

Is Your Network Ready for IP Telephony?

Presented by

Dr. Peter J. Welcher, Chesapeake Netcraftsmen



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About the Speaker

- **Dr. Pete Welcher**
 - Cisco CCIE #1773, CCSI #94014, CCIP
 - Network design & management consulting
 - Stock quotation firm, 3000 routers, TCP/IP
 - Second stock quotation firm, 2000 routers, UDP broadcasts
 - Hotel chain, 1000 routers, SNA
 - Government agency, 1500 routers
 - Teach many of the Cisco courses
- **Enterprise Networking Magazine articles**
 - <http://www.netcraftsmen.net/welcher/papers>



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Agenda

- **Introduction and Motivation**
- **Network Infrastructure**
- **Network Management**
- **Telephony Planning**

Why Do We Care?

... about IP Telephony Readiness?

- **For strategic planning purposes**
 - Evolve network so as to be IP Telephony (IPT) ready in the future
- **Fixing your network in the middle of an IPT deployment is costly**
 - \$\$\$
 - Time
 - Political layer credibility



A Bit of Context

- **Networking is evolving (or should be)**
 - Even less staff and time to make things happen
 - And more devices and WAN links
 - Shift from fire-fighting to managing
 - Once you get network design and implementation right
 - Sometimes, more task outsourcing: network staff manages purchased services, rather than doing it in-house
- **Wider range of skills needed**
 - To have some idea how all the technology works
 - To wisely choose future directions
 - And for troubleshooting problems



Network Evolution

- Networks are evolving from “binary” to “decimal” mode
- **Binary Mode** → **Connectivity yes/no?**
 - “I can ping it”
- **Decimal Mode** → **How good is the connection?**
- **Common steps along the way**
 - Redundancy
 - Operations Procedures (the human side of things)
 - Network Management Tools & Procedures
 - Quality of Service (QoS)
 - High Availability

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1 2 3 ... 10

Network Management

- **Currently we see a focus on low-cost, useful net management tools**
 - Grand solutions often viewed as high-risk, toolkit rather than solution, payback too delayed
 - Helpdesk / NOC deals with services
 - Network staff often needs to manage the infrastructure
- **Emphasis on what matters**
 - Fault visibility, especially when no outage
 - Performance management
 - Polling and traps, or
 - Reporting (sorted tables, graphs, health bar charts, ...)



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LAN Infrastructure

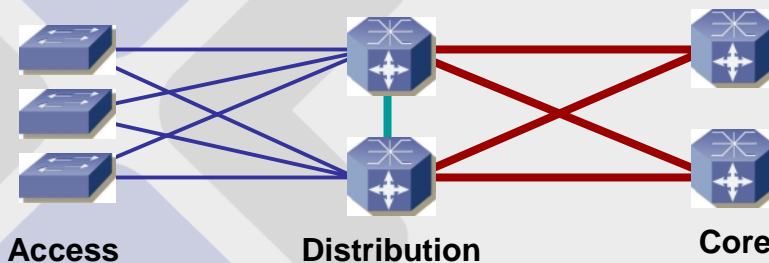
- **Minimum: 100 Mbps cabling and per-user switch ports, no shared media**
- **Increasing bandwidth towards core**
 - Low utilization
- **QoS supported by and configured on switch infrastructure**
 - Use L2 CoS on phone links and access-layer trunks
- **Stable design**
- **Redundant campus network design, with dual chassis at the core and distribution layers**



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High Availability Campus

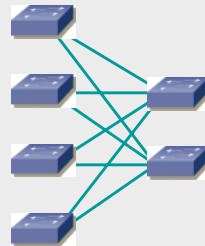
- **L2 / L3 hierarchy**
 - Small VLAN's for broadcast control and ease of troubleshooting
 - STP convergence, stability a non-issue
 - L3 switching limits scale of possible L2 problems



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High Availability Campus

- **The implementation should support fast convergence**
 - HSRP
 - OSPF or EIGRP
 - Small spanning trees, known root switch etc.
 - Uplink fast, backbone fast?
- **Scalable and simple routing**
 - Few / no static or policy-based routes
 - Little / no route redistribution
- **Use the high availability features where available**



