

## The SSCA® SIP training program

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### Overview

The SIP School™ is 'the' place to learn all about the Session Initiation Protocol also known as SIP. There is so much information on the internet about SIP that is both hard to read and poorly presented making it difficult for people to learn about this most important protocol. So The SIP School™ with its lively, clear and fully animated eLearning program has become the only place you need to learn about SIP.

### Who would benefit from the SSCA® SIP training program?

Everyone...! This training is designed to suit anyone working with SIP such as: Manufacturers of IP PBX and IP Phone equipment, SIP Security equipment manufacturers, SIP Trunk service providers, Hosted providers, Carriers, Mobile Network Operators, Network Design specialists, Sales and Marketing personnel working with Voice and Video over IP equipment and services; all of these will benefit from this program.

### What's in the SSCA® SIP training program?

Once you've enrolled, you'll see 12 modules (with one optional one). You can work through the modules in order or simply choose the ones you are most interested in. The modules are listed here but for more detail, please look further into this document.

1. [Core SIP](#)
2. [Wireshark](#)
3. [SIP, the PSTN and SIP-T](#)
4. [SIP, VVoIP and QoS](#)
5. [SIP Security](#)
6. [Firewalls, NAT and Session Border Controllers](#)
7. [SIP Trunking](#)
8. [Testing, Troubleshooting and Interoperability](#)
9. [ENUM, DNS and Peering](#)
10. [SIP in the Cloud, LTE, the IMS and VoLTE](#)
11. [SIP and Fax over IP](#)
12. [SIP with Unified Communications](#)

'Recommended', optional module

13. [WAN Broadband Assessment for SIP trunking](#)

### How long will it take to work through?

Running times for this program are **approximate** as the time will vary based on the student's own experience and of course, how much time they want to spend on the material and if they want to replay some modules.

**NOTE:** Timings do not include the optional 13<sup>th</sup> WAN assessment module or additional Skype for Business material and labs.

- The time it takes to 'Play' all of the slides and Videos = **11hours 47mins**
- The TOTAL time **will** be more than this and dependent on factors such as slides being replayed, note taking, working on Labs, also doing some extra work with the Software tools provided for the labs which we believe is a great idea as it increases student skills
- Extra study time for the SSCA® and the taking of the SSCA® final test itself will also be extra.

Continues on next page....

**Is there a Pre-requisite to this program?**

This program assumes the student has a 'good' understanding of Data networking technologies along with the 'basics' of Voice and Video over IP. This could be gained through long term working experience, other certifications such as Cisco's CCENT/CCNA/CCNP, even The SIP School's own 'Networking for VVoIP program' also available via the website. Please check carefully as having the skills required will make the SIP learning experience a more fruitful one.

**Become a 'SIP School Certified Associate' or [SSCA®](#)**

You can gain access to the certification test *separately* or with a 'bundle' license – check license 'purchase' options carefully.

The [SSCA®](#) certification is recognized in the Telecommunications world as the only certification on SIP to strive for 'Globally'. It is endorsed and supported by the TIA (Telecoms Industry Association), USTelecom, Incompas, the ITSPA along with BICSI and a rapidly growing number of Manufacturers, Service providers, Carriers and Mobile Network Operators

To prepare for the certification test, each SIP training module has its own 'mini' quiz at the end to help delegates '*gauge*' how well they are doing.

**NOTE:** An access license for any training course and certification test is for 12 months from the date of purchase.

# Core SIP

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## Module times

- Running time = 84 minutes
- Quizzes = 7 minutes
- Total = 91 minutes

SIP (The Session Initiation Protocol) is described in this module along with the many other Components and Services that will be encountered on a SIP based network

## Topics:

### SIP – Who Benefits

- Why SIP?
- What is SIP?
- SIP 'from the RFC'
- What are 'Requests for Comments' – RFCs?
- More than just 3261
- **New RFCs**
- **IETF Working groups**
- Based on HTTP
- Where does SIP fit in?
- SIP Clients and Servers
- SIP User Agents
- Simple Call Session Setup
- SIP System Architecture
- The URI - Unique Resource Identifier
- SIP Addressing
- SIP Addressing Examples

