ASR 1000 Solutions Overview

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Enterprise Solution Overview Agenda

- Quick Review of the ASR
- Solutions:
  - Secure WAN
    - Secure WAN Aggregation
    - Internet Transit / Gateway
    - High Speed FW
  - Voice
    - Next Generation Voice & Multimedia Gateways
  - WAN Optimizations
    - Performance Routing (PFR) & Netflow
    - Wide Area Application Services (WAAS)
  - Enterprise Operational Efficiencies Gained with ASR 1000:
    - Application Availability & QOS
    - High Availability
    - Traffic Monitoring (ERSPAN)
    - Managed CPE / Large Branch

- Solution and Technology Detailed Roadmap

= Aggregation Services Router Series 1000 (with QuantumFlow Processor shown)
Aggregation Services Router (ASR) Series 1000 Overview

- Next-generation of Midrange router family
  - 2RU/4RU/6RU chassis
  - 5 / 10 / 20 / 40 Gbps forwarding
  - Supporting same feature set at different price performance points

- ASR 1000 Differentiators
  - Highly available carrier-class design
  - Integrated services (SBC, FPM, Security..)
  - State of the art QoS
  - Unmatched midrange scalability & performance
  - Feature velocity

- Feature richness provides deployment flexibility
  - Support for Service Provider & Enterprise features
  - BNG (BRAS, LAC, LNS)
  - IPSec Termination
  - Distributed PE / MSE
  - High-speed CPE
ASR 1000 – Product Positioning

ASR 1000 Series
5-40Gbps+
(Depends on ESP/SIP not Chassis Type)

System Bandwidth

- >300G
- 20G
- 10G
- 5G
- < 3G

List Price

Price includes Chassis, engine

*ASR1000-ESP20 is Post-FCS

6500/7600, GSR,CRS

ASR 1000-ESP10

ASR1006 w/ dual
ASR1000-ESP10
ASR1000-RP1

ASR1000-ESP10

ASR1000-ESP5

ASR1002 w/
ASR1000-ESP10

ASR1004 w/
ASR1000-ESP20*
ASR 1000 Series Product Family

### SPA Slots
- **# of ESP Slots**
- **# of RP Slots**
- **# of SIP Slots**
- **IOS Redundancy**
- **Built in GigE**
- **Height**
- **Bandwidth**
- **Performance**
- **Air Flow**
- **Power Supply (Watts)**

#### 3-slot
- 1 Integrated (RP1)
- Integrated (SIP10)
- 4 S/W
- 3.5” (2RU)
- 5-10 Gbps
- 4-8 Mpps
- Front to Back 470

#### 8-slot
- 1 S/W
- 2 n/a
- 7” (4RU)
- 10-40+ Gbps
- 8-16+ Mpps
- Front to Back 765

#### 12-slot
- 2 H/W
- 3 n/a
- 10.5” (6RU)
- 10-40+ Gbps
- 8-16+ Mpps
- Front to Back 1275

**Aggregated Services & Scale**
Route Processor – RP1

- **Memory:**
  1. DRAM: Default: 2 GB; Max: 4 GB
  2. NVRAM: 1G of Internal Flash for code storage, boot, config, logs, etc.

- **Management Interfaces:**
  - Management ethernet management port, auxiliary port, console port

- **Storage:**
  - For core dumps, failure capture, etc; 40 GB Hard Disk Drive (rotary) initially;
  - Solid-state drive (SSD) option
  - External USB flash for IOS configs or File copying

- **Communications paths to other cards (for control and for network control packets)**

- **Stratum-3 network clock circuitry**

- **Miscellaneous control functions for card presence detection, card ID, power/reset control, alarms, redundancy, etc.**
Embedded Services Processor – ESP-5G, ESP-10G

- Centralized, programmable forwarding engine (i.e. QFP subsystem (PPE) and crypto engine) providing full-packet processing

- Packet buffering and queuing/scheduling (BQS)
  - For output traffic to SPA Interface Processors/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 midplane
  - Transports traffic into and out of QFP10
  - Input scheduler for allocating QFP10 BW among ESI’s

- FECP CPU managing QFP, crypto device, midplane links, etc
ASR 1000 Series Building Blocks

