Tektronix Communications' Spectra2 Total Test Solution for Next Generation (NGN) and Legacy Telecom Networks

Today's telecom networks are experiencing the convergence between legacy and emerging technologies. While legacy networks (PSTN/SS7, ISDN, VoIP, and Wireless 2G/3G) continue to offer telecom services, emerging technologies provide opportunities for new value-added services. The challenge for manufacturers and carriers alike is how to validate these NGN solutions for conformance, performance, and interoperability while maintaining a high level of quality with the legacy networks.

This document has been designed to provide you an overview of NGN functional elements, protocols, and media along with a catalog of how Spectra2's Total Test Solution helps you deliver on the promise of the NGN.

Tektronix® Communications

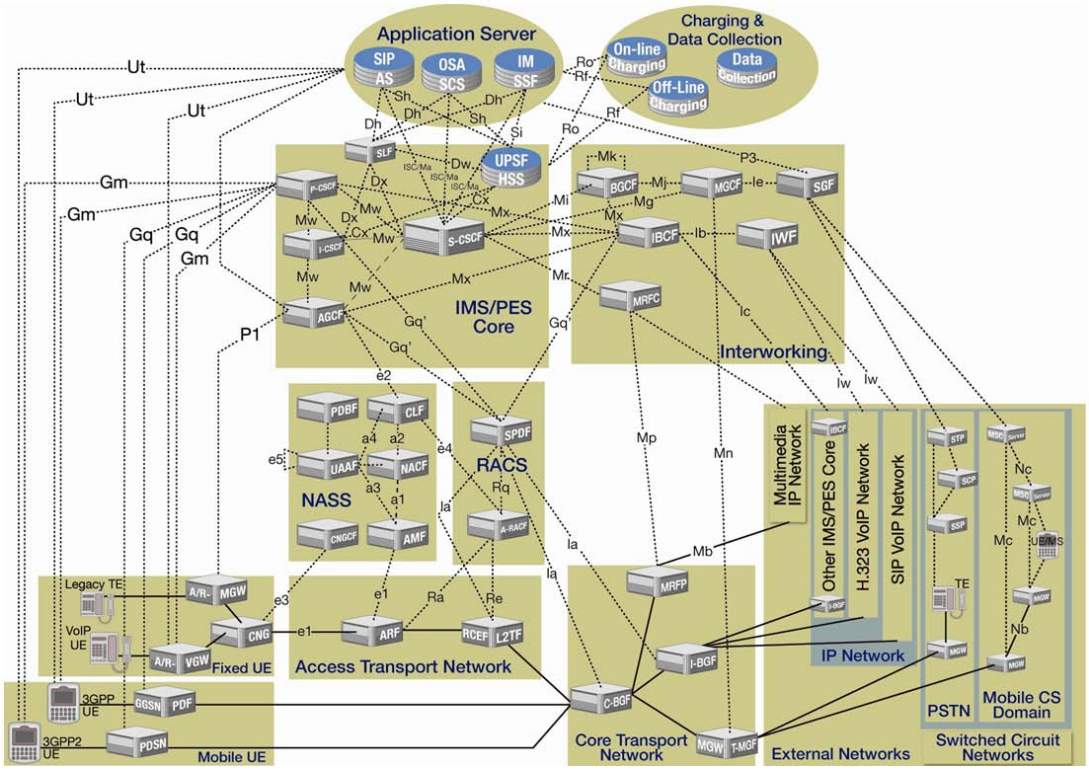
Telecom Technologies Highlights

ITU Next Generation Networking (NGN) architecture, IP Multimedia Subsystem (IMS) and Telecommunications & Internet converged Services & Protocols for Advanced Networking (TISPAN) are emerging technologies that offer real-time multimedia service on an open infrastructure for mobile and fixed network users. IMS was initially introduced by the wireless standard body 3GPP with the aim of delivering real-time services to UMTS, TD-SCDMA, and GPRS mobile users. IMS was also adopted by other standard bodies, including 3GPP2 for cdma2000 and ETSI TISPAN for PSTN and ISDN networks.

The ETSI TISPAN flavor of IMS is called PES (PSTN/ ISDN Emulation Subsystem).This open infrastructure makes IMS/TISPAN PES the “core” of the NGN. Wireline networks (PSTN, ISDN, VoIP, cable and xDSL) and wireless networks (UMTS, TD-SCDMA, GPRS, cdma2000, and WiMAX) are the access networks that anchor into the IMS/TISPAN core, offering seamless communication coverage for Fixed Mobile Convergence (FMC).

a1	DHCP	Gq’	Diameter	Mr	SIP
a2	Diameter/Radius	Ia	H.248	Mw	SIP
a3	Diameter/Radius	Ib	SIP	Mx	SIP
a4	Diameter/Radius	Ic	SIP	Nb	Nb-UP over RTP
Cx	Diameter	Ie	SIGTRAN	Nc	BICC/SIP-T/SIP-I
Dh	Diameter	ISC	SIP	P1	H.248
Di	Diameter	Iw	SIP/H.323	P3	TCAP Based
Ds	RTP	Ma	SIP	Ra	Not Defined
Dx	Diameter	Mb	RTP	Re	Not Defined
e1	PPPoE DHCP	Mc	H.248	Rf	Diameter
e2	Diameter/Radius	Mg	SIP	Ro	Diameter
e3	HTTP/FTP/TFTP	Mi	SIP	Rq	Diameter
e4	Diameter	Mj	SIP	Sh	Diameter
e5	Diameter/Radius	Mk	SIP	Si	MAP
Gm	SIP	Mn	H.248	Ut	XCAP
Gq	Diameter	Mp	H.248		

Protocol by Interface



NGN Architecture brings Fixed Mobile Convergence

Telecom Network Testing

The coexistence of legacy and emerging networks along with the convergence between fixed and mobile networks creates challenging conditions for telecom networks:

- Multiple standard bodies with unique requirements and specifications
- Immature emerging technology specifications with endless updates and extensions
- Access independence requires interworking between different networks
- Architecture independence creates proprietary specifications and interoperability challenges
- User independence requires advanced authentication, authorization, and security
- Service independence involves coordination between carriers and service providers

To rise above these challenges, NEMs must verify and validate the development of their products, and carriers must test and monitor deployed networks using the following key testing areas.

