TOMORROW starts here.
Next Generation Branch Architectures

BRKCRS-2000

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CCIE 3225

#clmel
Next Generation Routing: Performance and Service without Compromise
Cisco ISR Branch in a Box
Use the Slots on the Most Widely Deployed Branch Device

- Cisco IOS Firewall
- Cisco Unified Communications
- Cisco IP Routing
- Cisco VPN/IPSec/Remote Access
- WAN termination
- Cisco vWAAS
- Cisco vWLC
- Cisco VSM
- Switching with PoE
- Desktop Virtualisation
- Mission-Critical applications

All-in-One Device for Branch Services

- WAN Optimisation
- Application Hosting
- Wireless LAN/WAN
- Unified Communications
- Routing/Switching
- Security

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Agenda

• Evolving Branch Architecture
• Transport Independent Design
• Intelligent Path Control
• ISR 4300/4400
• Application Hosting
• Programmatic Branch
• Virtualised Branch Router
Evolving Branch Architecture
Internet Becoming an Extension of Enterprise WAN

- Commodity Transports Viable Now
- Dramatic Bandwidth, Price Performance Benefits
- Higher Network Availability
- Improved Performance Over Internet
Intelligent WAN: Leveraging the Internet
Secure WAN Transport and Internet Access

- Secure WAN transport for private and virtual private cloud access
- Leverage local Internet path for public cloud and Internet access
- Increased WAN transport capacity; and cost effectively!
- Improve application performance (right flows to right places)
Intelligent WAN Deployment Models

**Dual MPLS**
- **Branch**
- **MPLS**
- **Internet**
- **Public**

- Highest SLA guarantees
- Tightly coupled to SP
- Expensive

**Hybrid**
- **Branch**
- **MPLS**
- **Internet**
- **Public**

- More BW for key applications
- Balanced SLA guarantees
- Moderately priced

**Dual Internet**
- **Branch**
- **Internet**
- **Public**

- Best price/performance
- Most SP flexibility
- Enterprise responsible for SLAs

Consistent VPN Overlay Enables Security Across Transition
Intelligent WAN Solution Components

**Transport Independent**
- Consistent operational model
- Simple provider migrations
- Scalable and modular design
- IPsec routing overlay design

**Intelligent Path Control**
- Dynamic Application best path based on policy
- Load balancing for full utilisation of bandwidth
- Improved availability

**Application Optimisation**
- Application visibility with performance monitoring
- Application acceleration and bandwidth optimisation

**Secure Connectivity**
- Certified strong encryption
- Cloud Managed Security for secure direct Internet access
- Comprehensive threat defence

Control & Management with Automation
# IWAN Roadmap Overview

<table>
<thead>
<tr>
<th>IWAN 1.0</th>
<th>IWAN 2.0 Automation (Q4 CY2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain Scale</strong></td>
<td><strong>Large Scale (2000 Branches)</strong></td>
</tr>
<tr>
<td>Hundreds of Branches</td>
<td>Large Scale (2000 Branches)</td>
</tr>
<tr>
<td><strong>Transport Independence</strong></td>
<td><strong>VPN Scalability (DMVPN Phase 3)</strong></td>
</tr>
<tr>
<td>Secure VPN Overlay (DMVPN Phase 2)</td>
<td>VPN Scalability (DMVPN Phase 3)</td>
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<tr>
<td><strong>Intelligent Path Control</strong></td>
<td><strong>Simplified Path Control – PfRv3</strong></td>
</tr>
<tr>
<td>2nd Generation Path Control – PfRv2</td>
<td>Simplified Path Control – PfRv3 (Centralised Provisioning, Large Scale)</td>
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<tr>
<td><strong>Application Optimisation</strong></td>
<td><strong>Adaptive AVC</strong></td>
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<tr>
<td>AVC</td>
<td>Adaptive AVC (Performance Optimisation)</td>
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<td>WAAS</td>
<td>Adv. QoS (Adaptive Shaping, Local Admission)</td>
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<tr>
<td>Secure Connectivity</td>
<td><strong>Akamai Connect</strong></td>
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<tr>
<td>IPSec Suite-B crypto IOS ZBFW Firewall Cloud Web Security (CWS)</td>
<td>Akamai Connect</td>
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<tr>
<td><strong>Management</strong></td>
<td><strong>Key Management Automation</strong></td>
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<tr>
<td>Cisco Prime LiveAction Glue Networks</td>
<td>Key Management Automation (PKI Certificate/Trust Automation)</td>
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<tr>
<td><strong>Prime Infrastructure 2.2:</strong></td>
<td><strong>APIC-EM EFT:</strong></td>
</tr>
<tr>
<td>Transport Ind. Design (DMVPN) Application Optimisation (AVC), Automated Deployment Workflow Wizards</td>
<td>APIC-EM EFT:</td>
</tr>
<tr>
<td>PKI Automation Site-by-Site Provisioning CVD-based: QoS, AVC, PfR</td>
<td></td>
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</table>
Securing IWAN Transports with Front-door VRF
Isolation of external networks

- Virtual Route Forwarding (VRFs) create multiple logical routers on a single device
  - Separate control/forwarding planes per VRF
  - No connectivity between VRFs by default
  - Provider side VRF (yellow) for external networks, Global VRF (blue) for internal networks

