



Mission Critical Network Architecture

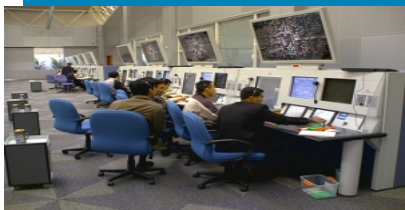
Paul Shreve
Vertical Solutions Manager
Air Traffic Control
April 2010



Agenda



**Demands Placed on
ATC Infrastructure
(Safety & Services)**



**Required Functionality for ATC
and other Services
(Radar, Voice & Data)**



Network Security Considerations

Safety Objectives in ATM

- A/G voice communication maximum interruption time = 4 sec
- G/G voice communication maximum interruption time = 30 sec
- G/G data communication (flight plans exchange, RADAR data exchange, etc.) : maximum interruption time = 30 sec
- For all types of service the occurrence of outages should be less than 1/month



Air Traffic Management Critical Services

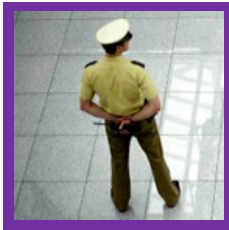
- Control Services
- Navigation Services
- Aeronautical Fixed Telecommunication Network (AFTN) Services
- Meteorological Information Services
- Aeronautical Information Services
- Search and Rescue Services



Key Infrastructure Demands

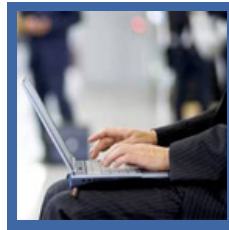
Network Security

Safety



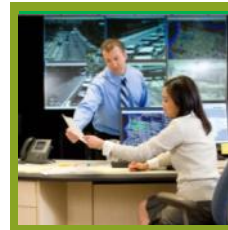
- Prevention of accidents
- Reduction of Interruptions in Services
- Fast response to incidents and interruptions

Utilisation



- Provision of reliable ATC control services
- Provision of infrastructure for internal and customer services

Flexibility



- Readiness for ED136-139
- Readiness for additional services to support SESAR vision

IT Efficiency



- Scalability
- Ease of Roll-out and Management and Servicability
- Interoperability

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Network Security Considerations

RADAR Data Dissemination

Adapting IP technology to support:

- Traditional synchronous bit stream technology
 - Converted on emulated point-to-point lines over IP technology – highly sensitive to delay variation
 - Transport ensured from Radar heads to MRT devices
 - Redundancy ensured on any radar head through dual lines deployment (no common path)

- Future (native IP) Radar data
 - IP Multicast based dissemination
 - Multiple levels of resiliency (path, RP etc...)
 - Tested also for IPv6
 - Infrastructure ready



Voice services

All voice transport migrated to IP technology

- Ground-Ground Voice services
 - CISCO Gateways – for VCSS intercom
 - Fast convergence and service restoration
 - Protection for ANY failure (including Gateways)
- Air-Ground voice
(controller to aircraft communication):
 - Partner solution employed for A-G
 - PTT transport solution provided by CISCO
- Administrative voice
 - CISCO Call Manager based solution
 - Tower communication covered also
 - CCM redundancy implemented