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WAN Infrastructure

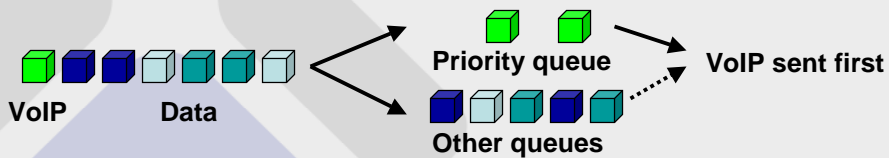
- **Absolute minimum required bandwidth for voice links:**
 - 64 Kbps FR or leased, preferably 128 Kbps or more...
 - 768 Kbps ATM or ATM/FR
- **Use traffic shaping on FR and ATM**
 - Shape to CIR for FR
 - Shape to SCR for ATM
 - Purpose: avoid data bursts causing dropped VoIP
 - ATM: Use CBR or VBR-rt for VoIP-only PVC's
 - Gives priority to VoIP traffic
 - But: pay for 2 PVC's
 - Routing complex unless use VC-bundle feature



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WAN QoS

- **Classification and marking of IP Precedence or DSCP for VoIP traffic**
- **Use Low Latency Queuing (LLQ) to prioritize VoIP traffic**
- **Link Fragmentation and Interleaving on links 768 Kbps or less**
 - MPPP on serial or ATM
 - FRF.12 on FR PVC's with CIR < 768 Kbps
- **Consider RTP header compression for slower links**



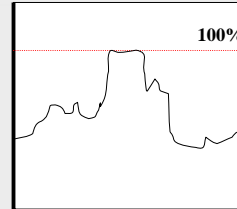
Agenda

- **Introduction and Motivation**
- **Network Infrastructure**
- **Network Management**
- **Telephony Planning**

Network Baseline

- **Recommend you monitor key variables**

- Link utilization and error rates
- Device CPU and memory
- Queue depth and output drop rate
- Packet delay and jitter (for various QoS markings)



- **Need to know if have enough bandwidth**

- For existing data traffic
- With enough headroom to support planned VoIP traffic (all kinds, sources)
- Target: peak link utilization **less than 75%**

- **Need to know current or planned devices will have enough CPU and memory to support VoIP or IPT**



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Fault Management

- **Do your network management procedures rapidly identify and resolve failures?**
- **Even where there is no service outage due to the high availability design?**

Ack	Cor	Severity	Date/Time	Source	Message
<input type="checkbox"/>		Major	Wed Nov 14 17:05:14	148.33.16.Segment1	Segment critical
<input type="checkbox"/>		Major	Wed Nov 14 17:05:14	148.33.16	Network critical
<input type="checkbox"/>	*	Warning	Wed Nov 14 17:05:14	172.16.1.1	Node down
<input type="checkbox"/>	*	Warning	Wed Nov 14 17:05:14	172.20.1.1	Node marginal
<input type="checkbox"/>		Warning	Wed Nov 14 17:16:30	148.33.16	Network status major (almost critical)
<input type="checkbox"/>		Major	Wed Nov 14 20:01:44	172.20.1.1	ifInOctets.3 threshold exceeded (> 1000.00 * 1
<input type="checkbox"/>		Normal	Wed Nov 14 20:01:49	172.20.1.1	ifInOctets.3 threshold rearmed (<= 500.00 * 1)
<input type="checkbox"/>		Major	Wed Nov 14 20:02:09	172.20.1.1	ifInOctets.2 threshold exceeded (> 1000.00 * 1
<input type="checkbox"/>		Major	Wed Nov 14 20:02:09	172.20.1.1	ifInOctets.3 threshold exceeded (> 1000.00 * 1
<input type="checkbox"/>		Major	Wed Nov 14 20:02:09	172.16.1.1	ifInOctets.2 threshold exceeded (> 1000.00 * 1
<input type="checkbox"/>		Normal	Wed Nov 14 20:02:19	172.16.1.1	ifInOctets.2 threshold rearmed (<= 500.00 * 1)
<input type="checkbox"/>		Normal	Wed Nov 14 20:02:19	172.20.1.1	ifInOctets.2 threshold rearmed (<= 500.00 * 1)
<input type="checkbox"/>		Normal	Wed Nov 14 20:02:19	172.20.1.1	ifInOctets.3 threshold rearmed (<= 500.00 * 1)
<input type="checkbox"/>		Major	Wed Nov 14 20:02:49	172.20.1.1	ifInOctets.3 threshold exceeded (> 1000.00 * 1
<input type="checkbox"/>		Minor	Wed Nov 14 20:10:15	172.20.1.1	Data Collection stopped on ifInOctets.11. Las

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Performance Management

- **Are you aware of:**
 - Resources, bandwidth being used
 - When performance drops off or excessive resources consumed?
- **Two common approaches:**
 - Software that polls and produces (web) reports
 - E.g. Concord, InfoVista, other
 - Do you maintain the lists of devices/interfaces?
 - Does somebody actually look at the reports?
 - Software that polls and sends alarm thresholds
 - E.g. CiscoWorks Device Fault Manager, ITEM Voice Health Monitor, HPOV, other
 - Does somebody actually look back to see what's been alarming? And tune thresholds?