- Functional Testing: Does each element of the network provide advertised functionality, and do services have end to end integrity?
- Conformance Testing: Does the network comply with standards and proprietary specifications?
- Load and Stress Testing: Can the individual components in the network perform under heavy traffic for long duration?
- Interoperability Testing: Can the network elements communicate with other elements without error?
- Quality of Service (QoS) Measurement: Does the media quality meet the Service Level Agreement?
- Monitoring: How is the network performing? Can it be optimized for better performance?

Spectra2 is the answer to meet the challenges!

Technology Overview

1. IMS/TISPAN Network Architecture

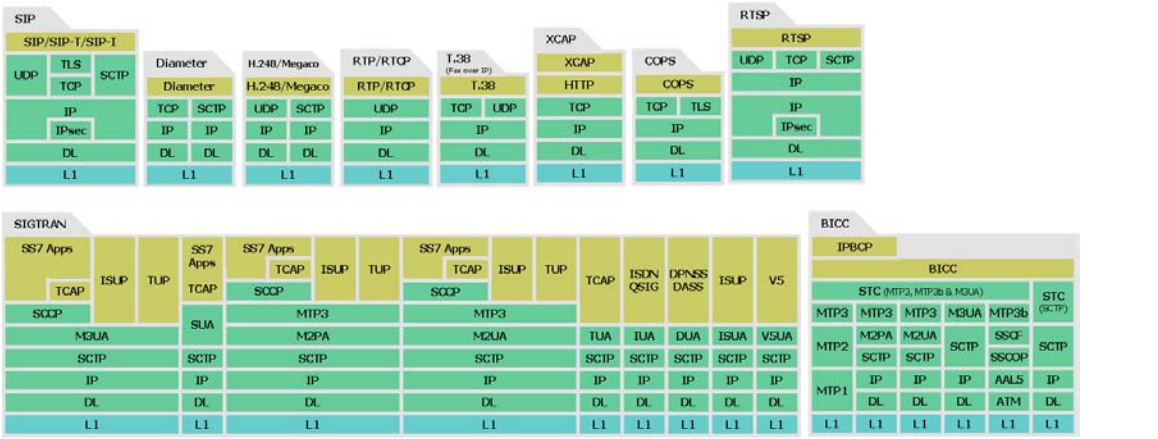
The IMS/TISPAN PES network architecture includes four main network components:

1) IMS Core and TISPAN PES Core
2) Application Servers
3) Interworking Components
4) Access Networks

IMS/TISPAN Protocols

The following lists the most common IMS/TISPAN protocols used in today's technology:

- **SIP (Session Initiation Protocol)**: an application layer text-based protocol for creating, modifying, and terminating IMS sessions
- **SIP-I/SIP-T: (SIP-ISUP/SIP-Trunking)**: an interworking protocol between a SIP network and PSTN or between a SIP network and the mobile CS Core; SIP-I specifies message mapping between SIP and ISUP, while SIP-T encapsulates ISUP messages in SIP messages
- **DIAMETER**: networking protocol for Authentication, Authorization and Accounting (AAA), policy negotiation, and QoS negotiation
- **H.248/Megaco**: a control mechanism protocol allowing Media Gateway Controllers (MGCs) or equivalents to control Media Gateways (MGs)
- **RTP (Real-time Transport Protocol)**: a standardized packet format for delivering audio, video, and fax media over the Internet
- **RTCP (Real-time Transport Control Protocol)**: provides out-of-band control information and QoS information for RTP flows
- **BICC (Bearer Independent Call Control)**: a call control protocol based on ISUP used between serving nodes adapted to support ISDN services independent of bearer technology and signalling message transport.
- **HTTP (Hypertext Transfer Protocol)**: an application level protocol for distributed, collaborative, hypermedia information systems
- **XCAP (XML Configuration Access Protocol)**: a set of conventions for mapping XML documents and document components into HTTP URIs; allows client to read, write, and modify application configuration data stored in XML format on a server
- **RTSP (Real Time Signaling Protocol)**: A protocol for controlling media streams for functions VCR like functions (PLAY, PAUSE, Forward, Reverse)



Common NGN Protocol Stacks

1.1 IMS/TISPAN PES Core

The following IMS and TISPAN PES core elements perform registration, authorization, and authentication functions for calls from different types of access networks, and perform interworking with the external networks.

- **P-CSCF (Proxy-Call Session Control Function)** for IMS/TISPAN: a SIP proxy that acts as first contact point of IMS terminal; represents UE to other servers
- **I-CSCF (Interrogating-Call Session Control Function)** for IMS/TISPAN: the contact point for IMS connections destined to a subscriber; switches calls based on routing information
- **S-CSCF (Serving-Call Session Control Function)** for IMS/TISPAN: provides session control services; maintains session stage and registration for users
- **SLF (Subscription Locator Function)** for IMS/TISPAN: provides the name of HSS based on inquires from I-CSCF, AS, and 3GPP AAA
- **HSS (Home Subscriber Server)** for IMS and UPSN (User Profile Server Node) for TISPAN: both HSS and UPSN are databases containing user information, such as, ID, numbering, addressing, location, and security
- **AGCF (Access Gateway Control Function)** for TISPAN: performs similar functions of P-CSCF; also performs as media gateway controller

1.2 IMS/TISPAN Application Servers

The following Application Servers (AS) offer value added multimedia services, such as, multi-party conferencing, gaming, messaging, and prepaid charging.