Provider VRF minimises threat exposure
- Default routing only in Provider VRF
- Provider assigned IP addressing hides internal network
- Provider IP address used as IPSec tunnel source
- Only IPsec allowed between internal Global and Provider Front Side VRFs
Protecting Public facing IWAN Interfaces

- Use ACLs, ZBFW or ASA to block all traffic except the DMVPN tunnel traffic to routers
- Zone Based Firewall (ZBFW) at the branch if there are plans for direct Internet access
- Typical ACL for protecting the Internet interface

```plaintext
interface GigabitEthernet0/0
  bandwidth 10000
  ip vrf forwarding INET-PUBLIC1
  ip address dhcp
  ip access-group ACL-INET-PUBLIC in
  duplex auto

! ip access-list extended ACL-INET-PUBLIC
  permit udp any any eq non500-isakmp
  permit udp any any eq isakmp
  permit esp any any
  permit udp any any eq bootpc
  permit icmp any any echo
  permit icmp any any echo-reply
  permit icmp any any ttl-exceeded
  permit icmp any any port-unreachable
  permit udp any any gt 1023 ttl eq 1
!```
Transport-Independent Design
Flexibility in WAN Design
Hybrid WAN Designs
Traditional and IWAN

Active/Standby WAN Paths
Primary With Backup

Two IPsec Technologies
GETVPN/MPLS DMVPN/Internet

Two WAN Routing Domains
MPLS: eBGP or Static
Internet: iBGP, EIGRP or OSPF
Route Redistribution
Route Filtering Loop Prevention

Active/Active WAN Paths

One IPsec Overlay
DMVPN

One WAN Routing Domain
iBGP, EIGRP, or OSPF
Minimal route filtering
IWAN Transport Independent Design
with Dynamic Multipoint VPN (DMVPN)

• Proven IPsec VPN technology
  – Widely deployed, large scale
  – Standards based IPsec and Routing
  – Adv QOS: hierarchical, per tunnel and adaptive

• Flexible & Resilient
  – Over any transport: MPLS, Carrier Ethernet, Internet, 3G/4G,..
  – Hub-n-Spoke and Spoke-to-Spoke Topologies
  – Multiple encryption, key management, routing options
  – Multiple redundancy options: platform, hub, transports

• Secure
  – Industry Certified IPsec and Firewall
  – NG Strong Encryption: AES-GCM-256 (Suite B)
  – IKE Version 2
  – IEEE 802.1AR Secure unique device identifier

• Simplified IWAN Deployments
  – Prescriptive validated IWAN designs
  – Automated provisioning – Prime, APIC-EM, Glue
Dynamic Multipoint VPN (DMVPN)

- Branch spoke sites establish an IPsec tunnel to and register with the hub site
- IP routing exchanges prefix information for each site
- BGP or EIGRP are typically used for scalability
- Only the WAN IP addresses need to be known by the WAN transport
- WAN interface IP address can be used for the tunnel source address
- Data traffic flows over the DMVPN tunnels
- When traffic flows between spoke sites, dynamic site-to-site tunnels are established
- Per-tunnel QOS is applied to prevent hub site oversubscription to spoke sites
DMVPN and GETVPN Comparison

**Overlay Routing**
- Minimal-to-no Peering With Provider
- Easy Multi-Homing Designs
- Provider Blackhole Protection
- BGP and Static Routing With Provider
- Provider Routes Traffic Between Sites
- Less Control Plane Overhead Traffic

**Data Plane**
- Any WAN Transport: Internet, MPLS
- Site-to-Site Requires Tunnel Setup
- Hubsite Multicast Replication
- Per-Tunnel QoS From Hub

- Private WANs Only: MPLS
- No Tunnels for Site-to-Site Connectivity
- Multicast Replication in Provider Network

**IPsec**
- Per Tunnel Keys
- Client IP Addressing Hidden From Provider

- Single Group Key for All Sites
- Client IP Addressing Exposed to Provider
Intelligent Path Control
Improving Application Delivery and WAN Efficiency
Intelligent Path Control with PfR
Voice and Video use-case

- PfR monitors network performance and routes applications based on application performance policies
- PfR load balances traffic based upon link utilisation levels to efficiently utilise all available WAN bandwidth

Voice/Video take the best delay, jitter, and/or loss path

Other traffic is load balanced to maximise bandwidth

Voice/Video will be rerouted if the current path degrades below policy thresholds
# PfR Enhances Classical Routing

<table>
<thead>
<tr>
<th>Path Control</th>
<th>CLASSICAL</th>
<th>PfR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topological state</td>
<td>• Least cost path</td>
<td>• Application-aware</td>
</tr>
<tr>
<td>Least cost path</td>
<td>• Static user preference</td>
<td>• Policy controlled</td>
</tr>
<tr>
<td>Static user preference</td>
<td></td>
<td>• Measured performance</td>
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</table>

