A New Era of Wan Edge Solutions

Introducing Cisco ASR 1000 Series Aggregation Services Routers

Daniel de la Rosa & Martina Beitat - Product Marketing - Midrange Routing Business Unit
## Cisco: History of Innovation Getting Ahead of Market Trends

<table>
<thead>
<tr>
<th>Then</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1984</strong> Cisco founded by two people, developing the first mainstream IP router</td>
<td>Employees exceed 63,000</td>
</tr>
<tr>
<td><strong>1986</strong> Ships first router</td>
<td>More than 60 million routers shipped</td>
</tr>
<tr>
<td><strong>1995</strong> Cisco introduces 7200 series optimized WAN aggregation router</td>
<td>Shipped in excess of 350,000 units</td>
</tr>
<tr>
<td><strong>2001</strong> Cisco introduces 7600 series, establishing Carrier Ethernet</td>
<td>More than 50,000 shipped, $1B annual run rate</td>
</tr>
<tr>
<td><strong>2004</strong> CRS-1 introduced for core, declared overkill by some with predictions of no more than 50 ever needed</td>
<td>More than 1000 shipped in less than three years</td>
</tr>
<tr>
<td><strong>2005</strong> Integrated services router introduced for CPE</td>
<td>More than 2,000,000 shipped in first two years</td>
</tr>
<tr>
<td><strong>2008</strong></td>
<td><strong>Cisco Aggregation Services Router Series Introduced for Edge</strong></td>
</tr>
</tbody>
</table>

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Introducing…

Industry’s Most Powerful, Compact Aggregation Routers

Cisco ASR 1000 Series

Transforming and Extending the Network Edge
New Enterprise WAN Requirements
Services Without Compromise…or Complexity!

High-Performance Services

Integrated Security

Redefined WAN

Non-Stop Communications

Application Intelligence

Operational Efficiency
ASR 1000 → Unified WAN Services, Scalable & Secure

Managed FR / ATM (higher BW)
Going to → Managed L2VPN / L3VPN

Objective
- Offer FULL SERVICE IPsec VPN Aggregation Router which scales to growing BW demands of SP IP VPNs

Benefits
- Consolidate a stack of 7200s into 1 ASR 1000
- Easy transition to increasing crypto performance
- No service blades required
- Optimized for QoS & Multicast

ASR 1000 delivers...
- 1000s of Sites / 10K IPsec tunnels
  - Up to 3 Gbps crypto + 7 Gbps non-crypto
  - 3DES/AES/SHA-1/IKEv1
  - DMVPN Phase 2 support

HQ / Regional HQ
QFP
DMVPN
QFP
DMVPN
GigE / 10GigE
POS / ATM

MPLS
IP
VPN

18xx
small
28xx
medium
38xx
large

Branch Offices
Full T1’s w/ satellite, DSL etc. backup
Going to multiples of Ethernet/DSL/Wireless…
ASR 1000 → WAN Optimization

Objective
- Optimized treatment of all WAN traffic

Benefits
- Improve network performance
- Route around problems at first sign of issue
- Path Selection based upon Application requirements
- Business critical applications & Voice over IP enjoy dynamic optimization - constantly tracked

ASR 1000 delivers...
- Optimization for Private and Public WANs w/o Service Blades
- Better throughput for certain prefixes
- High flow scalability & NBAR classification capability that can be leveraged by PFR

Hub Site
- Master Controller
- Border Router

WAN Access Links Are Bottlenecks
- BGP Chooses Best Path Based on As-Path Hops

Telecommuter
- Remote Site
- ISR
- MC/BR
ASR 1000 → Superior Application Availability

**Objective**
- Guarantee delivery of High Priority Applications regardless of which features are enabled

**Benefits**
- Guarantees High Priority Applications to be forwarded up to entire system BW.
- Clamps an arbitrary collection of Low Priority traffic to a certain BW
- High throughput for Quality of Service features
- Enables queue based operations without a performance hit

**ASR 1000 delivers…**
- Flexible Hierarchies
- 128K Queues
  - 2 Priority queues per policy
- Low 10s of usec of latency
Service Provider Trends

*Increasing BW needs!*

- **Video**
  - Integral to nearly every major service experience

- **Web 2.0 Collaboration**
  - Increasing dependency of services and applications