- **SIP AS** (SIP Application Server)
- **OSA AS** (Open Service Access Application Server)
- **CAMEL IM-SSF** (CAMEL - IP Multimedia-Service Switching Function)

1.3 IMS/TISPAN PES Core Interworking with other networks

IMS/TISPAN PES Core interworks with the following networks: 1) Circuit Switched Network, including PSTN, ISDN, Mobile Circuit Switched Core Networks, 2) IP networks, and 3) Multimedia IP Networks

1.3.1 Interworking between IMS/TISPAN Core and the Circuit Switched Networks

IMS/TISPAN interworks with CS networks to enable the connection between IMS/TISPAN and PSTN/ISDN or between IMS/TISPAN and 2G Mobile CS Core networks:

- **MGCF (Media Gateway Control Function)**: controls Media Gateway and converts signaling between SIP and ISUP
- **MGW (Media Gateway)**: supports media conversion, bearer control, and payload processing
- **BGCF (Breakout Gateway Control Function)**: allows interworking between IMS core and CS networks

1.3.2. Interworking between IMS/TISPAN Core and the IP Network

- **IBCF (Interconnection Border Control Function)**: performs interconnection between two operator domains and enables communication between IPv6 and IPv4 SIP applications. It is responsible for topology hiding; controlling transport plane, and generation of charging data records
- **TrGW (Transition Gateway)** for IMS or T-MGF (Trunking – Media Gateway Function) for TISPAN: provides codec convergence, network address/port translation, and IPv4/IPv6 translation

1.3.3 Interworking between IMS/TISPAN Core the Multimedia IP Network

- **MRFC (Media Resource Function Controller)** for IMS: interprets information coming from an AS and S-CSCF, controls media stream resources in the MRFP, and generates billing records
- **MRFP (Media Resource Function Processor)** for IMS: controls bearers, provides resources, mixes/sources/processes incoming streams, and manages floor control for conferencing

1.4 NASS and RACS Subsystems

Compared to mobile terminals and VoIP terminals, PSTN/ISDN terminals require additional subsystems, NASS (Network Attachment Subsystem) and RACS (Resource and Admission Control Subsystem), for transport control purposes.

NASS

NASS Functions:

Dynamic provisioning of IP addresses and other terminal configuration parameters, authorization of network access based on user profile, and location management.

NASS Network Elements:

- **NACF (Network Attachment Control Function)**: Responsible for IP Address Allocation to the UE and distribution of other Network Configuration Parameters (Address of DNS Server)
- **AMF (Access Management Function)**: performs access request translation and authentication forwarding
- **CLF (Connectivity Session Location and Repository Function)**: associates the IP address and location information
- **UAAF (User Access Authorization Function)**: performs user authentication and authorization
- **PDBF (Profile DataBase Function)**: stores user authentication data and access configuration information
- **CNGCF (CNG Configuration Function)**: Provide Customer Network Gateway (CNG) with configuration information during session initialization and update

RACS

RACS Functions:

- **Admission control**: implements admission control to the access network
- **Resource reservation**: implements a resource reservation mechanism that permits applications to request bearer resources
- **Policy control**: uses service based policy to determine how to support requests from varying applications for transport resources

RACS Network Elements:

- **A-RACF (Access-Resource and Admission Control Function)**: responsible for admission control and network policy assembly
- **SPDF (Service – based Policy Decision Function)**: makes the policy decisions by checking the request information, authorizes the requested resources, and determines the location of the border gateway and A-RACF

2 Access Networks

From IMS/TISPAN PES Core point of view, both wireline and wireless networks can be viewed as access networks.

Wireline Networks:

- VoIP (SIP and H.323)
- PSTN and ISDN
- Cable and xDSL

Wireless Networks:

- 3G UMTS/WCDMA, TD-SCDMA, cdma2000, EDGE, and GPRS
- WiMAX and WiFi/Wireless LAN