### SIP Servers and Operation

- Registration
- Re-Registration
- SIP Proxy servers and why we need them
- Proxy Server 'State' types
- DHCP and SIP
- SIP Proxy – Trapezoid Model
- SIP Server – Proxy Mode
- SIP Server – Re-Direct Mode
- Location Services
- SIP Server in Proxy Mode
- SIP Server in Proxy Redirect Mode
- Stateful and Stateless Proxies
- Location Server
- Location Server – Components
- Location Server – Information Sources
- Location Server – Example

### SIP Client Configuration

- Configuration scenarios
- Some basic elements needed to configure a client

### SIP Messaging

- Request Methods
- Response Codes
- SIP Headers
- INVITE – Example
- RESPONSE (200 OK) – Example
- More on Headers
- Support and Require Headers
  - Timer (Session Times)
  - 100rel (PRACK)
- Short form 'compact' Headers

### SDP – the Session Description Protocol

- SDP – The Session Description Protocol
- SDP in a SIP Message
- An SDP Example
- Extending SDP
- Multiple 'm' lines
- Changing Session Parameters
- SDP Example - Put a call on Hold

- SDP Example - Call Hold Trace
- Call Hold – Old and New Methods
- Music on Hold example
- INVITE and reINVITE

#### **SIP Mobility**

- SIP Mobility
- SIP Call Forking - Parallel
- SIP Call Forking - Sequential
- Call legs, dialogs and Call IDs
- Dialog trace example
- Dialogs and Transactions
- Branch Ids
- Call Forward to Voicemail
- Call Forward - No Answer
- **Replaces header**
- **Diversion headers**

#### **More on Proxies and SIP Routing**

- Stateless Proxy
- Stateful Proxy
- More Proxy information
- VIA and Record Route
- VIA Details
- Record-Route Defined
- Record Route Example
- Loose and Strict Routing
- Session Policies

#### **MIME**

- MIME
- Multiple MIME parts

#### **SIP and the PSTN**

- SIP and the PSTN
- SIP to PSTN Detail
- SIP to PSTN Call Flow
- SIP Codes and the PSTN

#### **SIP and B2BUA**

- B2BUA - Back to Back User Agent
- B2BUA Example
- B2BUA Benefits and Features

#### **SIP 'Call Process' Summary**

- The Call Process

# Wireshark

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## Module times

- Running time = 40 minutes
- Quizzes = 1 minutes
- Lab – ‘Various’ ~ approx. 80 minutes
  - *Labs equate to exercises suggested within the module*
- Total = 121 minutes

This module on Wireshark is an introduction and is intended to get students setup quickly so that they can capture traffic to analyze during the Core module and the rest of the course. More advanced Wireshark training can be found in the Troubleshooting, Testing and Interoperability module of this course.

**Note:** If the student wishes to take more time over the module – this could run to a few hours of learning. It’s completely dependent on the students desire to learn Wireshark

## Topics:

### Wireshark

- What is Wireshark?
- Initial Setup
- Free SIP Account options
- Free @thesipschool.com SIP account / address
- Desktop clients
  - Jitsi client for testing
  - Blink client for testing
  - X-lite client for testing
  - PhonerLite client for testing
- **Mobile clients**
  - **Media5 for testing**
  - **Linphone for testing**
  - **WeePhone SIP for testing**
- Social Study directory
- **Free DID and Credit**
- SIP test numbers
- Download Wireshark
- **Wireshark**
  - **Introduction**
  - **Menus, Screens and Views**
  - **Capturing traffic**
  - **Profiles**
  - **Display Filters**
  - **Capture Filters**
  - **SIP Packet Analysis**
  - **SIP ladders and Audio Playback**
  - **Other Menu options**
  - **SIP INVITE Analysis**
  - **Follow a UDP Stream**
  - **Frame Relationships**
  - **Colouring Rules**
  - **RTP Streams**
- View Captures in the ‘Cloud’
- LAB Exercises
- What are the codes?