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

- **ESP**
  - Handles forwarding plane traffic

- **SPA Interface Processor**
  - Shared Port Adapters provide interface connectivity

- **Centralized Forwarding Architecture**
  - All traffic flows through the active ESP, standby is synchronized with all flow state with a dedicated 10Gbps link

- **Distributed Control Architecture**
  - All major system components have a powerful control processor dedicated for control and management planes (using dedicated GigE links running between all system components – not shown)
Cisco QuantumFlow Processor (QFP) Architecture, 1st generation

1. **Scale** - Hundreds of resources & massive feature scale
2. **Performance** - Designed to deliver 5-100s of Gbps
3. **Feature Velocity** - Software designed to deliver a common forwarding plane for multiple systems.
4. **Multi-Generational** - This is only the 1st Generation!
QFP Summary

- **Packet Processing Engine (QFP-PPE)**
  - 40 Packet Processors – 4 Contexts (threads) each, total of 160 COMPLETE packets processed at the same time!
  - 1.2GHz (Tensilica ISA) processors + DRAM packet memory
  - HW assist for flow-locks, look-ups, stats, WRED, policers, range lookup, crypto, CRC

- **Buffer/queue subsystem (QFP-BQS)**
  - HW hierarchical 5 Leves
  - Fully configurable # of layers based on HQF
  - Priority propagation through the multiple layers
Software Architecture – IOS XE

- **IOS XE =** IOS + IOS XE Middleware + Platform Software

- **Operational Consistency -** same look and feel as IOS Router

- **IOS runs as its own Linux process** for control plane (Routing, SNMP, CLI etc). Capable of 64bit operation.

- **Linux kernel with multiple processes running in protected memory for**
  - Fault containment
  - Re-startability
  - ISSU of individual SW packages

- **ASR 1000 HA Innovations**
  - Zero-packet-loss RP Failover
  - <50ms ESP Failover
  - “Software Redundancy”
ASR 1000 → Scalable IOS Services Delivered

- **RP1**
  - 1.5 GHz PowerPC CPU
  - 2-4 GB SDRAM
  - 1 GB USB Flash
  - 32 MB NVRAM
  - 40 GB HDD (non-critical ops)
  - 10Gbps path to ESP used for network control and to scale features.

- **QFP Resources**
  - 160 ~1Ghz Threads
  - 10Mbit TCAM, QOS
  - 512 MB (Flow DB)
  - 10Gbps Forwarding Capacity

- **SPA Resources**
  - 4 x 10Gbps SPA Bays
  - Ingress QOS & 128 MB ingress buffer
  - Egress Queue Status
  - 800MHz PowerPC CPU
  - 2 GB SDRAM
  - 8 Core Crypto Engine

- **ESP 10**
  - 800MHz PowerPC CPU
  - 10Gbps dedicated datapath to ESP

- **SIP 10**
  - 800MHz PowerPC CPU

- **IOS Services**
  - Integrated with Platform Adaptation Layer (PAL) and inbox HA infrastructure here.
  - Modular RP scales multiple simultaneous services:
    - Security, Voice & Multimedia, WAN Optimization & Network Management

- **Adaptation Layer**
  - Extends to ESP to incorporate all of the respective service databases used by the QFP.
    - E.g. FW session state, Netflow caches, Voice terminations, IPsec SA DB ...
  - The QFP is fed and/or can build these databases on the fly while it is processing flows.
  - Significant offload of RP resources (flow exports, logs)

- **The SIP**
  - Enhances operational efficiency of all services:
    - Oversubscription
    - SPA Drivers & ISSU
    - Optimal Link Utilizations
1. Packet arrives on QFP
2. Packet assigned to a PPE thread.
3. The PPE thread processes the packet in a feature chain similar to 12.2S IOS (very basic view of a v4 packet):
   A. **Input Features applied**
      - Netflow, MQC/NBAR Classify, FW, RPF, Mark/Police, NAT, WCCP etc.
   B. **Forwarding Decision is made**
      - IPv4 FIB, Load Balance, MPLS, MPLSoGRE, Multicast etc.
   C. **Output Features applied**
      - Netflow, FW, NAT, Crypto, MQC/NBAR Classify, Police/Mark etc.
   D. **Finished**
4. Packet released from on-chip memory to Traffic Manager *(Queued)*
5. The Traffic Manager schedules which traffic to send to which SIP interface (or RP or Crypto Chip) based on priority and what is configured in MQC
6. SIP can independently backpressure ESP via ESI control message to pace the packet transfer if overloaded.
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
  - No load balancing
- RP’s are separate from ESP’s
  - Switchover of ESP does not result in switchover of RP
  - Switchover of RP/IOS does not result in switchover of ESP
- Single RP may be configured with dual IOS for SW redundancy (single RP only)
- No redundancy for SIP or other I/O cards
  - SPA plugs into a single SIP
- Protection against SPA or SIP failure is via APS or Y-cable redundancy feature (Future: requires SPA support)
System Architecture – Distributed Control Plane