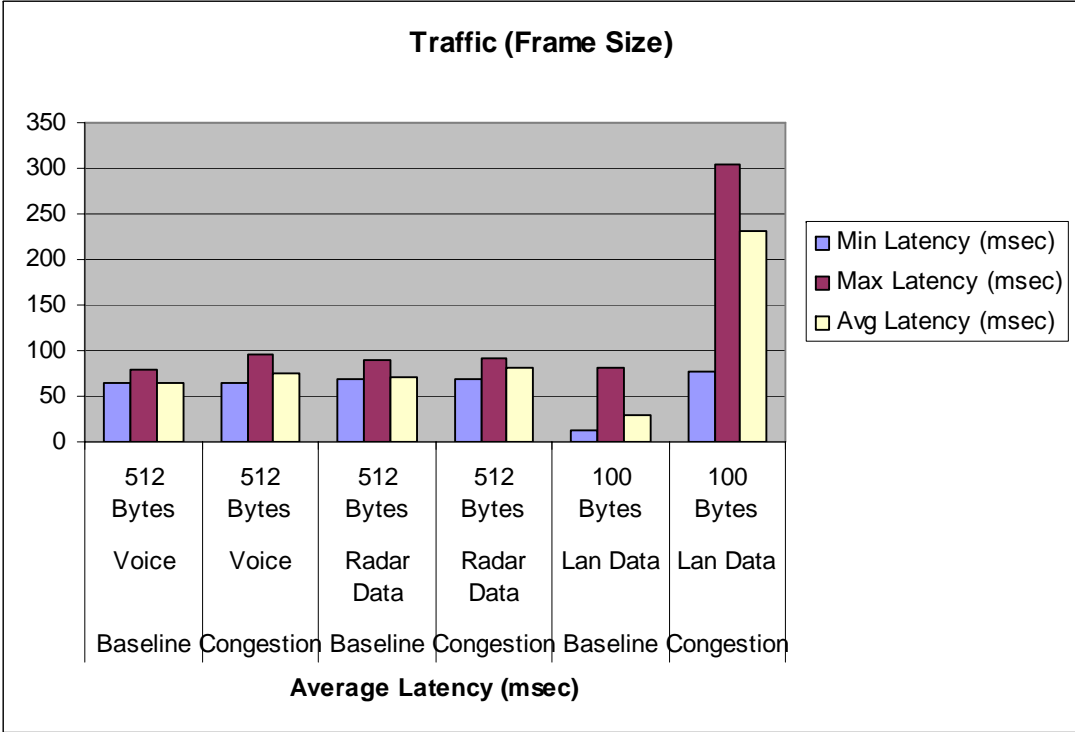


Detailed End-to-End Latency Results

Test Type	Traffic Class	Frame Size Used	Min Latency (msec)	Max Latency (msec)	Avg Latency (msec)
Baseline	Voice	512 Bytes	64.7	79.2	65.5
Congestion	Voice	512 Bytes	64.8	96	74.5
Baseline	Radar Data	512 Bytes	69.3	88.8	70.4
Congestion	Radar Data	512 Bytes	69.6	90.8	80.9
Baseline	LAN Data	100 Bytes	13.1	82	29.3
Congestion	LAN Data	100 Bytes	77.2	305.2	230.4

Smaller frames used on LAN to show impact on latency for low priority traffic irrespective of frame size.

Critical Support for Radar and Voice



High priority Radar and Voice have negligible latency impact.

Native IP Data based Communications

Data services operational & administrative

- Special requirements
 - For guaranteed QOS
 - For guaranteed bandwidth
 - For traffic separation into separate domains (VPN)
 - Administrative area
 - Operational area
 - External services areas

- WAN transport
 - Encryption required for all IP based WAN transport services
 - Multiple paths for the IP traffic (at least 3)
 - Ready for IPv6
 - Multicast capabilities



