

ECG Training

School of VoIP

Course Catalog



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About ECG

ECG is a leading Engineering and Operations Service Provider for VoIP Carriers and Internet Service Providers in the US, Canada, and the Caribbean. ECG has long experience building and operating Internet Service Providers, VoIP Carrier Networks, Major Enterprise Networks, and TDM/SS7 Telecommunications Networks.

Training Engineers

The secret of great training is simple: *all of ECGs 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.

School of VoIP

The *ECG School of VoIP* is an intensive, two-week program covering all the network fundamentals you need to know to operate and maintain VoIP networks.

- Learn how SIP calls are setup and controlled
- Control how IP packets routing in Ethernet and TDM networks
- Discover how SBCs work and how to exploit their features for your networks
- Configure TDM IP Routers, Ethernet Switches, and IP Phones

Week 1: IP Foundations for VoIP Carriers

"IP Foundations for VoIP Carriers" covers the fundamentals of High Performance, QoS-Guaranteed IP Networking for VoIP. We cover the nuts-and-bolts of how packets flow through networks. If you once learned the basics of basics of TDM, CDMA, GSM or Analog Signaling, you can now learn how IP Networks work.

The best way to learn Networking is to Do Networking! Get Hands On Experience configuring TDM IP Routers, Ethernet Networks, Subnets, Quality of Service, and Packet Captures.

Week 2: Advanced VoIP Engineering and Troubleshooting

"Advanced VoIP Engineering and Troubleshooting" covers VoIP call control with SIP and MGCP. We detail the way audio is encoded, compressed, and transferred using RTP. We detail the way Session Border Controllers (SBC) provide Security and enable VoIP over NAT Networks. Learn Key troubleshooting techniques for VoIP Carrier networks. Study High-Availability Systems like OSPF and HSRP.

Get Hands On practice configuring IP Phones, performing log analysis, building Fault-Tolerant Networks and troubleshooting.



IP Foundations for VoIP Carriers

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.

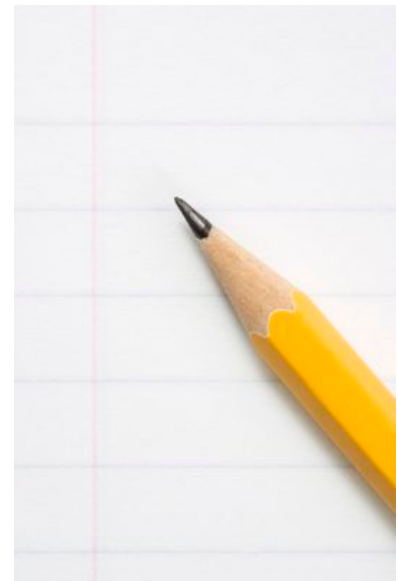
Course content

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 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.



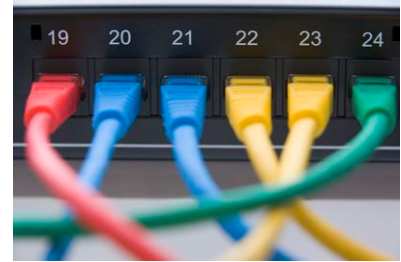
Transport Protocols -- TCP and UDP This module discusses the transport "middleware" used in IP networks, and how VoIP uses these systems. This module help participants understand fundamental operation of protocols in IP networks.

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

7th & 8th counter	Schedule Back	Expected Arrival	Actual Arrival Time	sig #
1	0.190	N/A	0.150	1
1, 2	0.210	0.170	0.170	2
	0.230	0.190	0.230	3
4	0.250	0.210	0.235	4
4, 5	0.270	0.230	0.230	5
5, 6	0.290	0.250	0.250	6
5, 6, 7	0.310	0.270	0.260	7
6, 7, 8	0.330	0.290	0.270	8
7, 8, 9	0.350	0.310	0.290	9
7, 8, 9, 10	0.370	0.330	0.300	10

