

ECG School of VoIP Course Catalog



Telecom races forward.

Train to win the race.

Train with the Best.

VoIP and IP Video Conferencing put big new demands on your network. Vendors can help you understand their product; ECG prepares you to build and support the whole network.

The secret of great training is simple: *all of ECG's trainers are active, practicing Systems and Network Engineers.* You get to the brightest and best VoIP Systems Engineers, who explain the way networks *really* work. You get experience with design and deployment engineers who work on real systems, every day.

ECG is a leading Network Design and Operations Consulting Firm for VoIP Carriers and Internet Service Providers in the US, Canada, and the Caribbean. ECG specializes in **Next Generation Telephone Switching Systems**. ECG has long experience building and operating Internet Service Providers, VoIP Carrier Networks, Major Enterprise Networks, and TDM/SS7 Telecommunications Networks.

BroadWorks Boot Camp

Installation & Upgrades.....	2
Call Processing & Troubleshooting.....	3

Acme Packet Boot Camp

SIP Trunking & Registration.....	4
----------------------------------	---

VoIP Fundamentals

IP Foundations for VoIP Carriers	5
Advanced VoIP Engineering & Troubleshooting.....	7

Special Topics

VoIP Systems Design	9
BroadWorks VoIP CPE Management.....	9
VoIP Security	9
Monitoring & Fault Detection	9
VoIP Network Performance Analysis.....	9

Locations and Training Engineer Bios.....	10
---	----



BroadWorks Boot Camp: Installation & Upgrades

Duration	Goal	Key skills
4.5 days	Install and Upgrade BroadSoft BroadWorks	BroadSoft BroadWorks, Application Server, Network Server, External Web Server, Media Server, Install, patch, troubleshoot, network design

The only training ANYWHERE that covers Installs, Upgrades, and Patching

This course prepares you to build and expand new BroadWorks services.

- Know the caveats and gotchas in advance
- Run installs safely and effectively
- Prepare the Operating System & Network properly
- Upgrade existing systems without interrupting service
- Integrate BroadWorks with your SBC, VoIP Gateways, DNS, Email, and other equipment.
- Use the BroadWorks CLI for configuration.

Get in-depth hands-on experience installing and configuring, in the safety of a dedicated lab, and the support of an experienced Deployment Engineer.

Requirements & Pre-requisites

Participants should either complete the *IP Foundations for VoIP Carriers*, or else have the Cisco Certified Network Professional (CCNP) certification and familiarity with VoIP systems. In addition, participants should have Unix System Administration experience, or attend the *Unix for VoIP System Administrators*.

Course Content

Plan the BroadWorks Deployment or Upgrade. Understand the servers you need for your applications. Plan the equipment you'll need, based on your supported growth.

Design the IP Network. Understand the IP networking requirements and best-practices. Assign IP addresses and design subnets to support fault tolerance, system maintenance, router and switch upgrades.

Install, Upgrade & Patch BroadWorks Servers. Get experience installing the BroadWorks Application Server, Network Server, Media Server, and External Web Server. Learn about patch application and how to troubleshoot patching when it breaks.

Configure and Integrate the Broadworks System. Understand the basic tasks to configure a new BroadWorks system to be internally-integrated and functional. Practice on a live system.

PSTN Gateway or SIP Peering Integration. Understand PSTN call routing profiles and policies. Setup PSTN gateways or SIP Peers

SBC Integration. Get experience with the Acme Packet OS-C SBC for SIP registration to your system. Understand registering and non-registering devices, and how they're configured in BroadWorks.

"BroadSoft" and "BroadWorks" are trademarks of BroadSoft, Inc., Gaithersburg, Maryland.



BroadWorks Boot Camp: Call Processing & Troubleshooting

Duration	Goal	Key skills
4.5 days	Master BroadSoft BroadWorks	BroadSoft BroadWorks, Application Server, Network Server, External Web Server, Media Server, bwcli, AS_CLI, NS_CLI, WS_CLI, MS_CLI, XSLogs, PSLogs, AuditLogs, ms.syslog, OCSLog, tshark, tcpdump, SIP, SDP, RFC3261

Once you have installation and upgrades under control, understand how BroadWorks processes calls and features. Learn how and where to troubleshoot.

- Read all the logs to find problems.
- Understand the BroadWorks maintenance tools.
- Configure and troubleshoot voicemail.
- Understand SIP signaling in depth.
- Troubleshoot in the TimesTen database with ttlsq.