<table>
<thead>
<tr>
<th>Metrics</th>
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<tbody>
<tr>
<td>Path cost</td>
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<tr>
<td>Interface state</td>
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</table>

<table>
<thead>
<tr>
<th>Adaptive</th>
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</thead>
<tbody>
<tr>
<td>Responds To:</td>
</tr>
<tr>
<td>• Link and node state changes (up/down)</td>
</tr>
</tbody>
</table>

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How PfR Works

Key Operations

Define Your Traffic Policy
Define Traffic Classes and service level Policies based on Applications or Transport Classifiers

Learn the Traffic
Border Routers learn current traffic classes going to the WAN based on classifier definitions

Measurement
Measure the traffic flow and network performance and report metrics to the Master Controller

Path Enforcement
Master Controller commands path changes based on traffic class policy definitions
Performance Routing - Components

The Policy Controller: Domain Controller (DC)
- Discover site peers, prefixes and connected networks
- Advertise policy and services
- One per domain, collocated with MC

The Decision Maker: Master Controller (MC)
- Discover BRs, collect statistics
- Apply policy, verification, reporting
- No packet forwarding/inspection required

The Forwarding Path: Border Router (BR)
- Gain network visibility in forwarding path (Learn, measure)
- Enforce MC’s decision (path enforcement)
- Does all packet forwarding
PfR Domain Controller

- Domain Controller Peering Framework
  - Site MCs register to Domain
  - Advertise to, or request services
  - Simplifies deployment and configuration
  - Provides topology auto-discovery

- Single point of configuration across the domain

- Used to distribute information to sites:
  - Learned site-prefix
  - Application/Traffic Policies
  - Performance monitoring
  - Traffic Class Database

Scaling: recommended 2000 sites max
PfR Config

Define the traffic to learn

learn
list seq 10 refname LEARN_CRITICAL
traffic-class access-list CRITICAL
list seq 20 refname LEARN_IMPORTANT
traffic-class access-list IMPORTANT
list seq 30 refname LEARN_NONCRITICAL
traffic-class access-list NON_CRITICAL
list seq 40 refname LEARN_BEST_EFFORT
traffic-class access-list BEST_EFFORT

ip access-list extended BEST_EFFORT
permit ip any any dscp default
ip access-list extended CRITICAL
permit ip any any dscp af41
ip access-list extended IMPORTANT
permit ip any any dscp af32
ip access-list extended NON_CRITICAL
permit ip any any dscp af23
ip access-list extended VOICE_VIDEO
permit ip any any dscp ef

pfr-map PFRMAP 10
match pfr learn list LEARN_CRITICAL
set periodic 90
set mode select-exit good
set delay threshold 200
set mode monitor fast
set resolve delay priority 1 variance 20
set resolve loss priority 2 variance 20
set loss relative 200
set probe frequency 30
set link-group MPLS fallback Internet

pfr-map PFRMAP 20
match pfr learn list LEARN_IMPORTANT
set periodic 90
set mode select-exit good
set delay threshold 400
set mode monitor fast
set resolve delay priority 1 variance 20
set resolve loss priority 2 variance 20
set loss relative 200
set probe frequency 20
set link-group MPLS fallback Internet

Define the Policy for path selection

Link Characteristics

Set the fallback alternative path
## Performance Routing Phases – Summary

<table>
<thead>
<tr>
<th>PfR/OER version 1</th>
<th>PfR version 2</th>
<th>PfR version 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOS 12.3(8)T, XE 2.6.1</td>
<td>IOS 15.2(3)T, IOS-XE 3.6</td>
<td>IOS 15.4(3)M, IOS-XE 3.13</td>
</tr>
<tr>
<td>Per Device provisioning</td>
<td>Per Device provisioning</td>
<td>PfR Domain</td>
</tr>
<tr>
<td>Passive monitoring with Traditional NetFlow (TNF)</td>
<td>Target Discovery (TD)</td>
<td>One touch &amp; APIC-EM provisioning</td>
</tr>
<tr>
<td>Active monitoring with IP SLA</td>
<td>Automatic provisioning of jitter probes</td>
<td>Auto Discovery of sites</td>
</tr>
<tr>
<td>Manual provisioning jitter probes 1000’s lines of configuration (pfr-map per site)</td>
<td>Passive monitoring with Traditional NetFlow (TNF)</td>
<td>NBAR2 support (*)</td>
</tr>
<tr>
<td></td>
<td>Active monitoring with IP SLA</td>
<td>Passive Monitoring (performance monitor)</td>
</tr>
<tr>
<td></td>
<td>10’s lines of configuration</td>
<td>Smart Probing</td>
</tr>
<tr>
<td>Blackout 6 seconds</td>
<td>Blackout 6 seconds</td>