# SIP, the PSTN and SIP-T

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## Module times

- Running time = 26 minutes
- Quizzes = 7 minutes
- Total = 33 minutes

SIP Networks will of course have to allow connections to and from the PSTN. This module works through SIP and PSTN connectivity

## Topics:

### **SIP-T and the PSTN**

- SIP to PSTN Overview
- SIP to PSTN Call Flow
- SIP to PSTN Detail
- PSTN to SIP Call Flow
- SIP to PSTN Call Failure
- SIP to PSTN Call trace

### **Early Media**

- Early Media - SIP to PSTN Call

### **Early Offer and Delayed Offer**

- Early Offer / Delayed Offer

### **Gateways**

- Default Gateway?
- Gateway Location and Routing with TRIP
- TRIP Examples

### **SIP-T and PSTN Bridging**

- SIP-T and SIP-I
- SS7, ISDN and SIP
- ISUP and SIP Messages
- ISDN User Part (ISUP) to SIP Codes
- PSTN to PSTN via SIP
- ISUP Encapsulation
- ISUP Encapsulation / SDP
- Addressing Notes

### **SIP and DTMF**

- DTMF - Quick Re-Cap
- What is DTMF?
- DTMF Transport methods
- DTMF 'Inband'
- RFC 2833 'Trace' example
- RFC 4733 replaces 2833
- RFC 4734
- **SIP INFO 6086**
- RFC 2833 'Trace' example
- SIP INFO 'Trace' example

# **SIP, VVoIP and QoS + access to the 'Optional' Wan assessment module**

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## Module times

- Running time = 81 minutes
- Quizzes = 7 minutes
- Lab – 'Various' ~ approx. 10 minutes
  - *Labs equate to exercises suggested within the module*
- Total = 98 minutes

This module starts as a 'refresher' module on the basics of Voice over IP before digging deeper. It then moves on to cover Video over IP and throughout the module there is a big focus on the components and (good) QoS practices that are important to a SIP based Network.

Access to a 'LIVE' WAN Broadband assessment module is available also here.

## Topics:

### **What is VoIP or Voice over IP?**

- What is VoIP?
- What is Voice over IP?
- VoIP – 'A Basic Call'
- VoIP and TCP / UDP
- VoIP over the Internet
- Branch to Branch VoIP
- Signaling paths
- Speech paths
- IP PBX

### **Voice Sampling and Codec**

- Encoding
- Codecs for Voice
- Try the Codec Test
- High Definition (HD) Voice
- Sound tests
- Wideband (HD) codecs
- **Opus codec**
- **Opus audio examples**
- **Codec choices and MOS – Mean Opinion scores**
- **Packet Rate / Packets per second**

### **The Real Time Protocol or RTP**

- RTP Intro
- RTP Encapsulation
- RTP Header Trace
- Real Time Control Protocol (RTCP)
- RTCP-XR (Extended Reports)
- RTP / RTCP and UDP Ports

### **Quality of Service**

- QoS described
- QoS Issues
- Measuring Delay
- Jitter and Packet Loss
- General VoIP Acceptance Criteria
- QoS across all Networks
- 802.1Q – VLANs
- 802.1Q/P Tagging
- 802.1P - L2 Classification
- TOS and DiffServe
- Layer 3 Classification
- **DSCP with Assured forwarding (AF)**
- **Bandwidth decisions**
- **Link options – Symmetric DSL (SDSL)**
- **Bandwidth (kbps) vs. Packet per Second (pps)**
- **Network Behavior Analysis**
- **Issues that can affect QoS**
- **QoS Summary**
- Testing your link

'OPTIONAL' Module – Refer to [WAN Broadband Assessment for SIP trunking](#)

**SIP, SDP and VoIP**

- SIP in the TCP/IP Model
- SIP and SDP Messages (e.g. Invite and 200OK)
- SIP and SDP Codec mapping