Get in-depth hands-on experience configuring the system, installing

Course Content

Understand Server Interactions. Which server controls voicemail? Which server controls call routing? Which server selects the Long Distance carrier? Which server determines the codec? Understand the server roles, and how they interact to provide features, play greetings, and modify settings.

SIP Call Control In Depth. This module provides a working understanding of SIP call processing. We go in-depth to see how calls are setup, maintained, how codecs are selected, and how calls are ended. Do hands-on analysis exercises, and learn how call transfer, hold, and DTMF transfer work. We cover SIP methods, SIP response codes, and all the basic transactions.

Analyzing Logs. Would that be in the XSLog? OCSLog? PSLog? MS Syslog? Learn what each of the logs has, how to manage logging, and how to read each log on the BroadWorks platform. We cover the Application Server, Network Server, Media Server, and External Web Server in depth.

Beyond Logs: Packet Captures. Logs won't show every detail. Learn how to use Packet Captures on the BroadWorks servers to look behind the curtain and troubleshoot network and feature issues.

Command-Line Diagnostics with BWCLI and ttlsq. Learn to use the BroadWorks CLI commands to do diagnostics and troubleshooting. Open the TimesTen database for fast access to internal data.

“BroadSoft” and “BroadWorks” are trademarks of BroadSoft, Inc., Gaithersburg, Maryland.



Acme Packet Boot Camp: Building SIP Trunks and Registration

Duration	Goal	Key skills
2.5 days	Dominate Acme Packet Configs	Acme Packet Net-Net SD, SBC, OS-C local-policy, sip-interface, realm-config, steering-pool, session-agent, ACLI, sip-port, allow-anonymous, packet-trace, sip-config



The Acme Packet OS-C Platform is enormously complex and powerful. This course shows you how to harness that power for SIP Peering/Trunking, and SIP Registration.

This is a fast-paced focused class intended to arm designers and technicians with practical, tactical knowledge.

- **Customized** content for your network, and your situations.
- Understand critical objects like local-policy, sip-interface, and realm
- Choose the best configuration model for SIP trunks and SIP registration support
- Build complete SIP trunking and registration configurations
- Test the configurations with BroadWorks and SIP CPE
- Use packet captures to troubleshoot configuration problems
- Understand key security threats, and build secure, robust configurations.
- Apply SIP Header Manipulation Rules to peering



Course Content

Understand how the SBC Works. How and when does the SBC forward packets? How is a route chosen? Learn how the numerous configuration elements work together to create successful SBC services.

Designing SIP Peerings. Understand the key design approaches for SIP Peering, including IP-based peering, port-number peering, registration, and domain-based routing.

Plan the SIP Peering. Choose IP addresses, port numbers, and appropriate configuration objects for effective SIP peering.

Build the Configuration. Understand the Acme Packet Command Line Interface (ACLI) to build and configure SIP peerings. Get hands-on experience with lab Acme Packet equipment in a safe, supported environment.

Troubleshooting SIP Peering. How do you understand what's happening when it breaks? Read logs on lab Acme Packet equipment, and packet captures on production systems.

“Acme Packet” is a trademark of Acme Packet, Inc.



IP Foundations for VoIP Carriers

Duration	Goal	Key skills
4.5 days	Configure Routing and Switching	Routing, Switching, OSPF, NAT, Firewalls, access-rule, access-group, ip route, VLAN, QoS, DSCP, Diffserv, policy-group

This course is intended for network planners, engineers, and operators of VoIP networks who need to know the specific details of the underlying technologies: IP Routing, Ethernet, Quality-of-Service systems, VLANs, and VoIP System components. This course is designed to enable focused learning on tactical skills needed every day at VoIP carriers. At the end of the course, you will be able to:

- Read and understand a router configuration
- Perform fundamental configuration on a Cisco router, including special requirements for VoIP
- Plan, configure and troubleshoot Ethernet switching
- Understand and plan a VoIP network interfacing with multiple devices and carriers
- Understand and configure NAT, and understand its affect on VoIP calling
- Understand core VoIP component types and their interaction

This class is great for engineers and technicians migrating from TDM/SS7 environments and for new staff learning IP networking.

Requirements & Pre-requisites

Each student should have a Windows PC, Apple Mac OS X system, or Linux computer. It will help if you know how to access and change the network settings on your computer, and access a Command Prompt or Terminal window.

Course content

IP Routing The IP Routing module introduces the concepts of Internet routing using point-to-point links. IP Routers are at the heart of service provider networks, and a solid understanding of their capabilities makes design and troubleshooting possible. Participants learn the basic theories of IP addresses, subnet masks, and routing tables. Examples center on WAN (point-to-point) networks. Exercises ensure knowledge of precise router function and use Cisco syntax.