The ALL in ONE Redundant Network

Based on IP technology

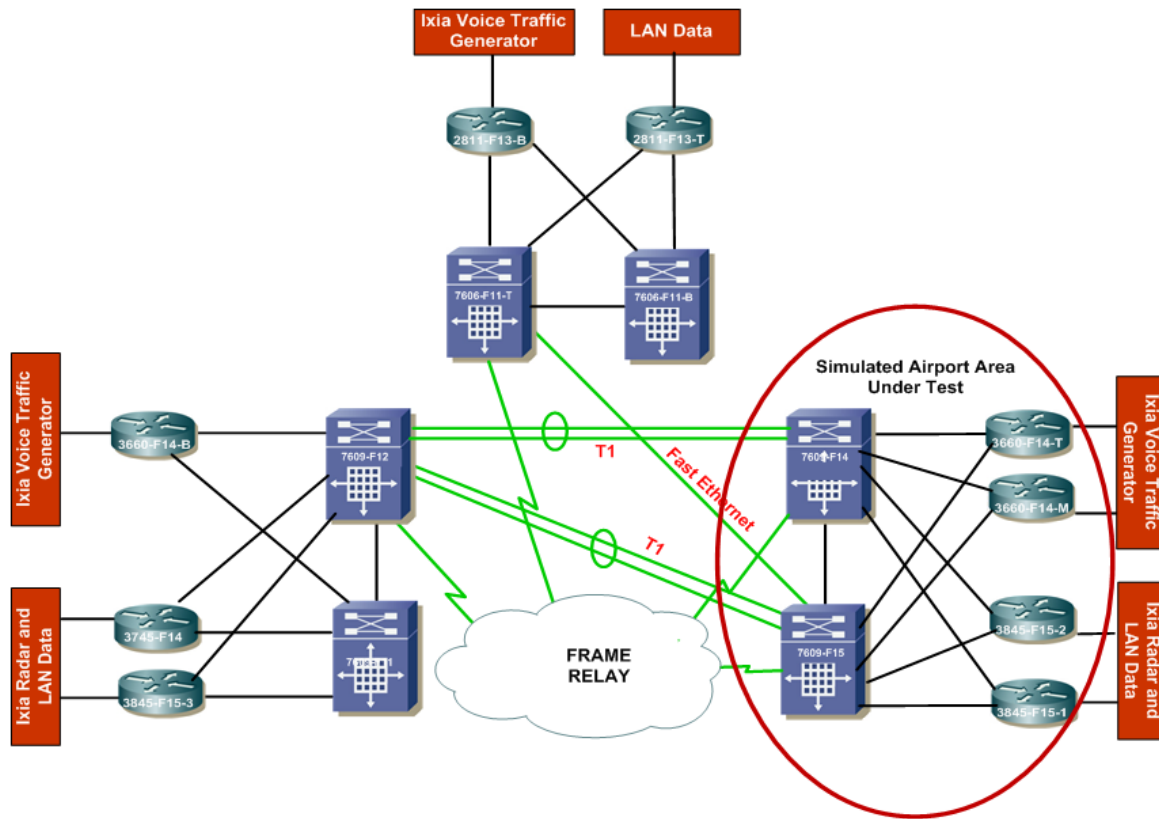
- Layered architecture
 - Core
 - Access
- Ensures separation:
 - Different features activated on different equipment
 - Multiple levels of resiliency
- Multiple levels of security
 - Traffic inspection
 - VPN separation

Cisco ATC 1.0 Architecture

AIR TRAFFIC CONTROL SYSTEM DESIGN AND IMPLEMENTATION GUIDE, RELEASE 1.0

Network System Integrations & Test Engineering
(NSITE)

March 2009



Cisco ATC 1.0 Testing Criteria

- Eurocae ED 136-139 compliant
- Validate Hardware
- Validate Software
- Validate Voice services, Radar Data Transport and LAN data services across simulated Service Provider Core
- Validate all services with reference to high load
- Validate all services for interrupt and reconvergence