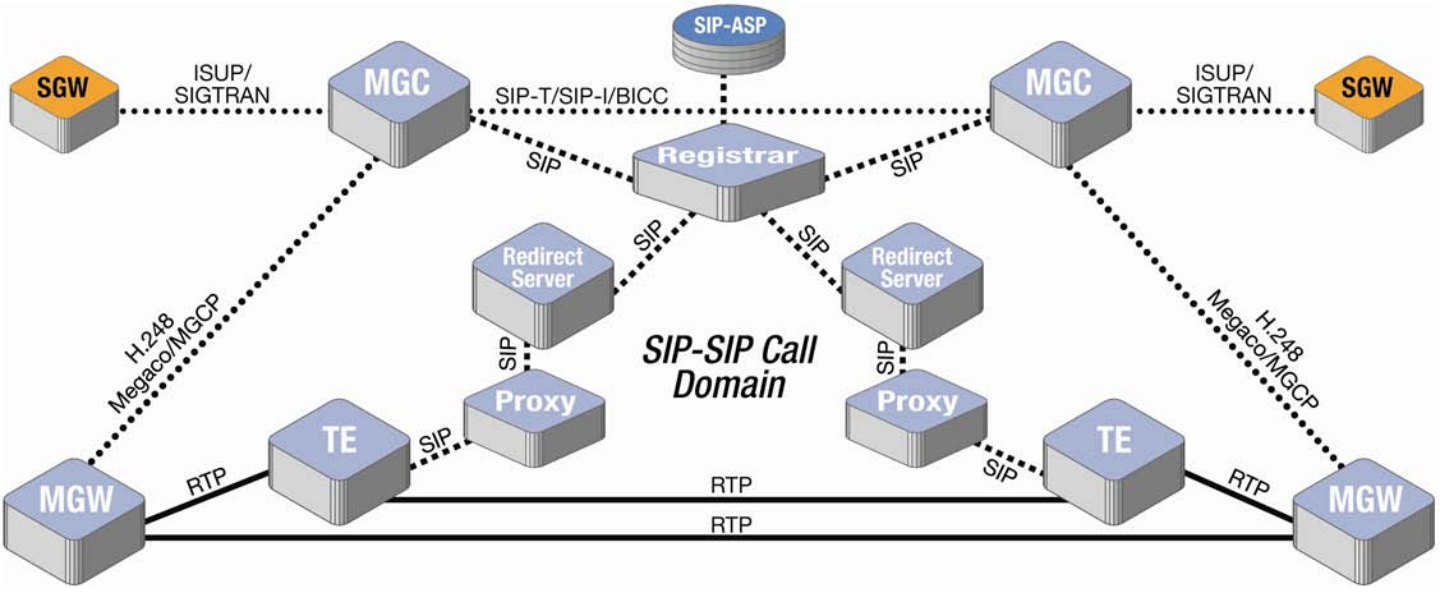
2.1 VoIP Network

Voice over IP (VoIP) is a cost-effective way of transmitting media over IP networks. Originally designed to transmit voice, VoIP networks today supports more media types, including audio, video, and fax. VoIP technology has two protocol families: H.323 VoIP specified by ITU-T and SIP VoIP specified by IETF.

2.1.1 SIP VoIP Network

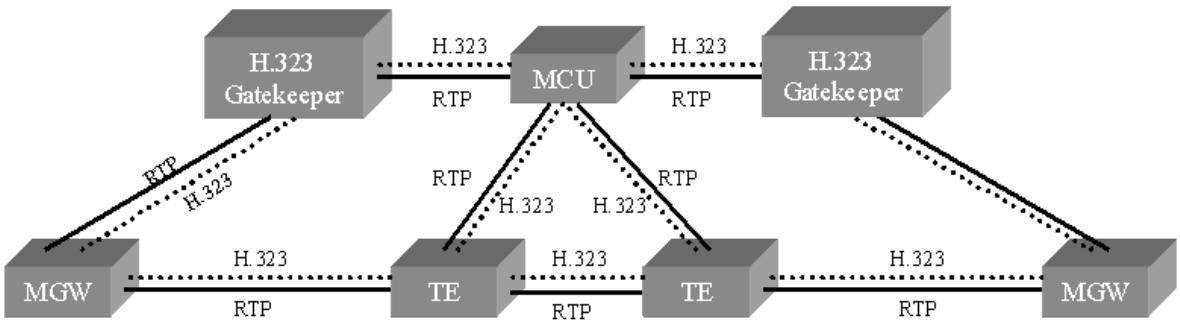
SIP VoIP Network Architecture

- **Proxy:** receives SIP client message and forwards it; authentication, authorization, network access control, routing, reliable request retransmission, and security
- **Redirect Server:** provides alternate routing for users; provide next hop(s) information
- **Registrar:** performs registration services and is often, colocated with a redirect or proxy
- **AS:** provides value added services
- **MGC:** also called softswitch/call agent; Responsible for call routing, signaling, call services, billing, and address translation
- **SG** (Signaling Gateway): performs conversion at transport level between the SS7-based and IP-based network
- **MG:** performs media conversion between RTP and TDM.



SIP VoIP Network Architecture

2.1.2 H.323 VoIP Network



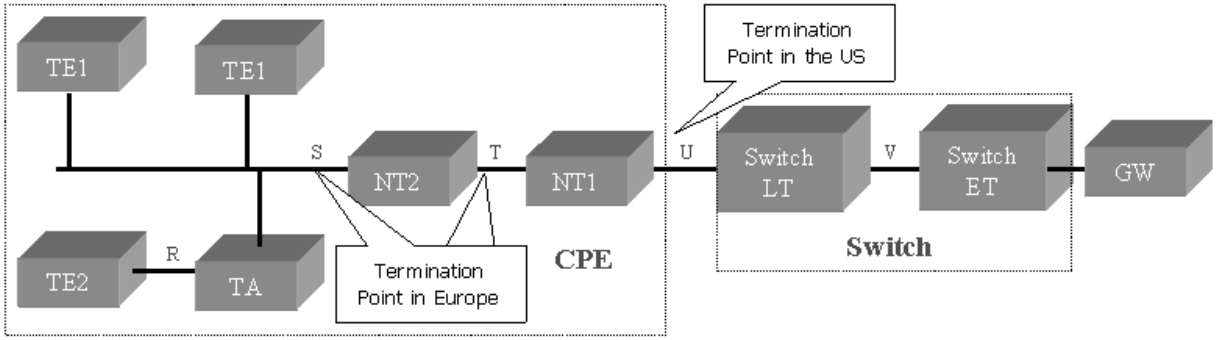
H.323 VoIP Network Architecture

H.323 VoIP Network Architecture

- H.323 Gatekeeper: Virtual switch, network address translation; admission and bandwidth control; authorization and bandwidth management; supplementary and call management services
- H.323 MG: performs media conversion between TDM and VoIP RTP
- MCU (Multi-point Control Unit): bridges conferencing connections

H.323 VoIP Protocols

- H.225.0: call signaling, media (audio and video), and streaming media
- H.245: multimedia control protocol for opening and closing channels
- H.450: supplementary services
- H.235: Security
- MGCP (Media Gateway Control Protocol): allows MGC the ability to control the MG for media access