IP over Ethernet For many simple networks, Ethernet just works. But new, large-scale Ethernet networks that spread Ethernet over large distances require detailed understanding of Ethernet's basics of operation. This module will enable you to make solid design and operation decisions both in local and customer networks, and in a carrier core network. Auto-learning Ethernet Switches and Ethernet rings add significant capability but latent complexity. This module covers MAC addresses and transmission rules, mapping of IP addresses to MAC addresses with ARP, the differences between Ethernet hubs and switches, and the detailed operation of Auto-learning Ethernet switches. This module's exercises cover knowledge of exact Ethernet behavior, and include troubleshooting of Ethernet problems.

Routing and Ethernet. This module covers specific issues related to IP routing on Ethernet. Participants learn to use Ethernet as a powerful tool both for local and distributed networks. IP Address management is covered in detail. The exercises are designed to provide thorough comprehension of routing and

ECG School of VoIP Course Catalog; www.e-c-group.com; +1-229-244-2099

Copyright © 2010 ECG, Inc. All Rights Reserved.

Update 4/20100315

Can you fully control IP packet routing and switching?

Does your QoS guarantee performance under heavy network load?

Can you protect your network against cybercriminal attacks?



Ethernet transmission function; further, participants gain experience performing basic network planning and configuration on Cisco equipment.

Real-Time Flows and QoS This module covers the fundamental of Real-Time flows used for VoIP audio and video. Participants learn how Internet networks are optimized, and how to implement prioritization to make VoIP calling successful. The exercises involve troubleshooting audio problems, and basic interpretation of packet captures showing RTP media.

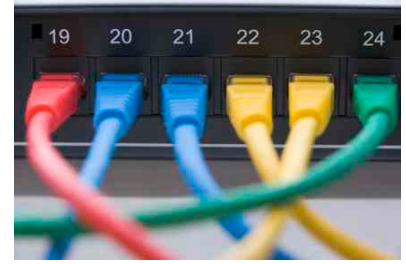
Transport Protocols -- TCP and UDP This module discusses the transport "middleware" used in IP networks, and how VoIP uses these systems. This module help participants understand fundamental operation of protocols in IP networks.

Firewalls and NAT Firewalls and Network Address Translation are facts of life for VoIP operators, often appearing both at customer locations and in the network core. However, they both have significant effects on VoIP signaling and media. This module covers the basics of firewalling and NAT technology, how to implement and configure routers to perform these functions, and how to plan for VoIP deployments involving these. Participants will configure routers to perform these functions, and analyze the precise effects on VoIP.

Dynamic Host Configuration Protocol The Dynamic Host Configuration Protocol (DHCP) is used by most VoIP Customer-Premise Equipment to enable basic configuration. A solid basic understand is required to deploy CPE in large numbers. The exercises in this module let participants configure, test, and analyze DHCP behavior.

Domain Name System The Internet Domain Name System (DNS) provides a key function for IP applications. It plays a special role in location VoIP servers. This module introduces participants to the operation of the technology, including recursive lookups to root Internet servers. In the exercises, participants learn how queries traverse the Internet.

VoIP Systems Overview Once the underlying VoIP network is understood, this module introduces the foundational VoIP servers and devices, including SIP servers, registrars, Session Border Controllers, and PSTN Gateways, and CPE.



After Arrival

With Routers connected	Scheduled Arrival	Expected Arrival	Actual Arrival Time	Set #
1, 2	0.190	N/A	0.150	1
	0.210	0.170	0.170	2
	0.230	0.190	0.237	3
4	0.250	0.210	0.235	4
4, 5	0.270	0.230	0.237	5
5, 6	0.290	0.250	0.250	6
5, 6, 7	0.310	0.270	0.267	7
6, 7, 8	0.330	0.290	0.270	8
7, 8, 9	0.350	0.310	0.292	9
7, 8, 9, 10	0.370	0.330	0.301	10

Advanced VoIP Engineering and Troubleshooting

Duration	Goal	Key skills
4.5 days	Understand & Troubleshoot VoIP Call Control	SIP, SBC, SDP, RFC3261, MGCP, Fault Tolerance, Call Control, INVITE, re-INVITE, Codecs, Faxing, RFC2833, QoS

Will your failover keep VoIP up non-stop?