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Network Management Tools

- **HP Openview Network Node Manager**
 - Monitor and manage faults
- **CiscoWorks (LMS, RWAN bundles)**
 - DFM, IPM, RTM monitor quality
- **CiscoWorks ITEM**
 - VHM monitors CallManagers and VoIP gateways
- **NetIQ Vivinet**
 - Assessor, Diagnostics, Manager Suite
 - Voice-readiness survey
 - Ongoing monitoring, synthetic MOS
- **Cisco NAM blade for 6500**
 - Monitors and reports on call quality



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Agenda

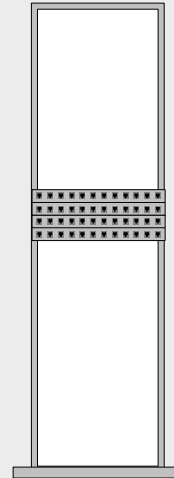
- Introduction and Motivation
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IP Address Planning

- **Subnets**
 - Will you be placing IP phones into separate VLAN's and subnets?
 - Is your DHCP set up to support this?
 - Is your DHCP set up to support the options Cisco phones use?
 - Or do you plan to address IP phones into existing subnets?
 - If so, do you have enough unused addresses?
 - Is there some way to differentiate the IP phone addresses from the PC addresses?

Power and Space

- **How do you plan to power the phones?**
 - Inline power from a Cisco switch, Cisco versus IEEE 802.3af
 - Power patch panel
 - Wall power
- **Will the source of phone power be on UPS?**
 - Equipment room versus entire building
 - Amount of UPS capacity needed
 - SNMP-manageable UPS's?
- **Facilities support**
 - Space (rack or floor)
 - Sufficient 220 V power
 - Adequate air conditioning capacity
- **Backup generators during longer outages?**



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Identifying Access Items

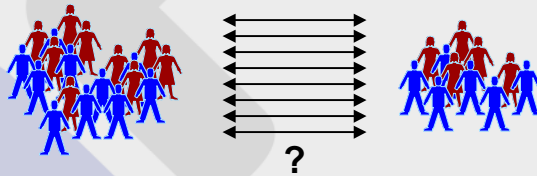
- **# of DID trunks?**
- **# of CO trunks?**
- **# of tie lines, where?**
- **Fax and individual lines?**
- **Digital versus analog?**
- **# Off Premise Extensions (OPE's)?**
- **Purpose(s) of lines**
- **Any Call Center or equivalent?**
 - If so, # of agents, data about call volume



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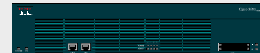
Telephony Capacity Planning

- **Current usage, sizing of PBX trunks, etc.**
 - Busy Hour Call Attempts
 - Erlang tables or calculator tools
- **For each of: PSTN, voicemail, inter-site voice traffic**
 - Similar to current voice planning, do need to take frame and packet overhead into account



Gateways

- **Number and sizing of VoIP gateway devices**
- **Protocols**
- **Sizing of connections to PSTN**
 - Direct inward dial (DID) requirements?
 - Direct outward dial (DOD) requirements?
- **Services (call hold, park, conferencing, other?)**
- **Functionality needed (encoding, calling line ID, analog or digital, fax relay, modem?)**
- **Redundancy and high availability features needed?**



Call Manager Design

- **Number of IP phones (physical, soft) and other devices**
- **Review CallManager design as to**
 - Sizing and location, based on number of phones, device weights, etc.
 - Sizing and location of conferencing and MTP DSP resources
 - Redundancy strategy
 - 100 Mbps connectivity between cluster servers
 - Number of clusters (distributed or local)



IPT Services Requirements

- **Voice mail? If so, what features are needed?**
 - Interested in unified messaging?
 - Current email environment?
- **Legacy voice mail integration? Details...**
 - Current environment and features?
 - Is SMDI supported?
 - Number of vmail users? Where located?
 - Minutes of storage per user
- **Message waiting indicator (MWI)?**
- **E911 requirements?**
 - Legal requirements
 - New services, e.g. 911 call awareness

Supplementary Services

- **Supplementary services consist of:**
 - Call hold
 - Call transfer
 - Call park
 - Conferencing
- **Media Termination Points (MTP's)**
 - How many DSP's needed
 - Where
- **Transcoding support for WAN**
 - G.711 ↔ G.729
 - DSP's!
- **Music on Hold (MoH)**
 - Server?
 - Unicast / multicast?