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**Demands Placed on
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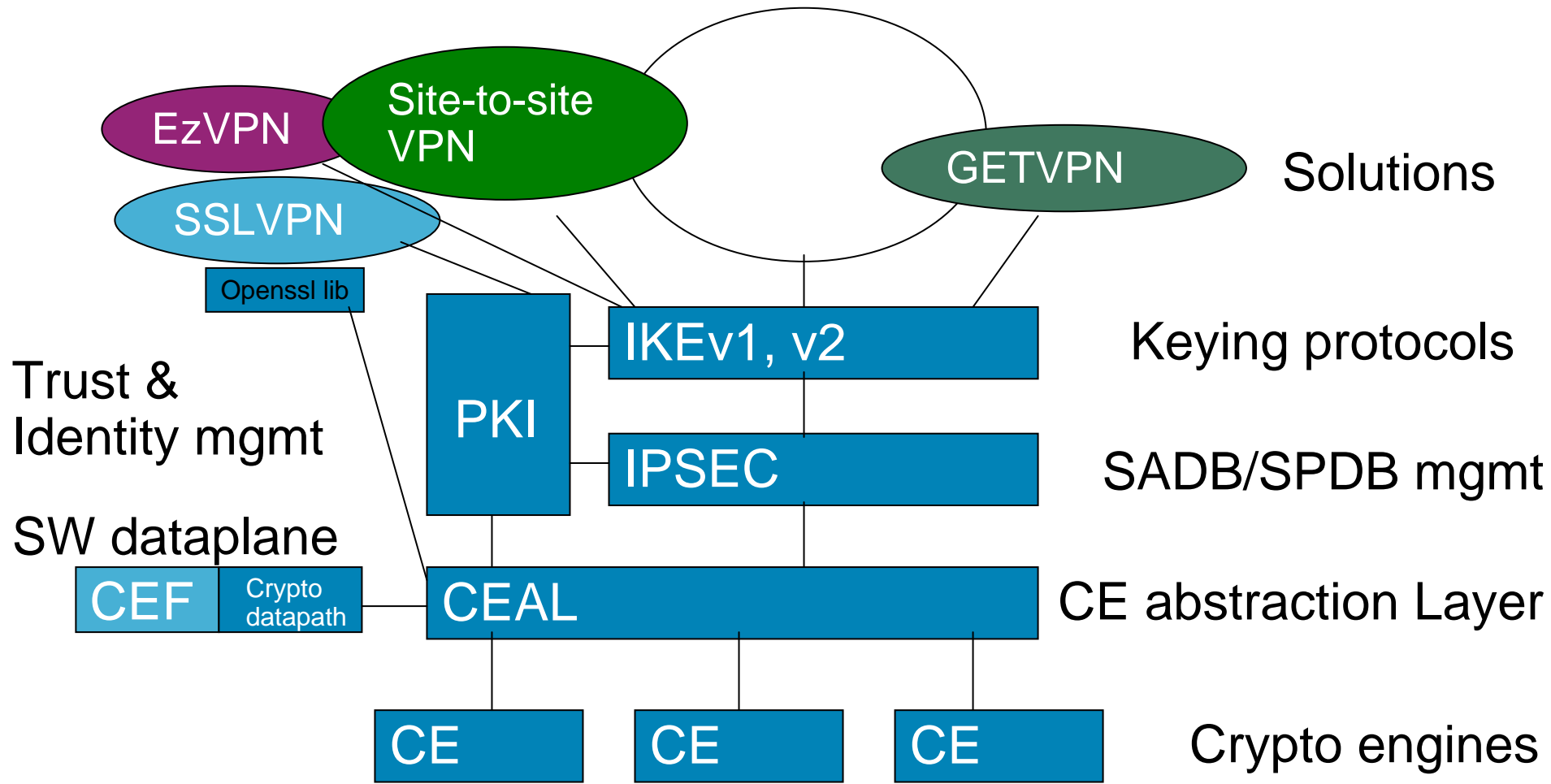


**Required Functionality for ATC
and other Services
(Radar, Voice & Data)**



Network Security Considerations

What is IOS crypto architecture?



CISCO Catalyst 7600

High performance completely redundant **Core Layer**

- Up to 720 Gbps in a single chassis, or 40 Gbps capacity per slot
- Broad level of services in same chassis
- High-performance IP/MPLS features
- Broad set of available Low- and High-Speed Interfaces ranging from T1/E1 up to 10GE/OC192
- The key focus areas for the Cisco 7600 Series are:
 - Carrier Ethernet & Quad-Play
 - Mobile Architectures
 - Public Sector & Enterprise



ASR 1000 Product Family



SPA Slots

3-slot

8-slot

12-slot

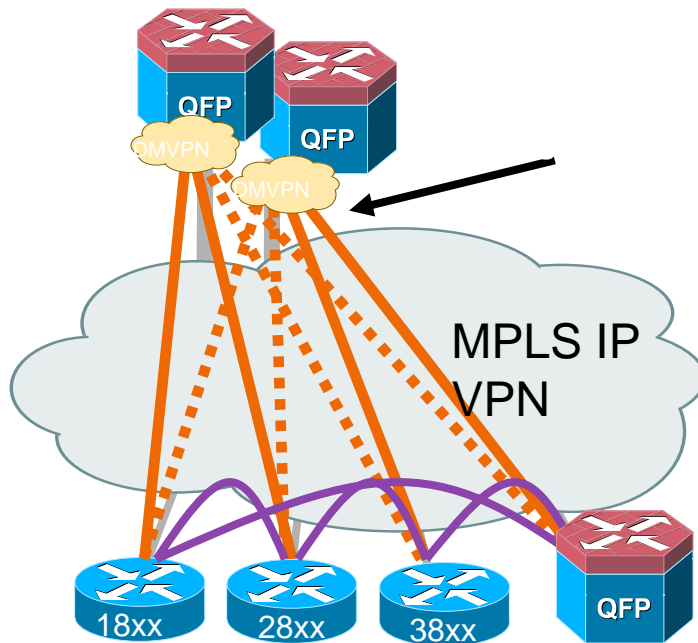
of FP Slots
 # of RP Slots
 # of CC Slots
 IOS Redundancy
 Built in GigE
 Height
 Bandwidth
 Performance
 Air Flow
 Power Supply (Watts)