<td>VRF Awareness</td>
</tr>
<tr>
<td>Brownout 9 seconds</td>
<td>Brownout 9 seconds</td>
<td>IPv4/IPv6 (Future)</td>
</tr>
<tr>
<td>Limited scalability due to provisioning (~ tens of sites)</td>
<td>Scale 500 sites</td>
<td>&lt;10 lines of configuration and centralised</td>
</tr>
<tr>
<td>Blackout 6 seconds</td>
<td>Blackout 9 seconds</td>
<td>Blackout ~ 2 second</td>
</tr>
<tr>
<td>Brownout 9 seconds</td>
<td>Scale 500 sites</td>
<td>Brownout ~ 2 sec</td>
</tr>
<tr>
<td>Scale 500 sites</td>
<td></td>
<td>Scale 2000 sites</td>
</tr>
</tbody>
</table>
Integrated Services Router 4000 Series
Pay-As-You-Grow with Cisco ISR 4000 Series

Investment Protection Without Oversubscription

ISR 4321
50-100 Mbps

ISR 4331
100-300 Mbps

ISR 4351
200-400 Mbps

ISR 4431
500-1000 Mbps

ISR 4451
1-2 Gbps

4-10X Faster
Add performance and services anytime
Flexible consumption options
Modular ISR Migration Paths

Branch consolidation

3945E
3925E
3945
3925
2951
2921
2911
2901
1921
1941

Application services

4451
(2 RU, 1000-2000 Mbps)

4431
(1 RU, 500-1000 Mbps)

4351
(2 RU, 200-400 Mbps)

4331
(1 RU, 100-300 Mbps)

4321
(1 RU (Desktop), 50-100 Mbps)
## Cisco ISR 4451

**ISR4451-X/K9**

### Entity | ISR 4451
--- | ---
CPU architecture | 4 core control/services 10 core data plane
Network Interface Modules | 3
Enhanced Service Modules | 2
Front-Panel Ethernet | 4 GE (all dual-phy RJ45 or SFP)
ISC slot | 1 for all ISC cards
USB type A ports | 2
Power | Dual internal AC or DC
Control/services memory | Base 4 GB; max 16 GB 1600 MHz DIMMs 2 DIMM slots
Mgmt Ethernet | 1 Gbps

**1 Gbps or 2 Gbps Performance**

**Migrate from Cisco® 3900E ISR**
Cisco ISR 4431
ISR4431/K9

500 Mbps or 1 Gbps Performance

Migrate from Cisco® 3900 Series ISR

<table>
<thead>
<tr>
<th>Entity</th>
<th>ISR 4431</th>
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<tbody>
<tr>
<td>CPU architecture</td>
<td>4 core control/services</td>
</tr>
<tr>
<td></td>
<td>6 core data plane</td>
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<tr>
<td>Network Interface Modules</td>
<td>3</td>
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<tr>
<td>Enhanced Service Modules</td>
<td>0</td>
</tr>
<tr>
<td>Front-Panel Ethernet</td>
<td>4 GE (all dual-phy RJ45 or SFP)</td>
</tr>
<tr>
<td>ISC slot</td>
<td>1 for all ISC cards</td>
</tr>
<tr>
<td>USB type A ports</td>
<td>2</td>
</tr>
<tr>
<td>Power</td>
<td>Dual internal AC or DC</td>
</tr>
<tr>
<td>Control/services memory</td>
<td>Base 4 GB; max 16 GB</td>
</tr>
<tr>
<td></td>
<td>1600 MHz DIMMs 2 DIMM slots</td>
</tr>
<tr>
<td>Mgmt Ethernet</td>
<td>1 Gbps</td>
</tr>
</tbody>
</table>
## Cisco ISR 4351

**ISR4351/K9**

**200 Mbps or 400 Mbps Performance**

**Migrate from Cisco® 2951 ISR**

<table>
<thead>
<tr>
<th>Entity</th>
<th>ISR 4351</th>
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<tbody>
<tr>
<td>CPU architecture</td>
<td>8-core CPU</td>
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<tr>
<td>Network Interface Modules</td>
<td>3</td>
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<tr>
<td>Enhanced Service Modules</td>
<td>2</td>
</tr>
<tr>
<td>Front-Panel Ethernet</td>
<td>3 GE (all dual phy RJ45 or SFP)</td>
</tr>
<tr>
<td>ISC slot</td>
<td>1 for all ISC cards</td>
</tr>
<tr>
<td>USB type A ports</td>
<td>2</td>
</tr>
<tr>
<td>Power</td>
<td>Single internal AC or DC</td>
</tr>
<tr>
<td>Control/services memory</td>
<td>Base 4 GB; max 16 GB 1600 MHz DIMMs 2 DIMM slots</td>
</tr>
<tr>
<td>Mgmt Ethernet</td>
<td>1 Gbps</td>
</tr>
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</table>
## Cisco ISR 4331

**ISR4331/K9**

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<th>Entity</th>
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<tbody>
<tr>
<td>CPU architecture</td>
<td>8-core CPU</td>
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<td>Network Interface Modules</td>
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<tr>
<td>Enhanced Service Modules</td>
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</tr>
<tr>
<td>Front-Panel Ethernet</td>
<td>1 dual-phy (SFP or RJ45)</td>
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<tr>
<td></td>
<td>1 RJ45 only</td>
</tr>
<tr>
<td></td>
<td>1 SFP only (copper SFP supported)</td>
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<tr>
<td>ISC slot</td>
<td>1 for all ISC cards</td>
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<tr>
<td>USB type A ports</td>
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<tr>
