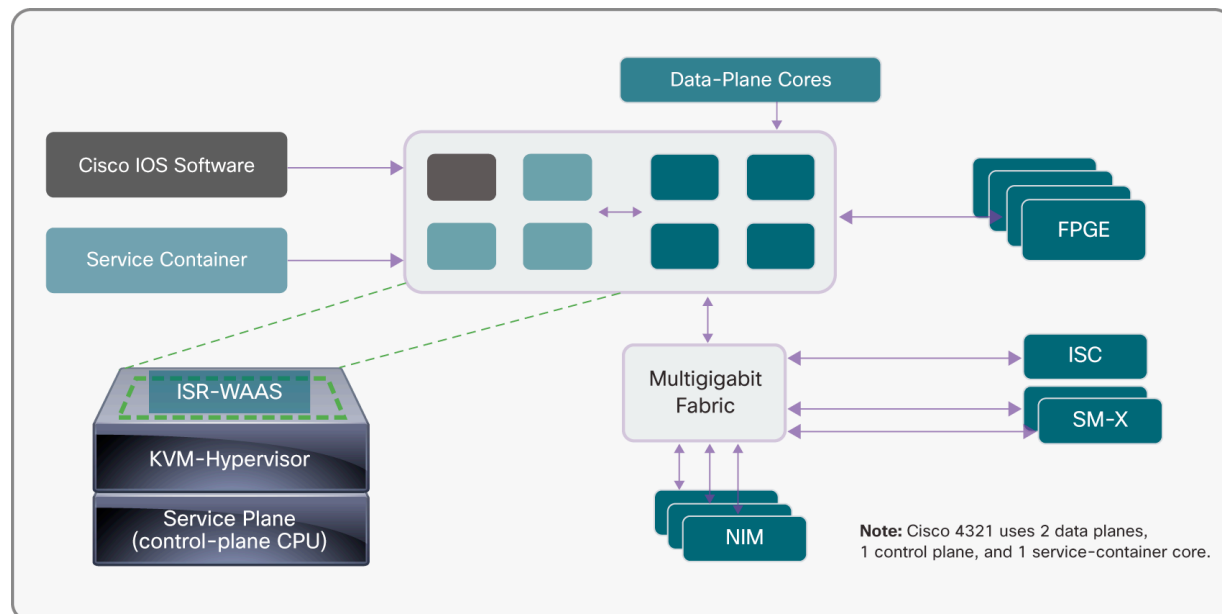
Individual Models in the Cisco 4000 Series

Figure 3 shows the Cisco 4451 Integrated Services Router.

Figure 3.   Cisco 4451

The Cisco 4451 is suggested for migration from the existing Cisco 3925E and 3945E routers. It offers 1-Gbps performance, upgradable to 2 Gbps, in a 2-rack-unit (2RU) form factor with 3 network interface module (NIM) slots and 2 enhanced service module (SM-X) slots. It includes an option for redundant power.

- 4-core processors (1 control and 3 services processors)
- 10-core data plane
- Single or double-wide Cisco UCS E-Series support
- Up to 16-GB control and services memory

Figure 4 shows the Cisco 4431 Integrated Services Router.

Figure 4.   Cisco 4431

The Cisco 4431 is suggested for migration from the existing Cisco 3925 and 3945 routers. It offers 500-Mbps performance, upgradable to 1 Gbps, in a 1RU form factor with 3 NIM slots and no SM slots. It includes an option for redundant power.

- 4-core processors (1 control and 3 services)
- 6-core data plane
- Up to 16-GB control and services memory

Figure 5 shows the Cisco 4351 Integrated Services Router.

Figure 5.   Cisco 4351

The Cisco 4351 is suggested for migration from existing Cisco 2951 routers. It offers 200-Mbps performance, upgradable to 400 Mbps, in a 2RU form factor with 3 NIM slots and 2 SM slots.

- 8-core CPU with 4 data-plane cores, 1 control-plane core, and 3 cores dedicated for services
- Single or double-wide Cisco UCS E-Series support, and up to 16-GB control and services memory

Figure 6 shows the Cisco 4331 Integrated Services Router.

Figure 6.   Cisco 4331

The Cisco 4331 is suggested for migration from the existing Cisco 2911 and 2921 routers. It offers 100-Mbps performance, upgradable to 300 Mbps, in a 1RU form factor with 2 NIM slots and 1 SM slot.

- 8-core CPU with 4 data-plane cores, 1 control-plane core, and 3 cores dedicated for services
- Single-wide Cisco UCS E-Series support, and up to 16-GB control and services memory

Figure 7 shows the Cisco 4321 Integrated Services Router.

Figure 7.   Cisco 4321

The Cisco 4321 is suggested for migration from the existing Cisco 2901 and 1941 routers. It offers 50-Mbps performance, upgradable to 100 Mbps, in a 1RU desktop form factor with 2 NIM slots and no SM slots.

- 4-core CPU with 2 data-plane cores, 1 control-plane core, and 1 core dedicated for services
- Up to 8-GB control and services memory

Conclusion

The Cisco 4000 Series is designed to help branch and remote offices do more with less. These routers mean more bandwidth and intelligent WAN management, and also more virtual machines, more data center–class servers, and more flexibility in upgrading. And they mean less need for rack space; lower cost for maintenance, power, and cooling; and less time spent by IT staff managing routers.

The Cisco 4000 Series is available now for ordering. For more information, contact your local Cisco sales representative.

For more information, please visit: cisco.com/go/isr4000.

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