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

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

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

ASR 1000: IPsec VPN Solution



Solution Objective

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

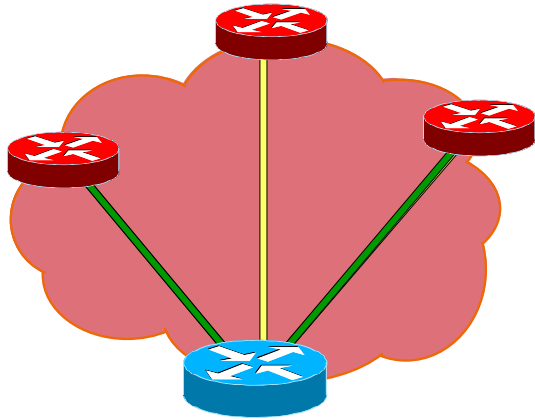
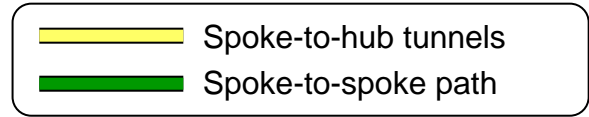
Solution Benefits

- 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 and Multicast

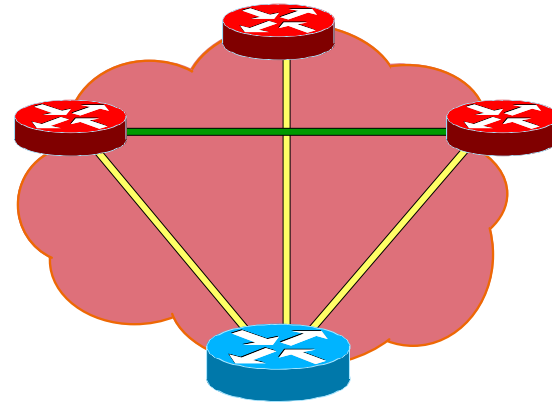
Keys to ASR 1000 (ESP20/RP1, IOS XE 2.2)

- 4000 IPsec tunnels (up to 90tps)
- 7 Gbps crypto BW + 13 Gbps non-crypto/clear text
- 3DES/AES/SHA-1/IKEv1
- DMVPN Phase 2
- Diffie-Hellman 14,15,16 (ESP5,ESP, ESP20, starting w/ IOS XE 2.2)

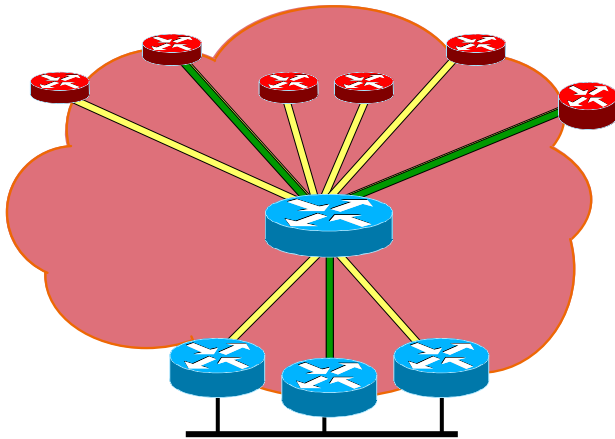
Network Designs



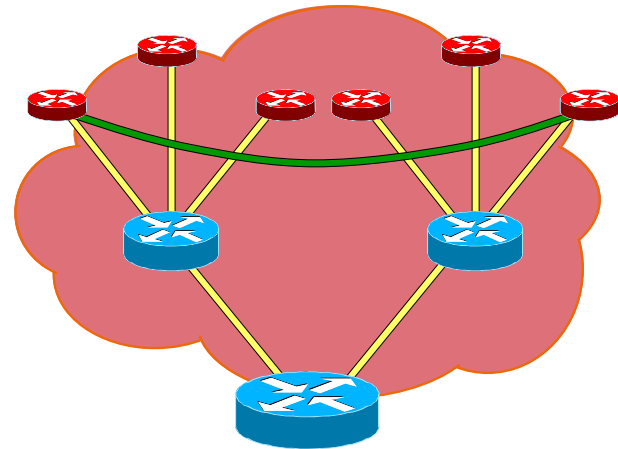
Hub-and-spoke



Spoke-to-spoke (Phase 2)