<td>Power</td>
<td>1 internal AC</td>
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<tr>
<td>Control/services memory</td>
<td>Base 4 GB; max 16 GB</td>
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<td></td>
<td>1333 MHz DIMMs 2 DIMM slots</td>
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<tr>
<td>Mgmt Ethernet</td>
<td>1 Gbps</td>
</tr>
</tbody>
</table>

### 100 Mbps or 300 Mbps Performance

### Migrate from Cisco® 2911 or 2921 ISR
# Cisco ISR 4321

**ISR4321/K9**

## 50 Mbps or 100 Mbps Performance

## Migrate from Cisco® 1941 or 2901 ISR

<table>
<thead>
<tr>
<th>Entity</th>
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<tbody>
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<td>Enhanced Service Modules</td>
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<tr>
<td>Front-Panel Ethernet</td>
<td>2 GE (1 dual-phy, 1 RJ45 only)</td>
</tr>
<tr>
<td>ISC slot</td>
<td>1 for all ISC cards</td>
</tr>
<tr>
<td>USB type A ports</td>
<td>1</td>
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<tr>
<td>Power</td>
<td>1 external AC</td>
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<tr>
<td>Control/services memory</td>
<td>Base 4 GB; max 12 GB 1333 MHz DIMMs 2 DIMM slots</td>
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<tr>
<td>Mgmt Ethernet</td>
<td>1 Gbps</td>
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### Cisco 4300 Comparison to 4400: Differences

<table>
<thead>
<tr>
<th>4400 Family Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundant power. Front-Panel PoE+</td>
</tr>
<tr>
<td>Physically separate control, services, and data plane CPU sockets</td>
</tr>
<tr>
<td>Additional service container capacity through faster CPUs and more dedicated cores.</td>
</tr>
<tr>
<td>Higher throughput for base and performance licenses</td>
</tr>
</tbody>
</table>
ASIC-Like Experience with New Services
Appliance-Level Performance

Miercom Testing: Cisco® 4451 ISR

Additive features and services

- 4451-X no-perf license
- 4451-X perf license
- Software-only router

Pay-as-you-grow performance boost

Enabling Technologies

- Multicore architecture
- Service-aware data plane
- Multigigabit fabric

Benefits

- Up to 10 times faster performance
- Scalability
- Layer 7 services
- Steady performance curve maintained with new additive services
What happens with a performance license?

Without Performance License

- Data Plane is limited to 6 CPU cores
- Platform Level Shaper limits total forwarding to 1Gbps across all interfaces

With Performance License

- All 10 Data Plane cores enabled
- Platform Level Shaper limits total forwarding to 2Gbps across all interfaces
G2 to 4k Performance Improvement

- Radically different, more predictable performance curve on ISR 4K.
- The heavier the services, the higher performance delta between platforms.
## IPSec Scalability Comparison

<table>
<thead>
<tr>
<th>ISR G2 IPsec VPN Tunnel Scalability</th>
<th>IOS Max number of tunnels (*)</th>
<th>ISR G2 HSEC+ISM VPN</th>
<th>IOS Max number of tunnels (*)</th>
<th>ISR 4K IPsec VPN Tunnel Scalability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tunnels</td>
<td>Tunnels</td>
<td>Tunnels</td>
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<tr>
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<tr>
<td>3945E</td>
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</table>

(*) license specific restrictions apply
# IPSec Performance Comparison

<table>
<thead>
<tr>
<th>ISR G2 IPSec AES with IMIX</th>
<th>No ISM-VPN</th>
<th>With ISM-VPN</th>
<th>ISR 4K IPSec AES with IMIX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mbps @ IMIX</td>
<td>Mbps @ IMIX</td>
<td>Mbps @ IMIX</td>
</tr>
<tr>
<td>1941</td>
<td>60</td>
<td>170.0</td>
<td>100</td>
</tr>
<tr>
<td>2901</td>
<td>60</td>
<td>170.0</td>
<td>300</td>
</tr>
<tr>
<td>2911</td>
<td>65</td>
<td>170.0</td>
<td>400</td>
</tr>
<tr>
<td>2921</td>
<td>80</td>
<td>215.0</td>
<td>1,000</td>
</tr>
<tr>
<td>2951</td>
<td>150</td>
<td>395.0</td>
<td>1,300</td>
</tr>
<tr>
<td>3925</td>
<td>215</td>
<td>715.0</td>
<td></td>
</tr>
<tr>
<td>3945</td>
<td>245</td>
<td>715.0</td>
<td></td>
</tr>
<tr>
<td>3925E</td>
<td>630</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3945E</td>
<td>800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For Your Reference
Cisco ISR 4000 Family I/O Design

Management Interface
out-of-band control plane connection directly to a management network

Front-Panel GE
- RJ45/SFP GE Interfaces