This course is intended for VoIP network engineers and operators to understand advanced issues in IP Networking, VoIP Signaling and Media, and Troubleshooting practice. At the end of the course, you will be able to:

- Understand and configure advanced Network issues especially relevant to VoIP Carriers
- Understand VoIP System Components
- Plan and understand high-availability networking technologies and their effects on VoIP
- Read and troubleshoot basic SIP and MGCP call signaling
- Troubleshooting new and complex problems with a consistent process
- Perform basic traffic engineering for capacities in VoIP networks
- Identify and avoid common VoIP service issues

Requirements & Pre-requisites

Participants should either complete the IP Foundations for VoIP Carriers, or else have the Cisco Certified Network Professional (CCNP) certification and familiarity with VoIP systems.

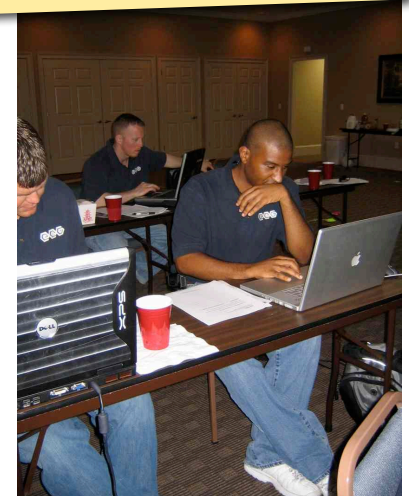
Course content

Ethernet VLANs Virtual LANs (VLANs) have become a standard part of Ethernet designs. Effective use can reduce equipment cost, and greatly improve reliability. Advanced VoIP deployment models require careful VLAN design and implementation. This module introduces VLANs, explains their use and configuration. In exercises, participants configure VLANs on managed Ethernet switches.

High-Availability Networking To provide fault-tolerant VoIP services, a number of high-availability techniques are applied, such as redundant Ethernet with Spanning Tree Protocol, IP routing protocols like OSPF, and virtual IP and MAC addresses. This module covers those and other technologies to help participants plan and operate high-availability network designs. Techniques for verifying high-availability designs are also covered. The exercises give participants a chance to configure and test some redundant networking technologies, including technologies used in geo-redundant networks.

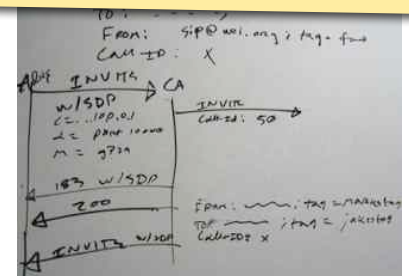
VoIP Basics & Components These modules introduces VoIP systems, including call flows, SIP, and MGCP. The VoIP Components module introduces VoIP Customer Premise Equipment, SIP Servers / Call Agents, Redirect servers, MGCP gateways and Session Border Controllers and how they interact with each other, and other network components. Participants will learn how to intelligently plan deployments cognizant of protocol interactions. Exercises ensure participants have a good understanding of the different roles.

Session Border Controllers (SBCs) play a key role in providing security an enabling the use of NAT in VoIP services. They are, however, complicated devices, and often not understood. In this module, participants learn about how the SBC can enable NAT traversal, SIP peering, and provide a security barrier



Can you diagnose call disconnect problems?

-- codec issues?



between untrusted networks and the VoIP core. In exercises, participants monitor and simulate the exact function of an SBC on SIP signaling.

VoIP Media Unlike TDM networks, IP networks can drop, re-order, and delay data as it is transmitted. Reliable transmission of toll-grade audio across such networks requires careful consideration of the underlying structure of the signal and its encoding. This section covers digital audio encoding, packetization into RTP, the effects of IP networks on RTP, jitter buffer operation, and the effects of prioritization and congestion on real-time streams. In exercises, students enable prioritization on routers and test the effects.

SIP Call Control – In Depth This module provides a working understanding of SIP call processing. We go in-depth to see how calls are setup, maintained, how codecs are selected, and how calls are ended. Do hands-on analysis exercises, and learn how call transfer, hold, and DTMF transfer work. We cover SIP methods, SIP response codes, and all the basic transactions.

MGCP Call Control – In Depth. This section covers MGCP call processing, including Call Agent / Gateway interactions, and MGCP processing.

VoIP Network Troubleshooting Process Troubleshooting is approached in this module as a first-class enterprise, required in every complex system. This module introduces a consistent process for identifying problems that encourages confidence, preparedness, and careful analysis of component behavior.