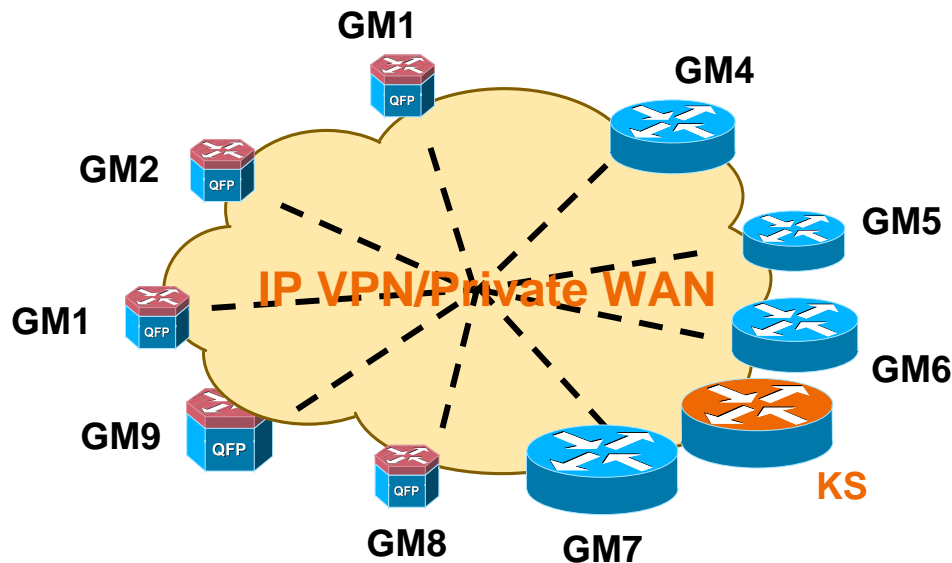


Server Load Balancing



Hierarchical (Phase 3)

ASR 1000: GET VPN Group Member



Solution Objective

- Delivers a new category of Virtual Private Network (VPN) that eliminates the need for tunnels