- PoE+ available on some models

Network Interface Modules
- Larger and more powerful than EHWICs
  - Up to 8 ports per module
  - DSPs directly on modules

Optional Drive NIM for Service Containers
- RAID 1 for data protection
- Single HD (future) and dual SSD options
- Embedded SSD option

Internal Services Card
Internal Expansion
Currently for CUBE DSPs

USB Connections
- 2 type A for file storage
- USB type B console in addition to RJ45 console and aux ports

Enhanced Service Modules
- Compatible with Cisco® ISR G2
  - Up to 10-Gbps connection to system
  - Faster and more powerful than SMs
Cisco ISR 4400 Series Architecture

Service containers live here

Control Plane (1 core) and Services Plane (3 cores)

Data Plane (6 or 10 cores)

Multigigabit Fabric

IOS

Service containers live here

KVM - Hypervisor

Service Plane (control plane CPU)

ISR-WAAS

NIM

FPGE

ISC

SM-X
Cisco ISR 4400 Packet Flow

Control Plane (1 core) and Services Plane (3 cores) → Platform Controller Hub → System FPGA → Data Plane (6 or 10 cores) → Multigigabit Fabric → FPGE

DRAM → 4xPCle → Mgt Eth → Cons/Aux → USB → Flash

4xPCle → DRAM

4xSGMI → 10G XAUI → 10 Gb/slot → ISC → SM-X

1 Gb SGMI → 2 Gb/slot → NIM
Cisco ISR 4300 Series Architecture

- **IOS**
- **Service Container**
- **ISR-WAAS**
  - KVM - Hypervisor
  - Service Plane (control plane CPU)

**Multigigabit Fabric**
- Data Plane Cores
- FPGE
- ISC
- SM-X
- NIM

**Note:** 4321 uses 2DP, 1CP & 1SC cores
Multi-Gigabit Fabric Configuration

• Most new modules include MGF and legacy links.
  – Interfaces will appear as two internal connections to the same module (SM1/0 and SM1/1 for example).

• Configuration for the module-side MGF connection is performed on the router-side “0” connection.
  – Configuration information is passed to the module on this interface.
  – The router-side MGF connection is a layer-2 trunk port and is not directly configurable.

• Layer 3 MGF configuration on the router is handled with VLAN interfaces.

• **Note:** MGF configuration not available when a HWIC-ESW is in the system.
ISR G2 Module Compatibility

- **ISR G2**
  - EHWIC
  - ISM
  - PVDM-3
  - SM
  - SM-X

- **ISR 4000**
  - NIM
  - ISC
  - PVDM-4
  - SM-X (not bkwd compatible)
  - SM-X (backward compatible)

EHWIC and ISM are backward compatible, but SM-X in ISR 4000 is not backwards compatible with SM in ISR G2.
ISR 4K DSP Resources

- PVDM4 uses the same DSP as the PVDM3
  - Physically different form-factor
- Designed to fit on voice NIMs as well as platform ISC slot
- Platform DSP intended for CUBE
- Module DSP intended for transcoding
- Allows DSP resources to grow incrementally with modules
SM-X Carrier Card for NIM

- Converts an SM slot to chassis equivalent NIM slot
- Supports ONE single-wide or ONE double-wide NIM
- Brings ISR 4K port density closer to ISR-G2.
- Facilitates high-density voice, data & compute solutions
## ISR 4000 Modules (1 of 2)

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Name</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN</td>
<td>SM-X</td>
<td>Ethernet Switches: 16, 24 &amp; 48 ports</td>
<td>Now</td>
</tr>
<tr>
<td>LAN</td>
<td>NIM</td>
<td>Ethernet Switches: 4 &amp; 8 ports</td>
<td>Q2 CY15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UCS E-Series</td>
<td>SM-X</td>
<td>CPU: 2, 4, 6 &amp; 8 cores</td>
<td>Now</td>
</tr>
<tr>
<td>UCS E-Series</td>
<td>NIM</td>
<td>CPU: 2 cores</td>
<td>Q3 CY15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voice</td>
<td>NIM</td>
<td>T1/E1: 1, 2, 4 &amp; 8 ports</td>
<td>Now</td>
</tr>
<tr>
<td>Voice</td>
<td>NIM</td>
<td>FXS/FXO: 2 &amp; 4 ports. Also, 4FXO+2FXO combo NIM.</td>
<td>Now</td>
</tr>
<tr>
<td>Voice</td>
<td>NIM</td>
<td>E/M &amp; BRI</td>
<td>Q4 CY14</td>
</tr>
<tr>
<td>Voice</td>
<td>PVDM</td>
<td>PVDM4: 32, 64, 128 &amp; 256 channels</td>
<td>Now</td>
</tr>
<tr>
<td>Voice</td>
<td>NIM</td>
<td>High-density DSP farm</td>
<td>Q4 CY15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAN Ethernet</td>
<td>SM-X</td>
<td>1GE: 4 ports OR 1-port 10GE</td>
<td>Now</td>
</tr>
<tr>
<td>WAN Ethernet</td>
<td>SM-X</td>
<td>1GE: 6 ports</td>
<td>Now</td>
</tr>
<tr>
<td>WAN Ethernet</td>
<td>NIM</td>
<td>1GE: 1 &amp; 2 ports</td>
<td>Q2 CY15</td>
</tr>
</tbody>
</table>
## ISR 4000 Modules (2 of 2)

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Name</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAN 4G / LTE</td>
<td>NIM</td>
<td>USA, Canada, Europe, Australia &amp; selected LATAM / APAC</td>