- **Emerging Services**
  - Network Intelligence needed to seize market opportunities

- **Cost Efficiencies**
  - CapEx and OpEx not growing as fast as change on networks, power not unlimited
ASR 1000 in Service Provider IP Next Generation Network

Mobile Subscriber
- High Speed CPE

Business
- Corporate

Residence
- HGW

Access & Aggregation
- Wireless
  - WiMAX

- Wireline
  - ETTx
  - xDSL
  - xPON

- Cable
  - DOCSIS
  - M-CMTS

Edge
- BRAS
- IPSec
- PE
- SBC
- BRAS-PPP0E
- LAC, PTA, ISG
- IPSec Aggregator
- VoIP SBC
- PE (L3VPN PE)

ISP
- LNS
- Peering

IP/MPLS Core
- RR
- L3TP Tunnel

Content Farm
- VOD
- TV
- SIP

- LNS
- Route Reflector
- Internet Peering

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Objective
- Offer high-speed Internet access focused on residential customers

Benefits
- Various access speeds
- Different QoS levels
- End-to-end SLAs & reporting
- Optional: DSL fastpath
- Upsell service: voice, video, remote access into VPN

ASR 1000 delivers...
- Scalability up to 32K subscribers with QoS
- Broadband high availability (HA)
- Carrier-class modular chassis
- Integrated features for future value-added services

IP/MPLS Core
Aggregation
BRAS
CPE
Residence
VoIP
B’cast TV
VConf
VOD
Applications
Policy Control Plane
Billing
RADIUS
RACS
PE
VoIP
PE
PE
PE
PE
PE
PE
PE
PE
PE
Benefits

- SP solution (C-BGF) to support services such as IP PBX-to-SP peering, Telepresence and the fast-growing residential IP telephony.
- Eliminate need for overlay networks and standalone appliances
- Distributed SBC for scalable design w/ centralized signaling & control

Objective

- To enable end-to-end feature rich and secure IP communications

ASR 1000 delivers...

- Integrated SBC solution w/o extra service blades
- Scalable solution, up to 32K sessions
- High Availability (SSO, ISSU)
- Consistent w/ other high end Cisco SBCs for features and interop
- Extensible through modular design
Cisco ASR 1000 Series
The Anatomy of Innovation

High Performance Services
• Instant-on services
• Future-ready provisioning
• Wire-speed secure services
• Reduced IT OpEx and CapEx

Integrated Security
• Instant-on highly available security services
• Tight integration of routing & security services
• Standards based, certified security services
• Auditable security services

Operational Excellence
• Reduced real-estate, power requirement
• Service and device consolidation
• Software redundancy, ISSU for hitless upgrades

NonStop Communications
• Rapid failover without service disruption
• In-service maintenance
• Reusable hardware
• Industry first - Dual-image software availability

Application Intelligence
• Ensures mission-critical application performance
• Full-circle optimization: Monitor, classify, control
• Meets compliance requirements
Cisco Routing Portfolio

- ISR Series
- 7200 Series
- ASR 1000 Series
- ASR 1000 with ESP-5G
- ASR 1000 Series
- ASR 1000 with ESP-10G
- Catalyst 6500 Series
- Cisco 7600 Series

Branch

Head Office / WAN Aggregation

Performance and Services Scalability
ASR 1000 Series Routers

Industry’s Most Powerful, Compact Aggregation Routers

ASR 1002
- 3 SPA Slots
- Modular Embedded Services Processor (ESP)
- Software Redundancy

ASR 1004
- 8 SPA Slots
- Modular ESP & RP
- Software Redundancy

ASR 1006
- 12 SPA Slots
- Modular ESP & RP
- Hardware Redundancy

Transforming and Extending the Network Edge
Cisco ASR1002 Router

- Integrated RP1 and SIP
- Exact same hardware features as RP1 with following exception
  - 4GB DRAM by default
  - 8 GB eUSB for mass storage + NVRAM (2X32MB NVRAM)
- Support of modular ESP-5G and ESP-10G
- Built-in 4XGE ports – feature/performance parity to GE SPA
Cisco ASR 1000 Series
Powered by Cisco QuantumFlow Processor