RP fails HW or SW

Standby Becomes Active

Zero Packet Loss

Active Forwarding Processor

Standby Forwarding Processor

SPA Interface Processor

SPA Interface Processor

SPA Interface Processor

Separate and independent internal communication link for control plane (GE)
System Architecture – Centralized Data Plane

- ESP fails – SW or HW
- Standby Route Processor
- Active Route Processor
- Standby Route Processor
- SPA Interface Processor
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- Punt Path
- Minimal Data Interruption
- ESI – 11.5G
- All packets processed by QFP for forwarding
- Separate and Independent links for Data Plane communication (ESI 11.5G)
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- Solution and Technology Detailed Roadmap

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## Architectural Insertion Roadmap

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### Service Provider
- **Committed**: WAN Aggregation
- **Planning**: NGWAN/MAN 2.0
- **Radar**: Internet Gateway
- **Committed**: Basic Firewall
- **Planning**: Advanced FW
- **Radar**: Enterprise Voice
- **Committed**: Voice Gateway

**Enterprise**

- **Committed**: WAN Aggregation
- **Planning**: NGWAN/MAN 2.0
- **Radar**: Internet Gateway
- **Committed**: Basic Firewall
- **Planning**: Advanced FW
- **Radar**: Enterprise Voice
- **Committed**: Voice Gateway
ASR 1000 → Multi-Service, Scalable & Secure

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

Solution Objective
- Offer a full service IPsec VPN Aggregation Router which scales to meet new BW demands of SP IP VPNs

Solution Benefits
- Consolidate a stack of 7200s into 1 ASR 1000
- Investment protected by smooth transitions to more Crypto Bandwidth as requirements change
- No service blades
- Optimized for QOS & Multicast

Keys to ASR 1000 (FCS h/w & s/w)
- 1000s of Sites / 10K IPsec tunnels (up to 50tps)
- Up to 3 Gbps crypto BW + 7 Gpbs non-crypto (FCS)
- 3DES/AES/sha-1/IKEv1
- DMVPN Phase 2

A Cisco First!
**ASR 1000 → Internet Transit / Gateway**

**Solution Objective**
- Provide Internet connectivity between Service Provider and Enterprise

**Solution Benefits**
- Full internet reachability by peering with other autonomous systems
- IPv4 and IPv6 support
- Investment protection via modular design & ESP upgrades
- Low Power Requirements
- Small Form Factor
- End-to-end SLAs & Netflow stats

**Keys to ASR 1000 (FCS h/w & s/w)**
- Scalable performance up to 14Mpps (v4/v6 only)
- Scalability (IPv4 and IPv6 Routing Tables) up to Millions of routes.
- Up to 10GE/OC192
Industry-leading VPN Performance
Multi-Gigabit IPsec Throughput (ESP-10G)

Packet sizes Bytes (clear-text)
Solution Objective
- Being able to scale IOS FW in a router to multi-gigabit BW

Solution Benefits
- Multi-Gigabit IOS FW in a router
- IOS Firewall supported on all interfaces in the router
- No service blades required
- IOS ZPF uses CPL for: L4, L7 (HTTP, IM, P2P…), Self, URL Filter, DOS Params & more.

Keys to ASR 1000 (FCS h/w)
- ALL FW processing is done within QFP up to 5/10Gbps
- High-Speed Logging (40K/sec) via NetFlow v9
- 2 Mpps+ with all baseline services combined & FW enabled
ASR 1000 → WAN Optimization → Measuring Performance

Performance routing

Solution Objective
- Offer a full service Path Optimized treatment of all WAN traffic.