<td>Q2 CY15</td>
</tr>
<tr>
<td>WAN T3/E3</td>
<td>SM-X</td>
<td>T3/E3: 1-port</td>
<td>Now</td>
</tr>
<tr>
<td>WAN T1/E1</td>
<td>NIM</td>
<td>T1/E1: 1 &amp; 2 ports</td>
<td>Now</td>
</tr>
<tr>
<td>WAN T1/E1</td>
<td>NIM</td>
<td>T1/E1: 8 ports</td>
<td>Q3 CY14</td>
</tr>
<tr>
<td>WAN xDSL</td>
<td>NIM</td>
<td>Multi-mode VDSL2 / ADSL Annex A, B &amp; M</td>
<td>Q4 CY14</td>
</tr>
<tr>
<td></td>
<td>NIM</td>
<td>G.SHDSL</td>
<td>Q4 CY15</td>
</tr>
<tr>
<td>WAN Serial</td>
<td>NIM</td>
<td>Serial: 1, 2 &amp; 4 ports</td>
<td>Now</td>
</tr>
<tr>
<td>Disk</td>
<td>NIM</td>
<td>Dual SSD carrier. Each SSD may be 200G or 400G.</td>
<td>Now</td>
</tr>
<tr>
<td>NIM Adaptor</td>
<td>SM-X</td>
<td>Converts SM-X slot to 1 NIM slot</td>
<td>Q4 CY14</td>
</tr>
</tbody>
</table>
G2/XE Feature Compatibility/Gaps

Supported

L2/L3 Routing
AAA, ACL, AToM, BFD, BGP, CEF, CoPP, DHCP, DNS, EIGRP, EEM, EIGRP, Frame Relay, FHRP, Flexible Netflow, HSRP, HTTP(S), IEEE 802.1Q, IGMP, IP SLA, IPv6 (Multicast, QoS, IS-IS, BGP, OSPF, RIPng, Switching), ISIS, L2TPv3, LISP, L2VPN, LLQ, MLPPP, MPLS (TE, VPN), MLPPP, Mobile IPv6, NAT, NBAR, NSF, Net Flow, NTP, NHRP, OER, OSPFv3, PIMv6, PPPoE, PfR, PBR, QoS, RADIUS, RGMP, RSVP, RRI, SNMPv3, SSH, SCPv2, SSM, TACACS+, VRRP, X.25

Security
TrustSec, DMVPN, TrustSec, MVPN, DMVPN, GETVPN, FlexVPN, SSLVPN, EasyVPN, RPKI server, ZBFW, IPS

Voice
CUBE, CME, SRST, TDM GW, TCL, MGCP, H323, SIP, SCCP, E-SRST, RSVP, CAC

SNA, SNAs w DLSw, STUN, BSTU, N...

No Support on IOS XE

On Roadmap

Feature Compatibility/Gaps

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Service Virtualisation for Networking

Service Containers

- Dedicated virtualised compute resources
- CPU, disk, memory for each service
- Easily repurpose resources
- Industry-standard hypervisor

Benefits

- Better performing network services
- Ease of deployment with zero footprint; no truck roll
- Greater security through fault isolation
- High reliability
- Flexibility to upgrade network services independent of router IOS® Software
UCS E-Series Portfolio

Scalability

- Service Module
- VMware and Hyper-V Certified
- Network Compute Applications – vWLC, vWAAS

Cisco UCS-EN120S

Feature Richness

- Service Module
- VMware, Hyper-V, Citrix Certified
- Intel E3 4 Core Processor
- vWLC, vWAAS, Physical Security

Cisco UCS-E140S

- Service Module
- VMware, Hyper-V, Citrix Certified
- Intel E5 6 Core Processor
- vWLC, vWAAS, Virtual Desktops, Physical Security

Cisco UCS-E160D

- Service Module
- VMware, Hyper-V, Citrix Certified
- Intel E5 8 Core Processor
- vWLC, vWAAS, Virtual Desktops, Physical Security, Security applications

Cisco UCS-E180D
Cisco UCS E-Series Single-Wide Blade
Compact, Multipurpose Blade Housed in Cisco ISR G2 – UCS-E140S M2

- Maximum 65 W power draw
- 80 percent less than server
- Intel® Xeon® E3 Family quad-core processor
- iSCSI initiator hardware offload
- Configuration and management through CIMC
- Two SD cards: One for the CIMC and temporary storage of OS and one for a blank virtual drive
- Up to 2 SATA, SAS, or SSD hard drives
- USB 2.0 port for external device connectivity
- On-board hardware RAID 0/1 with hot-swappable capability
- 8, 12, and 16 GB DRAM options
- Remote and schedulable power management
- One external and two internal GE ports
- 10/100 Ethernet management port
- KVM console connector
- Wire-free, plug-and-play modularity, low shipping weight (2.5 lb/1.1 kg)
- 80 percent less than server

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Cisco UCS E-Series Double-Wide Blade
Multipurpose Blade Housed in ISR G2 and ISR 4000 – UCS-E140D/UCS-E160D/UCS-E180D

- Maximum 130 W power draw, 80 percent less than server
- Intel Xeon E5-2400 Quad Core/Six-Core/Eight-Core Processor
- iSCSI initiators and hardware offload
- Out-of-band configuration and management through CIMC
- Up to 3 SATA, SAS, SSD hard drives or 2 HDD and a PCIe card
- On-board hardware RAID 0, 1, and 5 configuration options with hot-swappable capability
- Wire-free, plug-and-play modularity, low shipping weight (7 lb / 3.2 kg)

- 8 GB - 48 GB DRAM options
- Remote and schedulable power management
- Front-panel VGA, 2 USB, and serial console connectors
- Two SD Cards: one for the CIMC and temporary storage of OS and one for a blank virtual drive
- Two external and two internal GE ports with TCP/IP acceleration
- Maximum of 3 SATA, SAS, SSD hard drives or 2 HDD and a PCIe card
- On-board hardware RAID 0, 1, and 5 configuration options with hot-swappable capability