ISDN Network Architecture

2.2 ISDN Network

ISDN (Integrated Service Digital Network) is a circuit switched network that allows digital transmission of voice, data, video, and text. ISDN offers 2 types of Services:

- BRI (Basic Rate Interface): 2B + 1 D, 144 Kbps
- PRI (Primary Rate Interface): T1: US. 23B+1D, 1.544 Mbps; E1: Europe. 30B+1D, 2.048 Mbps

ISDN Network Architecture

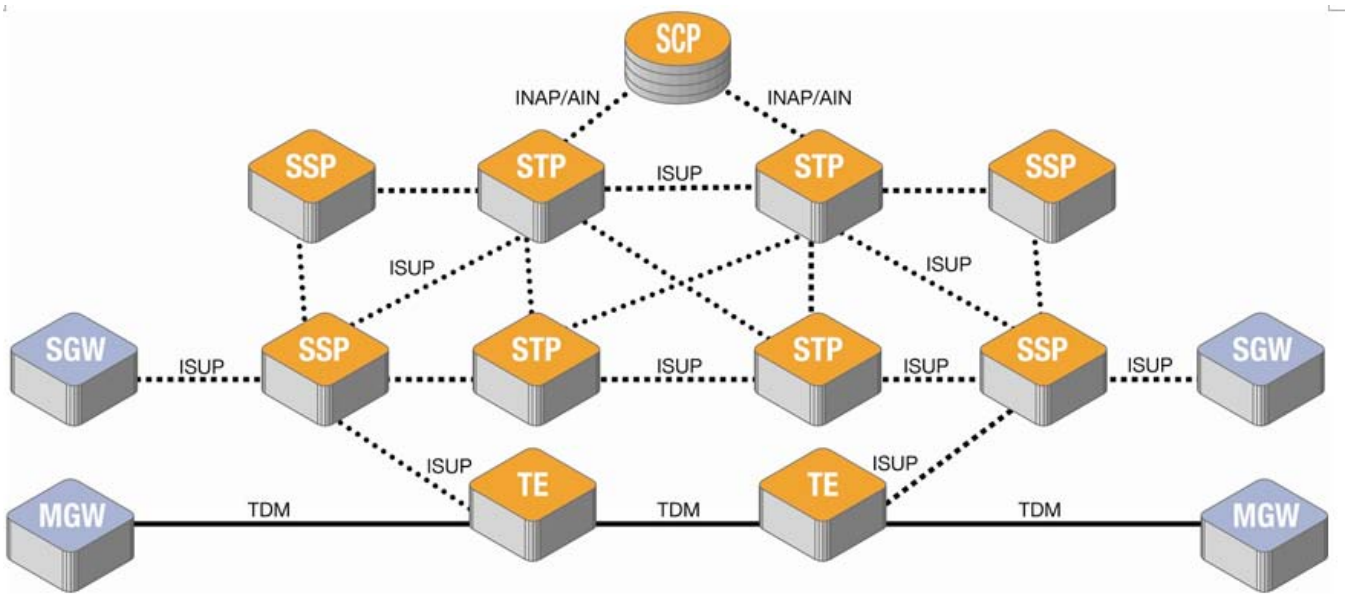
- **NT1** (Network Termination 1)/**NT2** (Network Termination 2): a functional grouping of CPE
- **TE1** (Terminal Equipment 1): ISDN capable
- **TE2** (Terminal Equipment 2): Non-ISDN capable Terminal, e.g. Analogue, Fax, Modem
- **TA** (Terminal Adapter): Connect TE2 to ISDN S/T Bus
- **LT** (Line Termination): Local loop connection
- **ET** (Exchange Termination): connection to other switches

ISDN Protocols and Variants

- **Q.931:** used for the ISDN call establishment, maintenance, and release of the connections
- **Q.921:** also called LAPD (Link Access Protocol – D Channel), is the Data Link Layer protocol used over ISDN's D Channel
- **QSIG**: protocol defined by ETSI and ISO for signaling between PBXs in a PISN (Private Integrated Services Network)
- **DPNSS** (Digital Private Network Signaling System): defined by BT (BTNR188) for trunk lines for connecting two PABXs (Private Automatic Branch Exchange)

2.3 PSTN/SS7 Network

PSTN is widely used in fixed line and mobile networks. PSTN uses Common Channel Signaling System No. 7 (SS7 or C7) as signaling protocol, and uses TDM as media.



H.323 VoIP Network Architecture

PSTN/SS7 Network Architecture

- **SSP** (Service Switching Point): performs call setup, management, and termination;
- **STP** (Signaling Transfer Point): Switches calls based on routing information;
- **SCP** (Service Control Point): centralized database for routing information and call services;
- **SGW** (Signaling Gateway): converts signaling transport between MTP and SIGTRAN;
- **MGW** (Media Gateway): Performs media conversion between TDM & VoIP RTP.

PSTN/SS7 Protocols

- **ISUP** (ISDN User Part): performs call setup, management, and release of trunk circuits that carry voice and data calls over the PSTN
- **INAP** (Intelligent Network Application Part): signaling protocol used in the Intelligent Network for applications such as number translation, time, etc.

SS7 Applications for

- **AIN** (Advanced Intelligent Network): protocols that allow operators to differentiate themselves by providing value-added services
- **MAP** (Mobile Application Part): non-call related signaling for location update,
- **CAMEL** (Customized Applications for Mobile Network Enhanced Logic): a protocol that allows operators to define services over and above standard GSM/UMTS services.


3. Tektronix's Spectra2 Supported Testing

Tektronix's Spectra2 Overview

Total Test Solution

Tektronix Spectra2 integrates functional testing, load/stress testing, conformance testing, interoperability testing, QoS measurement and monitoring into a single platform. Spectra2 supports emerging technologies, IMS, TISPAN, NGN & FMC, and legacy technologies (PSTN/SS7 and ISDN) and VoIP (SIP and H.323).