Solution Benefits
- Improve network performance
- Route around problems at first sign of (soft error) trouble
- Path Selection based upon Application requirements
- Business critical applications (ie: ERP, CRM, Oracle) & Voice over IP can enjoy dynamic optimization that is constantly being tracked.

Keys to ASR 1000 (FCS h/w, RLS3)
- Tracks TCP Header to provide DLY/Loss/Reachability metrics for applications & Throughput for prefixes
- QFP has a huge flow cache & NBAR classification capability that can be leveraged by PFR (2M).
- Able to optimize Private and Public WANs (IPsec) w/o Service Blades
ASR 1000 → WAN Optimization → DRE(WCCPv2) / TFO

Solution Objective
- Utilize expensive WAN more efficiently by minimizing amount of data and optimize TCP sessions transparently.

Solution Benefits
- Centralize more servers & storage
- Improve Large/Regional branch network responsiveness
- ASR 1000 can redirect traffic to Wide Area Application Engines (WAE) inline with IOS FW & QOS

Keys to ASR 1000 (FCS h/w, RLS2)
- L2 and GRE redirection performance expected to be in 8Mpps range
- Priority will be to offer as input feature first with both Hash & Mask based Load Balancing
- Supports 256 Services
ASR 1000 → Superior Application Availability

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

Solution Benefits
- Guarantees High Priority Applications always get forwarded up to entire system BW.
- Can clamp an arbitrary collection of Low Priority traffic to a certain BW.
- Forms an integral part of all Enterprise solutions, the QFP Traffic Manager enables queue based operations without a performance hit.
- Non-queue ops (police, WRED, classifications etc.) are performed by PPE threads and are h/w accelerated.

Keys to ASR 1000 (FCS h/w & s/w)
- Flexible Hierarchies
- 128K Queues
  - All queues can have a Min. BW, Max & Excess w/ Priority Propagation
  - 2 Priority queues per policy
- Low 10s of usec of latency
ASR 1000 → Superior High Availability / ISSU

Solution Objective
- Offer a carrier class platform which continues to forward traffic during planned or un-planned events.

Solution Benefits (FCS h/w & s/w)
- Software Redundancy for 2RU/4RU
- NSF / Graceful Restart
  - BGP, OSPF (Cisco/IETF), OSPFv3, IS-IS, EIGRP, LDP
- SSO/ISSU: (generally follow each other)
  - CEF, SNMP, ARP, NAT
  - Stateful ISIS
  - MPLS, MPLS VPN, LDP, VRF-lite
  - IPv6 (NDP, uRPF)
  - FR, PPP, MLPPP, HDLC, VLAN
  - Broadband: PPPoE, AAA, DHCPv4, DHCPv6 PD
- IPSec (SSO), FW/NAT (SSO/ISSU)
- Network
  - IP event dampening
  - BGP & SPF optimizations
  - Multicast sub second convergence
  - GLBP, HSRP, VRRP
  - BFD for BGP, ISIS, OSPFv2 & static v4/v6
ASR 1000 → Ease of Data Monitoring (ERSPAN)

Solution Objective
- Being able to capture L2-L7 packet and route it through L3 cloud all the way to DC

Solution Benefits
- RSPAN capability across a L3 cloud
- ERSPAN is Inter-operable with Cat6500/7600 ERSPAN
- No service blades required
- Full Packet Visibility compared to IP Export

Keys to ASR 1000 (FCS h/w & s/w)
- Uses QFP HW-assist for replication
- ERSPAN combined with scalable NetFlow
- Highest # of monitoring sessions available
Solution Objective
- A branch architecture that offers unparalleled investment protection with services and scale.

Solution Benefits
- Ensures branch ability to route correctly over various types of Ethernet SLAs
  - Encrypt multi-Gigabits of BW
  - Optimize the WAN to route around brownouts in the SP network to further guarantee mission critical applications
- Small form factor (2RU) which also offers IOS modularity and ISSU
- Manageable even when IOS is down

Keys to ASR 1000 (FCS h/w)
- Incredible Price/Performance
- IOS redundancy w/o a hardware requirement
- 5-10 Gbps FW/NAT + 1.5-3 Gbps IPsec + WAN Optimization + Voice

First in ANY 2RU system!
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