**Video over IP**

- **What is Video over IP?**
- **Streaming Voice and Video – 1 Way Transmission**
- **Two-way Conferencing with RTP**
- **Codec and Bandwidth Considerations**
- **Video bitrate Calculator**
- **Setting Video Codecs on Devices**
- **Audio and Video in the SDP body**

**Assured SIP Services**

- Assured SIP intro
- Service Provider Architecture
- Proxy and Access Router functions
- Resource-Priority
- Video 'example'
- Reason Header for Pre-emption Events
- More Proxy details
- Multi-Level Pre-emption and Precedence (MLPP)
- Summary



# SIP Security

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## Module times

- Running time = 41 minutes
- Quizzes = 7 minutes
- Lab – ‘Various’ ~ approx. 120 minutes
  - *Labs equate to exercises suggested within the module*
- Total = 168 minutes

SIP **Security** and ‘privacy’ are complex issues and this module covers many SIP Security problems along with possible solutions

## Topics:

### Authentication and Authorization

- SIP Proxy Authentication
- 401 and 407 Authorization
- SIP Authorization
- PROXY Authentication
- SSL with MD5 Cracked!
- MD5 v SHA

### Encryption

- Why Encrypt SIP?
- Certificates and HTTPS
- Certificate Authorities
- Certificate Example
- Self-Signed Certificates
- Format type
- Securing SIP and VoIP
- SSL and TLS
- SIP and TLS
- TLS Thoughts
- TLS and SIP in Action
- SIPS and SIP Addressing
- Secure RTP (SRTP)
- Setting SRTP on SIP Devices
- Secure RTP (SRTP) - Example
- SRTP and SRTCP
- sdes and the Crypto attribute
- Crypto attribute example
- **SRTP Call example ‘showing’ Crypto**
- **SRTP with ZRTP**
- RFC 4474 for Caller Identity
- Caller Identity
- DTLS/SRTP
- **Ongoing developments for Identity**
- S/MIME and SIP
- MIME and ISUP
- SIP Trunking and Security
- Enhancing SIP Trunk Security

### Attacks and Responses

- Types of Attack on a VoIP/SIP Network
- FBI network examples
- Responses and Protection
- Response Identity – A Problem!
- Rogue SIP Proxy
- Phishing and SIP exploit
- More Examples RFC 4475
- Try for yourself with ‘example’ software tools

### NIST Recommendations

- NIST Recommendations on securing VoIP

# Firewalls, NAT and Session Border Controllers

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## Module times

- Running time = 62 minutes
- Quizzes = 7 minutes
- Total = 69 minutes

Inevitably, all IP traffic traverses a Firewall / NAT device and in the case of SIP these devices can stop the flow of SIP messages. This module looks at the problems and the solutions including a focus on Session Border Controllers.

## Topics:

### Overview

- Issues to address

### Firewalls

- What does a Firewall do?
- Are Firewalls effective?

### NAT or Network Address Translation

- What is NAT?
- NAT Request
- NAT Response
- UDP Hole punching
- Hairpinning
- Multiple NATs
- The NAT Problem

### Types of NAT

- Types of NAT
- NAT – Full Cone
- NAT – Restricted Cone
- NAT – Port Restricted Cone
- NAT – Symmetric
- The NAT or (PAT) Problem
- Problems with NAT, Firewalls and SIP
- **BEHAVE**

### The Solutions

- STUN (Session Traversal Utilities for NAT)
- STUN and rport
- Problems with 'Classic' STUN
- TURN (Traversal Using Relays around NAT)
- STUN RFC 5389
- Interactive Connectivity Establishment (ICE)
- ICE 'In Theory'
- Candidate information and other 'ICE stuff'.
- ICE 'In practice'
- ICE tags
- **ICE-Lite and Trickle-ICE**
- ICE Client settings
- More on ICE
- Universal Plug and Play (UPnP)
- 'Near end' NAT
- 'Far end' NAT
- **GRUU (Globally Routable User Agent)**

### The RTP Problem

- The Firewall Problem
- Solving the RTP Problem
- Symmetric RTP
- Media Proxy
- Application Level Gateway
- SIP Aware Firewalls - Incoming
- SIP Aware Firewalls - Outgoing