Supported Technologies
NGN (IMS/TISPAN)
VoIP
PSTN/SS7
ISDN
Mobile CS Core

Supported Testing
Functional/Conformance
Load/Stress
Interoperability
Media QoS/QoE
Monitoring

Value Statements

Maximize Workforce Productivity
Manage Network Complexity with Ease
Experience Faster Time to Market
Ensure Product Quality
Increase Customer Satisfaction

Scalable: Scalable Hardware platform with flexible software architecture to fit network size and needs

Powerful: High signaling and media load with filtering, remote access and Multi-protocol call tracing

Ease-of-Use: Simplicity plus flexibility, intuitive GUI, Test Automation, built-in customizable features

Cost-Effective: Multi-user system ranging from PC Software-Only version to Portable to Rackmount

Time-To-Market: Timely support of latest/required specifications for emerging and legacy technologies

Reliable: High quality, proven platform with world-class service and support

All-in-one: Total test solution across development life cycle of emerging and legacy technologies

<table>
<tr><th rowspan="3"></th><th rowspan="3">IMS/TISPAN (PES)</th><th colspan="2">VoIP</th><th colspan="4">Circuit Switched Network</th></tr>
<tr><th rowspan="2">SIP Network</th><th rowspan="2">H.323 Network</th><th rowspan="2" colspan="2">PSTN/SS7</th><th colspan="2">Mobile CS Core</th><th rowspan="2">ISDN</th></tr>
<tr><th>UMTS GSM</th><th>cdma2000 CDMA</th></tr>
<tr><td rowspan="6">Functional, Load/Stress Testing & Monitoring</td><td>SIP</td><td>SIP</td><td>H.323/H.225.0</td><td rowspan="3" colspan="2">ISUP & Variants</td><td>MAP</td><td>IS-41D</td><td rowspan="3">ITU Q.931/Q.921, Q.SIG, DPNSS</td></tr>
<tr><td rowspan="2">H.248/Megaco</td><td>H.248/ Megaco</td><td>H.323/H.245</td><td rowspan="2">CAMEL/CAP</td><td>IS-41E</td></tr>
<tr><td>MGCP</td><td>MGCP</td><td>IS-771</td></tr>
<tr><td>Diameter</td><td>TGCP</td><td>TGCP</td><td colspan="2">AIN</td><td>PCS</td><td rowspan="2">IS-826</td><td rowspan="3">ETSI ISDN</td></tr>
<tr><td>XCAP/HTTP/RTSP</td><td>NCS</td><td>NCS</td><td colspan="2">INAP</td><td>AIN</td></tr>
<tr><td>RTCP</td><td>RTP/RTCP</td><td>RTP/RTCP</td><td colspan="2">TDM</td><td>INAP</td><td>IS-634A</td></tr>
<tr><td rowspan="5">Conformance</td><td rowspan="5">Can be scripted</td><td rowspan="2">SIP</td><td>H.323/H.225.0</td><td>ISUP</td><td>SUA</td><td rowspan="5">Do not apply</td><td rowspan="5">Do not apply</td><td rowspan="5">Do not apply</td></tr>
<tr><td>H.323/H.245</td><td>TUP</td><td>SCTP</td></tr>
<tr><td rowspan="2">H.248/Megaco</td><td rowspan="2">H.248/Megaco</td><td>TCAP</td><td>SSCOP</td></tr>
<tr><td>MTP3</td><td>M3UA</td></tr>
<tr><td>MGCP</td><td>MGCP</td><td>MTP2</td><td>M2PA</td></tr>
<tr><td rowspan="2">Media QoS</td><td>Audio QoS</td><td>Audio QoS</td><td>Audio QoS</td><td colspan="2">Audio QoS</td><td colspan="2">Audio QoS</td><td>Audio QoS</td></tr>
<tr><td>Video QoS</td><td>Video QoS</td><td>Video QoS</td><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="9">Spectra2 Protocol Testing Capabilities</td></tr>
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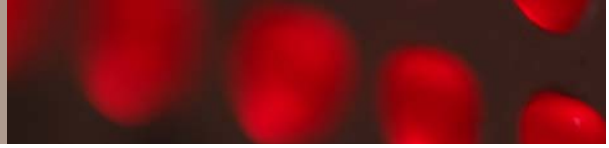
Note: Spectra2 also supports monitoring for MPLS, HTTP, PPPoE, RTSP, ARP, ICMP, and IGMP.