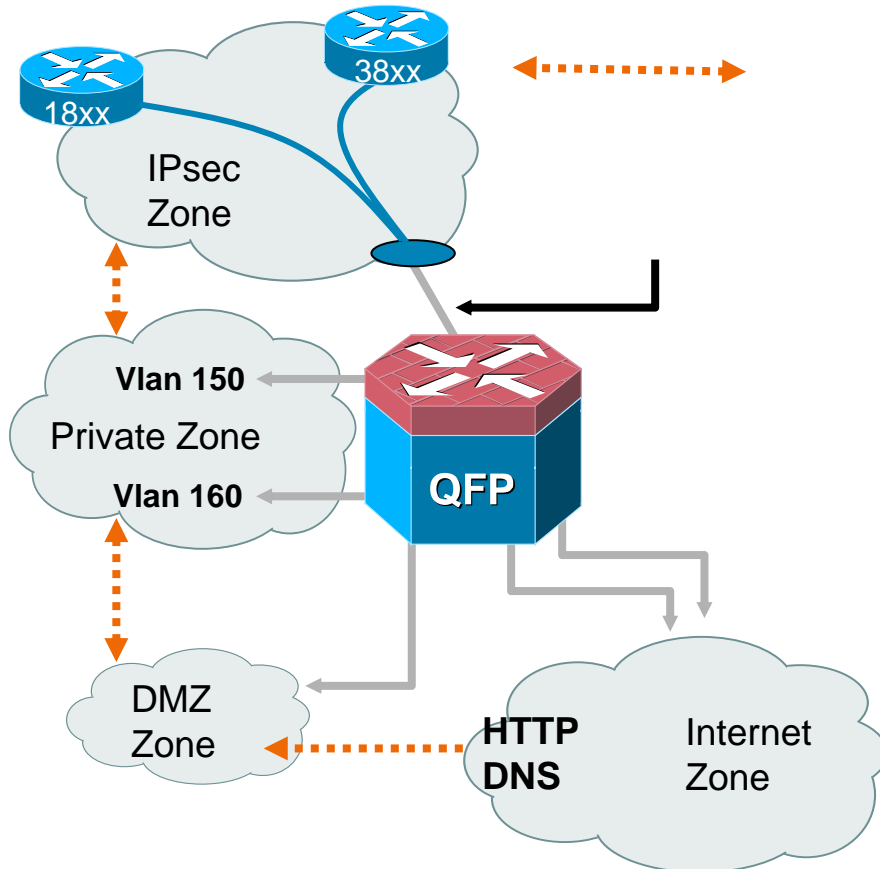
Solution Benefits

- Highly Scalable Model
- Any-Any instant connectivity with Encryption
- No Overlay Routing
- Efficient Multicast replication and encryption
- Standards based advanced QoS
- ASR1000 as the highest performing Group Member

Keys to ASR 1000 (ESP20/RP1, IOS XE 2.2)

- 7Gbps crypto + 13Gbps clear with ESP-20G
- Up to 100 Groups per GM
- Up to 100 ACEs/ACL per Group
- 3DES/AES/SHA-1/IKEv1
- Time-based Anti-Replay in hardware for robust security

ASR 1000: Zone-Based Policy Firewall



Solution Objective

- Being able to scale Cisco IOS FW in a router to multi-gigabit BW

Solution Benefits

- Cisco IOS FW in a router with 20/10/5 Gbps
- Cisco IOS Firewall supported on all interfaces in the router
- No service blades required
- IOS ZPF uses Class-Based Policy Language (CPL)
- Inspection engines: H.323, SIP, SCCP, DNS, FTP, TFTP, ICMP, RTP

Keys to ASR 1000 (ESP20/RP1, IOS XE 2.2)

- ALL FW processing is done within QFP up to 20Gbps:
 - HTTP Max Setup: 200K
 - HTTP Max Connections: 2 Million
- High-Speed Logging via NetFlow v9

VPN Technology Positioning

	EzVPN	DMVPN	GET VPN
Infrastructure Network	<ul style="list-style-type: none"> Public Internet Transport 	<ul style="list-style-type: none"> Public Internet Transport 	<ul style="list-style-type: none"> Private IP Transport
Network Style	<ul style="list-style-type: none"> Hub-Spoke; (Client to Site) 	<ul style="list-style-type: none"> Hub-Spoke and Spoke-to-Spoke; (Site-to-Site) 	<ul style="list-style-type: none"> Any-to-Any; (Site-to-Site)
Routing	<ul style="list-style-type: none"> Reverse-route Injection 	<ul style="list-style-type: none"> Dynamic routing on tunnels 	<ul style="list-style-type: none"> Dynamic routing on IP WAN
Failover Redundancy	<ul style="list-style-type: none"> Stateful Hub Crypto Failover 	<ul style="list-style-type: none"> Route Distribution Model 	<ul style="list-style-type: none"> Route Distribution Model + Stateful
Encryption Style	<ul style="list-style-type: none"> Peer-to-Peer Protection 	<ul style="list-style-type: none"> Peer-to-Peer Protection 	<ul style="list-style-type: none"> Group Protection
IP Multicast	<ul style="list-style-type: none"> Multicast replication at hub 	<ul style="list-style-type: none"> Multicast replication at hub 	<ul style="list-style-type: none"> Multicast replication in IP WAN network

Cisco's Value Proposition

- Traditional ATM/ATC solutions development and deployment
- High cost
- Often high risk
- Proprietary technology
- Lack of ability to integrate new systems

- Cisco's **Value Add**
- Reduced design time
- Economies of scale
- Migration Support => legacy traffic over new infrastructure
- Interoperability of Hardware, software, services & end-user
- Access to Technical Resources (Cisco, Technical Standards Bodies, etc.)
- IP based Commercial Off The Shelf (COTS) solutions => better ROI
- Proposal Support via the proposal Center for large RFI, RFP and bids
- **Unmatched** practical experience from actual implementation



rathornt1 As I was reading the bullets, the majority focused on COTs and the last one was IP - so I thought it might make more sense to say COTS and IP - but maybe not

Rachel Thornton (rathornt); 31-01-03

Benefits of the IP Conversion

- Plug compatible with state of the art Radio relay and Controller Work Positions
- Lower maintenance costs by using standards based IP solutions
- Simplified country wide Architecture – LAN & WAN are IP based. = one management system.
- Transparent failover of network = no interruption of CWP.



CISCO