- Wire-free, plug-and-play modularity, low shipping weight (7 lb / 3.2 kg)
Storage Options

NIM-SSD:
• 1 or 2 hot-swappable 200GB SSD drives
• 100GB and 400GB options in the future

NIM-HD:
• 1 hot-swappable 500GB or 1TB drive
• Available as soon as a container supports it

SSD-MSATA-200G:
• Doesn't consume a NIM slot!
• Embedded 200GB SSD storage
• Not available on 4451
Programmatic Branch
Evolving How We Interact With Network Devices

Traditional Approach
- CLI
- SNMP
- HTML
- XML
- AAA
- CDP
- Syslog
- Netflow
- Routing Protocols
- Span

New Paradigm
- App
  - C
  - Java
  - Python
- Anything you can think of
- Rich Actions, Rich Events, Rich Environment

Rich Actions, Rich Events, Rich Environment
Cisco Intelligent WAN App for APIC-EM

Business Policy Dictates Network Action

- IT Admin
- Access
- Business Policy: App SLA
- Application Network Profile
- Simple Workflow Templates
- Zero Touch Provisioning
- Network, Applications Monitoring
- Business Level Policies
- Open Architecture
Site topology choices in IWAN app
Link type selection in IWAN app
Application priority policy setting in IWAN app
CSR as a Branch Router
CSR in the Network

• CPE
  – vCPE
  – NFV
  – Branch-in-a-Box

• SP Edge
  – Network Services – VPN Gateway
  – Control Plane Functions – Route Reflector

• Cloud
  – Tenant Scale – vCE/vPE
  – Network Services – VPN Gateway
  – Hybrid Cloud Connectivity – L2/L3 extension
Cloud Ready Router (CSR 1000V)

Enterprise-class Networking with Rapid Deployment and Flexibility

- Full IOS-XE Virtualisation
  - Comprehensive feature set ~ 2600 features

- Infrastructure Agnostic
  - Any Server
  - Any Switch
  - Any Hypervisor (ESXI, KVM, Hyper-v, XEN)

- Throughput Elasticity
  - Delivers 10 Mbps to 20 Gbps throughput
  - Small footprint 1vCPU with 2.5 GB, up to 8vCPU with 16GB memory

- Multiple Licensing Models
  - Term, Perpetual, Usage based billing (Hourly, GB)*

- Programmability
  - RESTful APIs and OnePK for automated management
# CSR 1000V Features per Technology Package

<table>
<thead>
<tr>
<th>Technology Package</th>
<th>Virtualisation</th>
<th>IOS-XE Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STANDARD</strong></td>
<td>ESXi 5.5</td>
<td><strong>Basic Networking</strong>: BGP, OSPF, EIGRP, RIP, ISIS, IPv6, GRE, VRF-LITE, NTP</td>
</tr>
<tr>
<td>(Routing)</td>
<td>XenServer 6.1</td>
<td><strong>High Availability</strong>: HSRP, VRRP, GLBP</td>
</tr>
<tr>
<td></td>
<td>KVM (Ubuntu 12.04 LTS, RHEV 3.1, RHEL 6.3)</td>
<td><strong>Addressing</strong>: 802.1Q, VLAN, EVC, NAT, DHCP, DNS</td>
</tr>
<tr>
<td></td>
<td>Hyper-V 2012 R2</td>
<td><strong>Basic Security</strong>: ACL, AAA, RADIUS, TACACS+</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Management</strong>: IOS-XE CLI, SSH, Flexible NetFlow, SNMP, EEM, NETCONF</td>
</tr>
<tr>
<td><strong>ADVANCED</strong></td>
<td></td>
<td><strong>STANDARD</strong></td>
</tr>
<tr>
<td>(Standard + Security)</td>
<td></td>
<td><strong>QoS</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Multicast</strong>: IGMP, PIM</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Advanced Security</strong>: Zone Based Firewall, IPSec VPN, EZVPN, DMVPN, FlexVPN</td>
</tr>
<tr>
<td><strong>PREMIUM</strong></td>
<td></td>
<td><strong>ADVANCED</strong></td>
</tr>
<tr>
<td>(Advanced + AppX + Hybrid Cloud)</td>
<td></td>
<td><strong>Advanced Networking</strong>: L2TPv3, BFD, MPLS, VRF, VXLAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Application Experience</strong>: WCCPv2, APPNAV, NBAR2, AVC, IP SLA</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Hybrid Cloud Connectivity</strong>: LISP, OTV, VPLS, EoMPLS</td>
</tr>
</tbody>
</table>
Summary
Optimising Branch For The Journey To The Cloud

- **IWAN**  Faster branch WAN – Transport Independent and Intelligent Path Control
- **ISR4000**  Performance & Service without compromise
- **APPLICATION HOSTING**  Embedded appliance and user virtual machines directly on an ISR
- **CSR – Virtual CPE**
Related Sessions

- BRKRST-2641 Enterprise SDN - APIC Enterprise Module
- BRKRST-2045 L3 VPN over IP Transport, Design and Solutions in the WAN
- BRKRST-2642 Introduction to IWAN
- BRKVIR-2605 vCPE and Network Function Virtualisation for Enterprises
- BRKRST-2362 Implementing Next Gen Performance Routing – PFRv3
- BRKRST-2042 Highly Available Wide Area Network Design
- BRKRST-2041 WAN Architectures and Design Principles
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