Spectra2 Total Test Solution

Scalable	Single User and Multi-User Platforms	For the carrier, NEM or System Integrator, whether in the lab, network operations center, or in the field, Spectra2 offers a variety of platforms to meet your test and monitoring needs
	Multiple Interfaces	Spectra2 supports a variety of interfaces: 10/100/1000 Ethernet, T1/E1, DS3, and OC-3/STM-1 allowing for easy expansion as capacity needs grow.
	Emerging technology	Test deep into your NGN core network
	Legacy Technology	Test legacy technologies, such as VoIP, PSTN/SS7, and ISDN
Powerful	Traffic generation	Large-Scale Load Solutions validate Signaling and Media Delivery at Maximum Stress Levels.
	SG - STP Blaster	Level 2/Level 3 TCAP and ISUP traffic blaster designed to stress SG/STP's while measuring metrics such as cross-office delay
	Failed Call Analysis	Troubleshoot failed calls during long duration load tests.
	Filtering	Real-time and off-line filters to filter in the wanted data while filtering out the unwanted data.
	Multi-protocol Call Trace	Thread multiple protocols into a single correlated and aggregated session based on configurable correlation rules
	Remote Access	Test remotely using the Spectra2 client/server architecture, Telnet interface, or from a third party test harness with Spectra2's Application Programming Interface (API).
	Conditional Branching	Use powerful If, Then, Else constructs to create the most detailed test case scenarios
	Dynamic Parameter Management	Manipulate protocol data units in real time with the ability to extract, warehouse, and replace message parameters in real-time
Ease-of-use	Low learning curve	Single software application, Intuitive GUI, simple scripting mechanism, logical work areas, consistent look and feel for all protocols
	Buit-in PDU	Pre-built message libraries for IMS/TISPAN, VoIP, PSTN/SS7, ISDN and Mobile CS Core
	Customization	Built-in element profiles provide highly intelligent emulation capabilities
		Create and customize messages from the packaged protocol library, from data captured during monitoring sessions, or by importing from Wireshark traces with full capabilities to customize
	Statistics	Collect statistics and forward the data to any ODBC-compliant database
Cost-effective	Software Only	Software only version for smaller budgets, field operations, or desktop testing
	Multi-user	Multiple simultaneous active testers and an unlimited number of off-line users
Time-to-market	Test Automation	Schedule and execute test cases for individual or recurring runs based on calendar/clock events
	Regression Testing	Use Spectra2 to warehouse regression tests for frequent reuse
Reliable	Product Quality Assurance	20 year product lifespan, over 4000 units sold
	Global support center	Industry best technical service and support
	Maintenance	Industry best maintenance and support programs to ensure low year over year cost
All-in-one test platform	Functional	Test features and functionality in the network for normal and abnormal behavior
	Conformance	Built-in conformance test suites for SIP, H.323, H.248/Megaco, ISUP, MTP3, M3UA, and more
	Load/Stress	Generate high volume signaling and media traffic with customizable call models
	Interoperability	Validate the interoperability of network nodes
	QoS	Audio QoS (MOS, PESQ, R-factor), Video QoS (M)S-V, VSTQ) and Voice Path Verification
	Monitoring	Monitor and troubleshoot the network with ease



3.1 Spectra2 Supported Functional Testing

No matter what NGN (IMS/TISPAN), VoIP, PSTN/SS7, ISDN or Mobile CS Core network element you need to test, Spectra2 can simulate the surrounding nodes for the Device Under Test (DUT) or the System Under Test (SUT):

- Simulate different network nodes
  - IMS/TISPAN Core: P-CSCF/AGCF, I-CSCF, S-CSCF, SLF, HSS/UPSF
  - Application Servers: Presence, Video Streaming, Instant Messaging, POC, etc.
  - Interworking Components: MGCF, MGW, SGW, MRFC, MRFP, IBCF, TrGW, and IBGF
  - Access Networks:
    - SIP VoIP: SIP UA, Proxy, Redirect, Register, MGC, MGW, SGW
    - H.323 VoIP: H.323 UA, H.323 Gatekeeper, MCU
    - TISPAN: RACS and NASS
    - Mobile CS: MSC Server, MGW, HSS, CAMEL entity
    - PSTN/ISDN: PSTN/ISDN TE, SSP, STP, SCP, Local Exchange
- Support various Protocols and Interfaces
  - SIP and its extensions including Gm, Mw, ISC, Mg, Mi, Mj, Mk, & Mr interfaces for IMS/TISPAN, and all the interfaces for SIP VoIP network
  - DIAMETER for Cx, Dx,Sh, Gq, Gq', Rf, e2, e4 Interfaces
  - H.248/Megaco Version 1,2, and 3 for Mn, Mc, Mp, Ia interfaces
  - BICC, SIP-T, SIP-I for Nc interface
  - HTTP, XCAP, RTSP for Ut interface
  - SIGTRAN: support SS7 over IP (SIGTRAN)
  - RTP/RTCP for Mb and Gi interface
  - SIP Torture Test Messages (IETF RFC 4475) workspaces to thoroughly exercise a SIP implementation.
- Support a variety of Audio and Video Codec
  - Audio: G.711 A/Mu law, G.723.1, G.726, G.729.A, AMR-NB, AMR-WB; EVRC-A
  - Video: H.263, H.263+
  - Data: T.38 (Fax over IP)

3.2 Spectra2 Supported Load and Stress Testing

Use Spectra2 to generate heavy signaling and media traffic with any call model or traffic profile for performance or stress testing.

- Highly flexible call patterns and traffic models with various traffic combinations: Signaling only, Signaling + Authentication, Signaling + Security, Signaling + Media (Audio&/ Video), Signaling + Media + QoS
- Traffic profiles can be customized using many different variables such as: call traffic type, BHCA, Calls Per Second, Simultaneous Calls, Call Hold Time, Packet Size, Packet Rate, and Inter-packet Delay
- Multi-gateway Support for Megaco and MGCP. Spectra2 can emulate a large number of Media Gateways. This allows Spectra2 to support load testing of Media Gateway Controllers responsible for Customer premise equipment such as Multimedia Terminal Adapters, Integrated Access Devices or residential gateways.
- Multiple Generator Models: Spectra2 now supports the simultaneous generation of multiple traffic models from a single user license and interface board. This performance enhancing feature enables concurrent execution of test cases thereby reducing overall test time and increasing product time to market.
- Common Look and Feel: Regardless of protocol the Spectra2 software application utilizes a common GUI to architect load models and traffic profiles.

Spectra2: A complete NGN and Legacy Test Solution

3.3 Spectra2 Supported Conformance Testing

Spectra2's approach to conformance testing starts with standards-based conformance testing to ensure NGN protocol compliance to the specifications. Spectra2 provides hundreds of conformance test cases. Each test case can easily be edited to adapt to your testing requirements.