### Session Border Controllers

- SBC for the Enterprise and SBC for the ITSP
- Recommended Session Border Controller features
- SBCs in Action!
- SBCs and message manipulation / normalization

- SIP 'Refer' problems
- SBC 'Interop' example
- SBC Manufacturers - examples
- **From SIP to WebRTC (and back)**

# SIP Trunking + 'optional' Skype for Business access

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## Module times

- Running time = 70 minutes (not counting the 'optional' Skype material)
- Quizzes = 7 minutes
- Lab – 'Setting up SIP Trunks' ~ approx. 120 minutes
  - *Labs equate to exercises suggested within the module and also if student has access to a SIP server.*
- Total = 197 minutes
  
- **NOTE:** Total including the 'optional' Skype material is approx. 212 minutes

This module teaches the theory of connecting a SIP based PBX into an ITSPs own network and also focuses on Network technologies, Security, Troubleshooting as well as offering advice on how to select an ITSP for your company or clients.

## Topics:

### SIP Trunks

- What is a SIP Trunk
- Alternative to TDM
- Separate Data and Voice connections
- Converging the network
- SIP Trunks and Codecs
- SIP Trunk Benefits

### SIP Trunking – In More Depth

- SIP Trunk Capabilities
- SIP Trunking Network Examples
- SIP Peering
- Peering problems?
- Least Cost routing (LCR)
- Disaster Recovery
- Disaster Recovery 'Expanded detail'
- Disaster Recovery – Last resort?
- Number Consolidation
- Virtual Presences

### Trunking Variations

- Single Site, No 'Forklift'
- Single Site, TDM PBX
- Single Site, Converged
- Converged – SIP/IP PBX
- Multiple Site, 'Converged'
- Multiple Site, 'Converged' + central SBC
- **Multiple Site, 'Converged' + Multiple SBCs**

### Media Gateways

- SIP PBX to Non-SIP PBX
- SIP PBX to Non-SIP PBX, Call Flow

### SIP Trunk Performance

- Connection types
- The ADSL issue
- Codecs, Voice and Data
- Symmetric DSL (SDSL)
- Bandwidth Calculator
- Testing your link
- ADSL Developments
- Fibre Options

### SIP Trunking, MPLS and SD-WAN

- MPLS, basic explanation
- MPLS Label format
- MPLS in a MAC frame
- MPLS example network
- MPLS benefits
- Your own private WAN
- but 'Not the only client'
- Separate MPLS networks
- VPLS explained

- **WAN Optimization, Hybrids and SD-WAN**
- **Software Defined WANs explained**

### **Security and SIP Trunking**

- SIP Trunk Security - Overview
- Session Border Controllers

### **More on SBCs**

- The 'corporate' SBC
- SIP REFER issues

### **Setting up a SIP Trunk**

- Add a VoIP Provider
- Provider SIP Servers
- Authentication
- Add a Dialling Rule
- Trunk setup complete
- Call out Trace
- Comparing SIP packets from two ITSP providers
- Skype for Business and SIP trunks

#### ***'Optional' Lab exercises***

- ***Skype for Business 'Network Environment'***
- ***Topology Builder***
- ***Control Panel***
- ***Management Shell and basic commands***
- ***Installing Skype for Business Client***
- ***Making Calls***
- ***Using Wireshark to monitor calls from a Skype network environment to the PSTN across a SIP trunk***

### **Some PBX Requirements**

- Enterprise PSTN Identities
- P-Preferred and P-Asserted
- Call Progress Tones

### **Troubleshooting and Interops**

- SIP Trunks and Common Problems
- The SIP Forum
- SIPits
- SIPit Results
- SIP Connect
- SIP Connect 1.1 onto 2.0

### **Choosing an ITSP**

- Understanding ITSP Offerings
- 'Sticking points'?
- What you may need in the future
- **SIP trunk 'connectivity'**
  - **Things to watch out for when connecting to your ITSP**
- **'Finding' an ITSP**
- SIP trunking Checklist for ITSP evaluation