Technical Benefits
- 40 independent processors
- 160 threads in parallel
- Services without penalty

Business Benefits
- High performance embedded services
- User/Application optimization
- Platform longevity

World’s Most Advanced Piece of Networking Silicon
ASR 1000 Series Building Blocks

- **RP (Route Processor)**
  - Handles control plane traffic
  - Manages system

- **ESP (Embedded Services Processor)**
  - Handles forwarding plane traffic

- **SIP (SPA Interface Processor)**
  - SPAs provide interface connectivity

**Centralized Forwarding Architecture**
- Processes all traffic
- Standby is synchronized with all flow state with dedicated 10Gbps link

**Distributed Control Architecture**
- All major system components have a powerful control processor dedicated for control and management planes
ASR 1000 Route Processor
RP1

General Purpose CPU 1.5GHz

Memory
- DRAM: Default: 2 GB; Max: 4 GB
- 1GB of Internal Flash
  - For code storage, boot, config, logs, etc.
  - 2X32 MB of NVRAM are partitioned

Management Interfaces
- Ethernet management port, auxiliary port, console port

Storage
- Default: 40 GB Hard Disk Drive
  - 2X32 MB NVRAM are partitioned
- Option: 32 GB Solid State Drive (Post – FCS)
- For core dumps, failure capture, etc
- External USB flash for IOS configurations or File copying

40 GB HDD
ASR 1000 Embedded Services Processor
ESP-5G, ESP-10G

Cisco QFP engine
Centralized forwarding engine
Programmable providing full-packet processing

Cisco QFP Traffic Manager
Packet buffering and queuing/scheduling
For output traffic to carrier cards/SPA’s
For special features such as input shaping, reassembly, replication, punt to RP, etc.

Interconnect providing data path links (ESI) to/from other cards over mid-plane
Transports traffic into and out of QFP
Input scheduler for allocating BW among links

ESP CPU managing QFP, crypto engine, mid-plane links, etc
<table>
<thead>
<tr>
<th>ESP Generation</th>
<th>Bandwidth</th>
<th>Based on</th>
<th># of Processors</th>
<th>Clock Rate</th>
<th>Crypto Engine BW</th>
<th>QFP Memory</th>
<th>Packet Buffer</th>
<th>TCAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESP-5G</td>
<td>5Gbps</td>
<td>QFP</td>
<td>20</td>
<td>900 Mhz</td>
<td>~1Gbps</td>
<td>256MB</td>
<td>64MB</td>
<td>10Mb</td>
</tr>
<tr>
<td>ESP-10G</td>
<td>10Gbps</td>
<td>QFP</td>
<td>40</td>
<td>900 Mhz</td>
<td>3Gbps</td>
<td>512MB</td>
<td>128MB</td>
<td>10Mb</td>
</tr>
<tr>
<td>ESP-20G</td>
<td>20Gbps</td>
<td>QFP</td>
<td>40</td>
<td>1.2 Ghz</td>
<td>8Gbps</td>
<td>1GB</td>
<td>256MB</td>
<td>40Mb</td>
</tr>
</tbody>
</table>
ASR 1000 System Bandwidth

- ESP bandwidth denotes the total ‘output’ bandwidth of the system, regardless of the direction
- High priority traffic (as long as it is not over-subscribed - Example: \( \leq 10G \) for ESP-10G) will not be affected by this bandwidth limit
- ESP-10G Examples:

<table>
<thead>
<tr>
<th>Direction</th>
<th>Total Output Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>5G 5G</td>
<td>10G</td>
</tr>
<tr>
<td>6G 6G</td>
<td></td>
</tr>
<tr>
<td>1G 1G 10G 1G 10G</td>
<td></td>
</tr>
</tbody>
</table>

5G Unicast in each direction
Total Output bandwidth 5+5=10

1G Multicast with 8X replication in one direction
2G unicast in the other direction
Total Output bandwidth 8+2=10G

5G Unicast in one direction & 6G Unicast in the other direction
Total output bandwidth (5+6=11) exceeds 10G; Only 10G will go through

1G Multicast with 10X replication in one direction
1G Unicast in the other direction
Total bandwidth (10+1=11) exceeds 10G; only 10G will go through
## ASR 1000 Ingress Oversubscription