Advanced VoIP Engineering and Troubleshooting

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

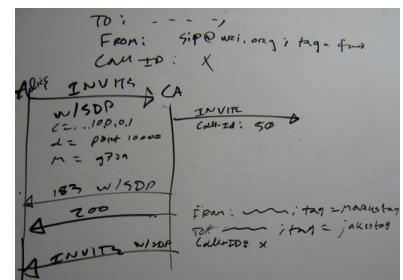
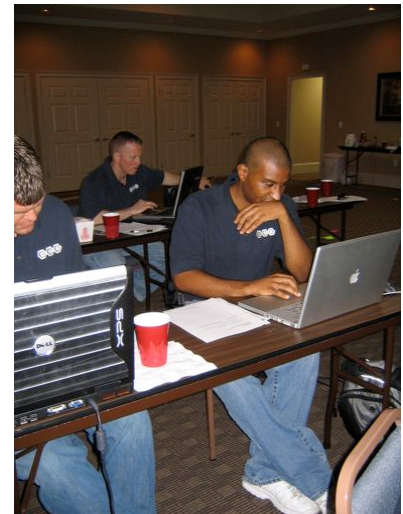
Ethernet VLANs Virtual LANs (VLANs) have become a standard part of Ethernet designs. Effective use can reduce equipment cost, and greatly improve reliability. Advanced VoIP deployment models require careful VLAN design and implementation. This module introduces VLANs, explains their use and configuration. 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 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 & MGCP Operation These modules provides a working understanding of SIP and MGCP processing, and introduce the key facts needed to understand and troubleshoot problems in SIP and MGCP networks. Coverage is given to the differences between the protocols. Participants have opportunities to read and troubleshoot call traces.

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.

IMS Overview

This module is an overview of IMS covering practical engineering aspects. How does IMS differ from standard Carrier VoIP? In what cases is IMS Compliance beneficial? This module cuts through the hype to identify the real business opportunities and technical realities for VoIP Services Providers.

VoIP over 3G/4G Wireless

Many wireless service providers offer wireless high-speed data services. As the network capacity and the Over-The-Air latency drops for 3G/4G data services, VoIP over 3G/4G is becoming a reality, and may displace conventional CDMA or GSM call control. This module covers the state of the industry for VoIP over 3G/4G, and explains a technical architecture to accomplish VoIP over 3G/4G.

VoIP CPE Management: Control, Inventory, Troubleshooting

SIP Phones and IADs have complex software and configuration files. Manually configuring them is impractical and labor-intensive. Effective CPE Management can make the difference between successful, reliable operation and unreliable, expensive services. This module describes the challenges of CPE Management, and describes effective technical approaches to managing CPE through centralized configuration. 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.

Advanced SIP for Engineers and Technicians

This module covers advanced SIP calling and feature scenarios, including:

- Call Transfers
- Busy Lamp Field
- Shared Line Appearance / Shared Call Appearance
- Message Waiting Indicator
- SIP over TCP
- SIPConnect
- Feature Key Synchronization
- N-Way Conference Calling



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. We cover SNMP polling and traps, syslog, and use Zenoss to introduce network monitoring. The information in this course can be applied to other systems such as HP OpenView and IBM Tivoli NetCool.

Acme Packet SBC 3000/4000/9000 principles: Peering and Hosted NAT Traversal

This is a high-speed boot camp for real world configuration and management on the Acme Packet SBC. We avoid theoretical issues and show time-tested, battle-proven techniques for Acme Packet SBC configuration. Participants in the course learn how to boot an SD from scratch, configure Hosted NAT Traversal (used for IP PBX / Centrex) and SIP Trunking / Peering.

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? This module shows how to analyze your network to identify performance problems. We cover Ethernet switches, Routers, TDM interfaces, Acme Packet SBC, SIP and MGCP performance. Participants learn to analyze packet queueing, congestion, drops, CPU issues, memory issues, and spurious SIP/MGCP signaling.

Unix & Log Analysis for VoIP BroadWorks System Administrators

This module is focused on BroadWorks service providers. We introduce Unix basics, show how to move and manipulate files. We also study 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.

VoIP Capacity Planning and Forecasting: Managing Standard Dialtone and Advanced Features

VoIP network capacity planning is complicated by the richness of features. A system that supports 20,000 basic residential users may only support 5,000 users with enhanced business features. To properly set prices for your features, you must understand the workload of each feature. How do you predict system capacity requirements? How do you know if your system is approaching overload? How do you engineer capacity for new subscribers when features like N-Way Conference Calling are used? We cover



Logistics & Training Engineers

Training Locations

ECG offers classes at its corporate office in Valdosta, Georgia, 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, such as 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