### **Working together**

- **SIP trunk connectivity items 'from the field'**

# Testing, Troubleshooting and Interoperability

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## Module times

- Running time = 54 minutes
- Quizzes = 7 minutes
- Lab – ‘Various’ ~ approx. 240 minutes
  - *Labs equate to exercises suggested within the module*
- Total = 295 minutes

Learn how to Monitor and Test SIP devices and services using Wireshark. This tool enables delegates to analyze call control messages to establish where a fault may lie in a SIP infrastructure. Full examples are provided and delegates are encouraged to follow the exercises to try for themselves.

## Setting up your test environment

- **Your Setup**
- **Using SIP IP Phones and Softphones**
- **Jitsi, Blink, X-Lite and PhonerLite setup – reminder.**
- **Linphone, Media 5 and WeePhone SIP setup - reminder**
- **Choosing a ‘Trial/Test’ ITSP**
- Get ‘another’ SIP account
- SIP2SIP account
- Configure Blink and Jitsi on the same PC for testing
- Using ‘Test Numbers’

## Wireshark

- **Where to ‘capture’**
- **More options for Packet Capturing**
- **Wireshark ‘Revisited’**
- **Colours and the Intelligent Scrollbar**
- **Packet ‘Marking’ and ‘Comments’**
- **New Packet Window**
- **Exporting ‘Specified’ Frames**
- **RTP Streams**
- **TShark (Terminal-based Wireshark)**
- **PCAP-ng and PCAP formats**
- Alternatives to Wireshark
- You try!

## Interoperability Testing

- Interop Testing and why Interop can be tough
- Different interpretations in the RFC 3261
- Interop Test Scenario
- Interop Test Operations
- Sample Interop Traces with Wireshark
- Wireshark example videos to help understand interop issues
- More Sample captures
- Video call testing
- Video tests with Wireshark trace analysis
- ‘Basic’ Interop Test List
- SIPIT events

## Common SIP problems

- Will it ever work?
- Where can you start checking?
- What else can you do?
- Common SIP/VoIP Problems
- Troubleshooting SIP Trunks
- 4xx — Client Failure Responses
- 5xx — Server Failure Responses
- 6xx — Global Failure Responses

## More SIP Testing Tools

- SIP Workbench
- SIP Scan
- Visualware for testing
- HoverIP
- NSLookup
- Voip-info for more tools!
- Using the NET to find answers
- Other SIP Resources

# ENUM, DNS and Peering

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## Module times

- Running time = 43 minutes
- Quizzes = 7 minutes
- Lab – ‘Registering / Testing ENUM’ approx. 20 minutes
  - *Labs equate to exercises suggested within the module*
- Total = 70 minutes

**ENUM** (along with **DNS**) is developing into an essential protocol on SIP networks and its purpose is to assist in finding destination SIP devices from a single SIP address. Peering is also talked about as more and more services providers are ‘connecting’ to allow a full IP to IP experience.

## Topics:

### ENUM Explained

- What is E.164?
- What is ENUM?
- **Why ENUM?**
- Call Routing and ENUM - Example

### Enum, DNS and Domains

- Why are we using DNS?
- DNS Operation
- DNS Root Server ‘Mirrors’
- ‘Finding’ Domain name servers using NSLookup
- The e164.arpa Domain
- Approved ENUM Delegations (RIPE)
- TIERS 0, 1, 2 and 3
- e164.arpa Domain ‘in action’
- ENUM Delegations
- Address of Record
- PSTN to SIP UA – Example
- The ENUM Query
- DNS Response to an ENUM query
- PSTN to SIP UA – Example (2)
- NAPTR Query – a different view
- Finding SIP servers using the tool - DIG
- IP to PSTN (Simplified)
- RFC 6140

### Types of ENUM

- **Different ‘Types’ of ENUM**
- The Problems with ‘Public’ ENUM
- Example – ‘Private’ ENUM
- **‘Carrier’ ENUM and e164enum.net**