Effective Mental Models for VoIP Troubleshooting A key to effective troubleshooting is reasonable comprehension of the system; this module shows ways to develop coherent depictions of VoIP networks to help quickly isolate faults and plan changes. We cover a variety of diagram formats to describe networks. Participants have opportunities to develop diagrams of their own networks that clearly identify certain functionality in the context of network layers and signaling design.

Experimental Troubleshooting by Testing Components To find problems, you must know which components are *not* the problem. This module shows techniques for testing components with the aim of identifying problems.

Common Problems Encountered in VoIP Networks This module is about isolating some of the common issues that affect VoIP networks. The problem types cover audio quality, faxing, signaling, and registration. Here we show the effects of these problems, and how to isolate the root causes.

Advanced VoIP Troubleshooting Labs [OPTIONAL] This module includes lab exercises where participants gain real experience troubleshooting complex VoIP system problems. Exercises are based on real-world VoIP networks using systems from lots of different vendors.



Advanced Modules & Short-Courses Available

VoIP Systems Design:

Equipment, Networks, Security, Capacity, & Management

Overview of all of the considerations in building or upgrading VoIP carrier networks, including mapping services to systems, CPE selection, network transmission capacity planning (Mbps), switching capacity planning (PPS), security requirements, end-to-end product testing, billing, etc.

BroadWorks VoIP CPE Management

SIP Phones and IADs have complex software and configuration files. Manually configuring them is impractical and labor-intensive. We cover the BroadWorks IP Device Management system, and cover Configuration Management for PolyCom, Aastra, Linksys, and Cisco phones in detail. We also review distribute approaches, including the EdgeWater CPE management system.

Network Management: VoIP Security

VoIP networks are subject to attacks that were impossible on SS7 networks. We cover the key attacks and failure conditions. We show how un-protected networks are subject to attackers can interrupt service, steal confidentiality (such as recording phone calls), steal service, overload the system, retrieve customer data, etc. We include US Federal government requirements for Customer Proprietary Network Information (CPNI). And we show how to defend your network against VoIP network attacks.

Network Management: Monitoring and Fault Detection

VoIP Carrier networks are complex. Every network includes numerous vendors; monitoring and detection includes SNMP traps, monitoring, syslog monitoring, and other tools. How do you know what to monitor? How can you identify future problems before your customers do? This course covers effective techniques for taming the data feed to understand the health of the system and quickly identify problems.

VoIP Network Performance Analysis

VoIP Networks have stringent requirements -- far more rigorous than ISP networks. How do you keep your VoIP network in top performance? We cover Ethernet switches, Routers, TDM interfaces, Acme Packet SBC, SIP and MGCP performance. Participants learn to analyze packet queuing, congestion, drops, CPU issues, memory issues, and spurious SIP/MGCP signaling.

Unix for VoIP System Administrators

This module is focused on BroadWorks service providers. We introduce Unix basics, show how to move and manipulate files. We review the BroadWorks logs on the BroadSoft Application Server, Network Server, and Media Server to identify call problems, and assess system behavior. We study statistical measurements output by BroadWorks to understand system load issues.



Locations & Training Engineers

Training Locations: Raleigh, NC, Valdosta, GA, or YOUR Office

ECG offers classes at its corporate office in Valdosta, Georgia, Raleigh, North Carolina, or on-site at your location. Each student needs:

- Six (6) square feet of table-top space
- A laptop or desktop computer running Microsoft Windows, Mac OS X, or Linux. The student should have administrator-level access to the computer to install new software.

Training Equipment

ECG can provide equipment, or you can provide your own. The training lab requires the following for every team of three (3) students:

- One TDM router, (e.g., Cisco 1721), with T1 Interface,
- One Ethernet Switch, such as Cisco 3550-EMI or Cisco 2912
- One SIP Phone (Polycom, Cisco, Linksys, Aastra, etc.)
- T1 crossover cable, Quantity 1
- Straight-through Ethernet cable, Quantity 5
- Crossover Ethernet cable, Quantity 4
- Cisco console cable, Quantity 1

Training Engineers

All ECG training is taught by active, practicing Engineers.

- **Sherwin Crown, BS CS**, ECG Partner & Senior Network Engineer.
- **Mark Lindsey, MS CS**, ECG Partner & Senior Systems Engineer.
- **Russ Penar, BS CIS**, ECG Senior Network Engineer.
- **James Puckett, BS CS**, ECG President and CTO.

For more information or to schedule training, contact ECG:

- <http://www.e-c-group.com/>
- **+1-229-244-2099 OR US toll-free +1-866-324-0700**
- sales@e-c-group.com



**Training at
YOUR site on
YOUR schedule.**