<table>
<thead>
<tr>
<th>ESP Version</th>
<th>Max SPAs per SIP</th>
<th>Max BW / SPA (Gbps)</th>
<th>Max BW / SIP (Gbps)</th>
<th>SIP Oversubscription Ratio (worst case)</th>
<th>ASR1006 Oversubscription Ratio (worst case)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESP10 (with SIP10)</td>
<td>4</td>
<td>10</td>
<td>10</td>
<td>4:1</td>
<td>12:1</td>
</tr>
<tr>
<td>ESP20 (with SIP40)</td>
<td>4</td>
<td>10</td>
<td>20</td>
<td>2:1</td>
<td>6:1</td>
</tr>
</tbody>
</table>

The ASR 1000 Series is designed for oversubscription
ASR 1000 SPA Interface Processor
*SIP-10G*

- Physical termination of SPA
- Supports up to 4 SPAs
  - 4 half-height
  - 2 full-height
  - 2 full-height+1 half-height
  - Full OIR support
- Offers Ingress QoS
  - Ingress packet classification – high/low
  - Ingress over-subscription buffering (low priority) until ESP can service them
- Captures stats on dropped packets
- Distributes Network Clock to SPA’s
- Manages Midplane links, SPA OIR, SPA drivers (via IOCP CPU)
### 1GE SFP & WDM
- SFP-GE-L
- SFP-GE-S
- SFP-GE-T
- SFP-GE-Z
- CWDM-SFP-1470
- CWDM-SFP-1490
- CWDM-SFP-1510
- CWDM-SFP-1530
- CWDM-SFP-1550
- CWDM-SFP-1570
- CWDM-SFP-1590
- CWDM-SFP-1610

### 10GE XFP
- XFP-10GER-OC192SR (10GE mode)
- XFP-10GLR-OC192IR (10GE mode)
- XFP-10GZR-OC192LR (10GE mode)

### POS SFP
- SFP-OC3-SR
- SFP-OC3-MM
- SFP-OC3-LR2
- SFP-OC3-LR1
- SFP-OC3-IR1
- SFP-OC12-SR
- SFP-OC12-MM
- SFP-OC12-LR2
- SFP-OC12-LR1
- SFP-OC12-IR1

### Ethernet SPA
- SPA-1X10GE-L-V2
- SPA-2X1GE-V2
- SPA-5X1GE-V2
- SPA-8X1GE-V2
- SPA-10X1GE-V2
- SPA-4X1FE-TX-V2
- SPA-8X1FE-TX-V2

### POS SPA
- SPA-1XOC12-POS
- SPA-2XOC3-POS
- SPA-4XOC3-POS

### Serial + Channelized SPA
- SPA-2XT3/E3
- SPA-2XCT3/DS0
- SPA-4XCT3/DS0
- SPA-4XT3/E3
- SPA-8XCHT1/E1
IOS XE – An ASR 1000 Innovation

Software Virtualization

Step 1
- IOS Active
- IOS Standby
- IOS XE Virtual Machine

Step 2
- IOS Active
- IOS Standby
- IOS XE Virtual Machine

Industry first, delivering hitless upgrades without costly hardware redundancy

Feature
- Combines rich edge feature set of IOS
- Common look and feel to IOS

Benefit
- Broad services: Enterprise & SP, hosted or managed
- Decreases OpEx, increases training ROI

ASR 1002 & 1004 (SW Redundancy)

Zero Packet Loss

ISSU

ISSU

ISSU
ASR 1000 Software Architecture – IOS XE

Route Processor

IOS (Active) — IOS (Standby)

IOS XE Platform Adaptation Layer (PAL)
- Chassis Manager
- Forwarding Manager
- Interface Manager

Kernel

Control Messaging

SPA Interface Processor
- SPA Driver
- Interface Manager
- Chassis Manager

Embedded Services Processor
- QFP Client/Driver
- Forwarding Manager
- Chassis Manager
Software/System Stack on ASR1000/QFP

System View
- Route Processor
- ESP CPU
- GigE EOB (IPC)
- Embedded Services Processor (Active)
- QFP Subsystem
- Carrier Card / SPA