### Peering for VoIP and Video

- Stay ‘On-Net’
- From ITSP to PSTN and Back...!
- Loss of features with the PSTN
- Peering Profiles and Agreements
- Bi-lateral Peering
- **Multi-lateral Peering**
- **Back to ENUM**
- **A complete ‘infrastructure’**

### ViPR

- Verification Involving PSTN Reachability (ViPR).
- What is ViPR
- ViPR and P2P
- Initial PSTN Call
- ViPR Call Record
- Query the DHT
- DHT query and Validation
- The Next call is a SIP Call
- ViPR Summary

### Try for yourself

- Register your number
- Testing ENUM
- DIG and NAPTR records



# SIP in the Cloud, LTE, the IMS and VoLTE

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## Module times

- Running time = 53 minutes
- Quizzes = 7 minutes
- Total = 60 minutes

SIP is becoming critical to phones and servers involved in a hosted setup. SIP is also critical when used by VoLTE calls in order to make voice sound great on a mobile device. This module aims to make students aware of SIPs role in all of these environments.

## Hosted SIP

- What Hosted SIP service is
- Hosted functions and features
- Example Network including 'failover'
- 'Hosted' clients in action
- Why Hosted – Benefits and things to consider
- Why on-site PBX – Benefits and things to consider

## Auto Provisioning

- Auto Provisioning Example
- Boot Server
- Client Config
- Client boot sequence
- Client config download
- RFC 6011
- Benefits of Hosted SIP Service
- Benefits of Onsite PBX and SIP trunks

## SIP, LTE, the IMS and VoLTE

- Network Overview
- RAN, eNodeB, EPC, IP Core and 3GPP
- 4G, LTE, LTE Advanced, WiMAX2
- The RAN and EPC
- Default Bearer Setup
- Introduction to the Servers and Functions in the IMS
  - CSCF
  - S-CSCF
  - P-CSCF
  - I-CSCF
  - Home Subscriber Server HSS
  - Application Server
  - TAS
  - PSCF
  - DNS and ENUM
- Device Registration (with SIP)
- SIP Registration packet example
- SIP in the IMS – Call Flow explained
- Introduction to VoLTE and the threat of OTT services
- Making VoLTE work
  - SIP Preconditions in Action
  - With Codec examples within SDP
- SIP Call flow for VoLTE
- Quality settings 'recap'
- VoLTE media flow
- More on VoLTE
- The IMS
- Layers architecture
  - Application
  - IMS / Session Control
  - Access and Transport
  - 3GPP
- Multiple access devices
  - RCS and OTT
- Who provides IMS solutions?
- IPX and Peering for Security, QoS and SLAs
- GSMA and IR.92
- HD Voice News

# SIP and Fax over IP

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## Module times

- Running time = 33 minutes
- Quizzes = 7 minutes
- Total = 40 minutes

A lot of companies are now trying to run Fax services across SIP trunks and finding it's not an easy service to get working successfully. This module intends to describe the various flavors of Fax over IP along with what should be focused on in order to troubleshoot any issues.

## Topics Include

### Faxing Basics

- Faxing background
- T.30 Fax signaling
- Associated tones and protocols
- The ITU and TIA standards

### Fax over IP

- Fax over IP benefits
- From the old to the new
- Intro to FoIP
- FoIP and SIP trunks
- Protocol conversions

### Fax Protocols

- G.711 Pass-through
- T.37 Store and Forward
- T.38 Relay
- Where does SIP fit in?
- UDPTL
- Protocol options for the future

### FoIP in action

- SIP in FoIP – Call Flow
- SIP INVITE
- INVITE for T.38
- The INVITE SDP body
- Wireshark FoIP example
- SIP T.38 Call flows – IETF draft document

### Bandwidth

- T.38 and G.711 network traffic

### Troubleshooting

- The basics
- More complex issues to watch out for

### Ongoing Efforts

- RFC 6913 and sip.fax tag
- Use DTMF events instead?

# SIP and Unified Communications

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## Module times

- Running time = 42 minutes
- Quizzes = 7 minutes
- Total = 49 minutes

SIP and Unified Communications shows you how SIP underpins all the elements of Unified Communications to realize efficiencies that a successful implementation promises to business.