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Bandwidth

- **Review required bandwidth, especially for WAN**
 - Call VoIP traffic including L2 and L3 overhead
 - Signaling volume
 - CallManager intra-cluster traffic, if across WAN
 - PBX signaling and trunking bandwidth
 - Voice mail bandwidth needs
- **Slower WAN links**
 - Consider cRTP (Compressed RTP)
 - Consider G.729 codec
 - Consider VAD (Voice Activity Detection): saves bandwidth but may lower VoIP quality



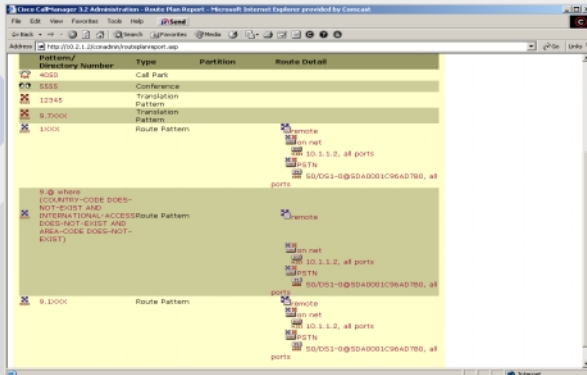
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Call Admission Control

- **Use some form of CAC to protect voice from excess voice**
 - Locations in CallManager
 - H.323 Gatekeeper
 - H.323 Call Sync + RSVP
 - Other
- **CAC is also needed with IP Videoconferencing**
- **Make sure WAN has adequate bandwidth to support VoIP, generally at most 33% of total bandwidth**
- **Create a dial plan and use VoIP gateways, to use PSTN for surplus call traffic**

Dial Plan

- **Dial plan ready?**
- **Does dial plan providing redundancy with fallback to PSTN?**
- **Route groups allowing use of redundant gateways?**
- **Emergency dial?**
- **Class of Service needs understood?**



The screenshot shows a web browser displaying the Cisco CallManager 3.2 Administration interface. The page title is "Route Plan Report". The main content is a table with columns for "Directory Number", "Type", "Partition", and "Route Detail".

Directory Number	Type	Partition	Route Detail
4000	C&F Park		
5555	Conference		
12345	Translation Pattern		
9.7000	Translation Pattern		
1000	Route Pattern		remote in net 10.1.1.2, all ports PSTN SD/OS1-0@SDA001C9A0780, all ports
? where (COUNTRY-CODE DOES NOT-EXIST AND INTERNATIONAL-ACCESS DOES-NOT-EXIST AND AREA-CODE DOES-NOT-EXIST)			
	Route Pattern		remote in net 10.1.1.2, all ports PSTN SD/OS1-0@SDA001C9A0780, all ports
9.1000	Route Pattern		remote in net 10.1.1.2, all ports PSTN SD/OS1-0@SDA001C9A0780, all ports

See Also

- This seminar is based in part on the questions in Cisco's online IP Telephony Readiness Assessment
- Web assessment questionnaire at:
<http://tools.cisco.com/Assessments/jsp/welcome.jsp?asmt=VOIP>

Summary

- **Make sure your infrastructure is solid, using redundancy at crucial points**
- **Make sure your L2 and L3 protocols add to the stability**
- **Make sure your network management is telling you what's going on – and make sure you're listening to it!**
- **Do your IPT planning homework up front!**
- **Sweat the details now, or they'll make you sweat later!**

Disclaimer: this presentation touches on most of the high-level issues, but it definitely does not cover all the details of IPT planning.

Questions?

THANK YOU !



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A Word From Us ...



- **We can provide**
 - Network design review: how to make what you have work better
 - Periodic strategic advice: what's the next step for your network or staff
 - Network management tools & procedures advice: what's right for you
 - Implementation guidance (your staff does the details) or full implementation
- **We do**
 - Small- and Large-Scale Routing and Switching (design, health check, etc.)
 - IPsec VPN and V3PN (design and implementation)
 - QoS (strategy, design and implementation)
 - IP Telephony (preparedness survey, design, and implementation)
 - Call Manager deployment
 - Security
 - Network Management (design, installation, tuning, tech transfer, etc.)



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Cisco Certifications

Chesapeake Netcraftsmen
is certified by Cisco in:



- IP Telephony
- Network Management
- Wireless
- Security
- (Routing and Switching)



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