Legend
- Forwarding Information Path
- Transit Data
- Interconnect
- HT
- SPI4.2

Software View
- IOS®
- Forwarding Manager
- Forwarding Manager
- QFP Client / Driver
- QFP Datapath s/w

Software/System Stack on ASR1000/QFP

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Each ASR 1000 functional element supports different software sub-packages

7 different software sub-packages in total

Sub-packages are designed to maximize ‘In Service Software Upgrade’ capability

All 7 sub-packages are integrated and available as one consolidated package for download from CCO

**RP**

1. **RPBase**: RP OS
2. **RPControl**: Control Plane processes that interface between IOS and the rest of the platform
3. **RPIOS
4. **RPAccess**: Software required for Router access; 2 versions are available. One that contains open SSH & SSL and one without (RPAccess and RPAccess-K9)

**SIP**

5. **SIPBase**: SIP OS + Control processes
6. **SIPSPA**: SPA drivers and FPD (SPA FPGA image)

**ESP**

7. **ESPBase**: ESP OS + Control processes + CPP client/driver/ucode

**+ ROM Monitor**: One ROM Monitor image containing ROMMON for RP, ESP, SIP (released when needed)
IOS XE SOFTWARE  CONSOLIDATED PACKAGES

FOUR different Cisco IOS XE consolidated packages

1. Cisco ASR1000 Series RP1 ADV ENTERPRISE SERVICES
   All features including legacy protocols (no SNA Switching)

2. Cisco ASR1000 Series RP1 ADVANCED IP SERVICES
   Excludes all Legacy Protocols

3. Cisco ASR1000 Series RP1 IP BASE
   Includes basic IP features with SSH support

4. Cisco ASR1000 Series RP1 IP BASE W/O CRYPTO
   Includes basic IP features

- ADV ENT and ADV IP both include SBC and LI
ASR 1000 HA Highlights

- ASR 1000 leverages Cisco IOS HA infrastructure
  NSF/SSO, ISSU
- 1+1 redundancy option for RP and ESP
  Active and standby
- Software Redundancy with single RP
HW Redundancy with dual RP on ASR1006

RP fails HW or SW

Standby Becomes Active

Active Forwarding Processor

Standby Forwarding Processor

Separate and independent internal communication link for control plane (GE)

Minimum Packet Loss

SPA Interface Processor

SPA Interface Processor

SPA Interface Processor

SPA
HW Redundancy with **dual ESP** on ASR1006

- ESP fails – SW or HW
  - Minimal Data Interruption
  - Standby Becomes Active
- All packets processed by QFP for forwarding
- Separate and Independent links for Data Plane communication

**Active Route Processor**

**Standby Route Processor**

**SPA Interface Processor**

**SPA**
Stand-by IOS sub package in the single RP systems (ASR1004/ASR1002)

Two IOS sub packages in a single RP function similarly to the IOS sub packages on separate RPs

Supports all NSF/SSO features as supported by dual RP system (ASR1006)

Requires 4 GB DRAM on RP
What Customers Are Saying...

"The ASR 1000 is uniquely positioned to blend a very positive TCO with flexibility and innovation to support not only our current requirements, but those that we are just beginning to envision. Scalability, security and reliability are three areas where we look to the ASR 1000 as a ground-breaking platform."

John Burns, Vice President, Network Architecture and Planning

"We operate IT systems for our customers that are critical for their core business processes. So non-stop operations is an extremely important issue for us. We are witnessing an increased demand on highly secure, scalable, and reliable IT infrastructure services. The Cisco ASR 1000 Series helps us meet those demands. For example, the 'in service software update' feature offers great improvements towards non-stop operations."

Bardo Werum, VP Cross-Industries and Operation, Lufthansa Systems

"For Texas Instruments, the Cisco ASR 1000 Series gives us the assurance we need to manage and secure vastly greater traffic flow at our network edge, while enabling us to focus on what we do best - accelerating the pace of innovation and serving our customers."

Brian Bonner, CIO, Texas Instruments
Summary

Cisco transforms and extends the Enterprise WAN & SP Edge

Cisco ASR 1000 Series Routers deliver instant-on, secure, and reliable services

Cisco ASR 1000 Series simplifies operation and delivers increased return on investment

ASR 1000 Series Routers Services... without compromise or complexity

NOW AVAILABLE