**Note: Recent updates are in Blue**

## Topics Include

### Communication Breakdown

- Playing Voicemail tag
- Can't find people
- Available but not Available..!
- More Examples of communication problems

### IM Clients

- **IM Client Examples and Features**
- **More in IM Clients**

### The Background Stuff

- The IMPP working group
- IMPP and CPP
- More IMPP work
- SIMPLE

### How it all works

- Presentity
- A Basic SIP subscription
- Multiple Presence States
- Presence and P2P
- A Presence Network
- Getting inside the SIP packets
- Presentity and more!
- A Basic SIP Subscription
- Multiple Presence States
- Presence and P2P
- A Presence Network
- Get inside the SIP packets
- The Packet Structure
- PIDF Message Body
- XML
- Tuples
- Example Presence doc with Tuples (using a Mobile Phone)
- **The METHODS in Action**
- **PUBLISH**
- **SUBSCRIBE**
- **NOTIFY**
- **MESSAGE**
- **is-composing**
- **Rich Presence**
- 2 Places at the same time

### 'Presence' Federations

- What is Federation?
- Multiple Presence sources
- Super-Aggregation
- Inter-Domain Federation

### Conferencing

- What SIP does in Conferencing
- INITIATE a conference
- JOIN a conference
- LEAVE / EXIT a conference
- INVITE other participants
- REFER conference server to invite or others to join
- EXPEL participants
- CONFIGURE the media stream

- CONTROL a conference
- Why SIP?
- Centralized conferencing
- Centralized Signaling
- Centralized Mixing (optional)
- Centralized Authentication
- B2BUA (Discussed in core module)
- Conference Components
- The Focus
- More than one Focus
- **Creating a Conference**
- **Creating a Conference: Details**
- **Adding a participant**
- **Adding a participant: Details**
- Alternative INVITE with REFER
- IETF work and Conferencing

#### **Unified Communications**

- What's all the fuss?
- Unified Confusion
- **What is Unified Communications?**
- **From UC to UCaaS**
- Components involved
- What should UC do?
- 21<sup>st</sup> Century Dial tone
- The Unified inbox
- Unified aware applications
- Find me – Follow me
- Device awareness
- Unified Comms for Business
- Do your Homework
- Humans and UC
- **Migrating to UCaaS**
- **UCaaS, SIP and the WAN**

# WAN Broadband Assessment for SIP Trunking 'Optional'

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## Module times

- Running time = 54 minutes
- Quizzes = 7 minutes
- Total = 61 minutes

This is a free 'optional' module that has been provided to allow students of The SIP School to get some 'real' experience of working with a SIP trunk configuration in order to test if it can cope with the demands that is required of it by a business. Although it is 'optional' it really does compliment and re-enforce what has been learned in other modules of this course. It is NOT part of the SSCA® certification test, hence it's 'optional' status.

## Topics:

### Planning Steps

- Servers and Operation
- Do you have BYOB or OTT?
- Your ISP and ITSP – do they support QoS?
- What is a good time to run assessment tests
- Assess the components and configuration of your WAN
- Set up the WAN assessment network

### The Assessment System

- Logging onto the Assessment system
- VoIP Assessment items
  - SIP Call flows
  - Call Metrics
  - Jitter
  - Lost Packets
  - MOS estimates
  - Traffic Flows
  - Reporting
- Starting a test
  - Test types
  - Codec selection
  - Number of trunks
  - Number of calls
  - Assessment period
  - Traceroute test?
  - ToS and QoS requirements
- Analyzing a test
  - Call Metrics
    - Lost Packets
    - Jitter
    - Types of traffic flow i.e. UDP / TCP, Real Time etc.
    - MOS results
- Generating Reports
- Analyzing Reports
  - Analyzing MOS
  - Analyzing Jitter / Delay / Packet Loss
  - Router RTT responses
  - How to spot problems in the network from the report
- Advice on how to configure a WAN network