Conformance Test Suite

SIP

User Agent, Proxy, Registrar, Redirect, Server

- ETSI TS 102 027-2 V.4.1.1 (2006-07)
- IETF RFC 4475 (SIP Torture Test)

Megaco/H.248

Media Gateway Controller/Media Gateway

- ETSI TIPHON TS 101 889
- ETSI TS 102 374-2 V1.1.1 (2004-11)

MGCP

Media Gateway

- PacketCable TGCP-MG-CTP
- PKT-CTP-TGCP-MG-D08-03010103

Media Gateway Controller

- PacketCable TGCP MGC and Call Flows CTP
- PKT-CTP-TGCP-MGC-CF-D05-030103

H.323

Terminal, Gatekeeper

- ETSI TIPHON TS 101 804 (H.225.0)

Originating Endpoint, Terminating Endpoint

- ETSI TIPHON TS 101 890 (H.245)

ISUP

- Q.788,User-network-interface compatibility test for ISDN, non-ISDN and undetermined access interworking over international ISUP
- T1-236-2000, ANSI ISUP Call Control

ISUP/TUP

- Q.783, Q.784, Q.785, Test Call Setup & Tear Down Procedure

M2PA

- draft-bidulaock-sigtran-m2pa-test-07
- MTP2-User Peer-to-Peer Adaptation Layer

M3UA

- draft-anshoo-test-spec-m3ua-01
- Conformance to the M3UA protocol definition

MTP2

- Q.781, Ensure an SS7 stack's stability and reliability

MTP3

- Q.782, Confirm End-to-End ntwk routing and congestion management

MTP2/MTP3

- ANSI - T1.234-2000

SCTP

- DTS MTS 00086v0.0.1 Conformance to SCTP protocol definition

SSCOP

- AF-TEST-0067.001 Service Specific Connection Oriented Protocol (SSCOP) ITU Recommendation Q.2110 protocol conformance

SUA

Endpoint-to-Endpoint conformance

- Tektronix Implementation

TCAP

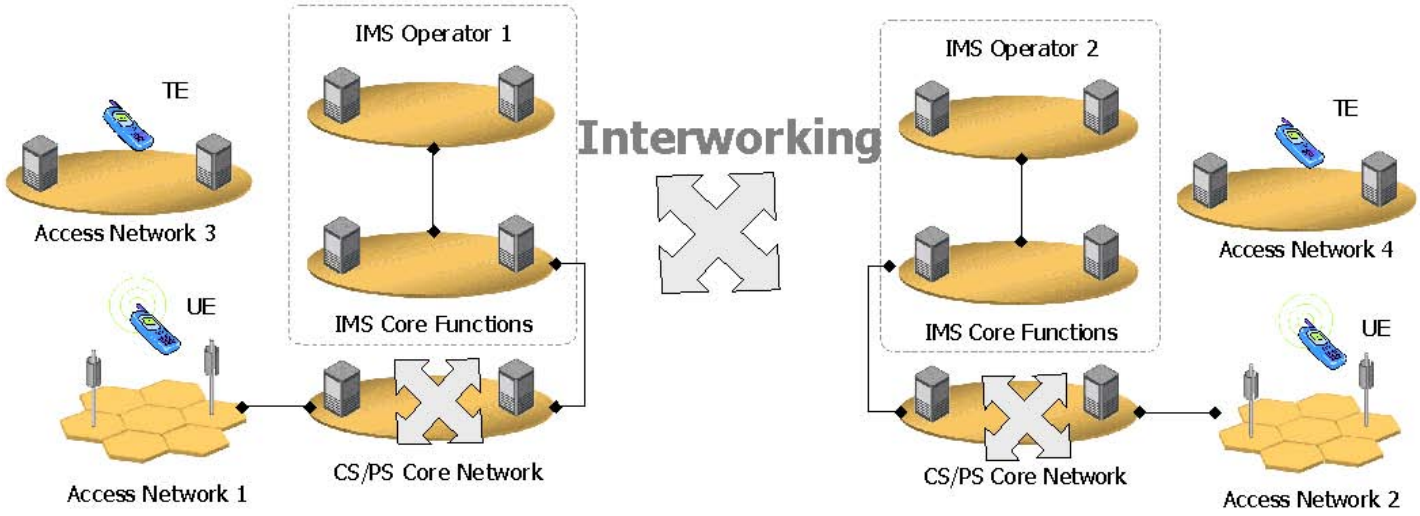
- Q.787 Validate TCAP based applications such as CLASS, INAP, IOS

3.4 Spectra2 Supported IMS/TISPAN Interoperability Testing

IMS/TISPAN interoperability testing involves the interworking between:

- Multiple standard body protocols with their unique variants as well as manufacturer defined proprietary specifications
- IPv4 networks and IPv6 networks
- Transport Layer Security
- Different network architectures planned and deployed by different carriers

Spectra2 supports multiple standard body protocols and proprietary specifications, coupled with the ability to customize PDUs to meet any specialized testing need.



Use Spectra2 to ensure network interoperability

3.5 Spectra2 Media Quality of Service Measurement

QOS General

QoS measurements are critical for IMS/TISPAN and VoIP networks. Key QoS parameters, such as Network Delay, Jitter (Variation in Delay) and Packet Loss need to be measured to ensure the quality of the audio, video, and multimedia services.

- Passive QoS provides analysis and scoring of RTP stream integrity using MOS, PESQ, and R-Factor based scores
- Active QoS provides a PESQ or MOS QoS score based on a comparison of transmitted and received audio payload

Spectra2 QoS Support

Spectra2 measures QoS for both audio and video media, as well as voice path verification.

Audio:

- MOS (Mean Opinion Score), PESQ, R-Factor
- Supported Audio Codecs: G.711 A/Mu law, G.723.1, G.726, G.729.A, AMR-NB, AMR-WB, EVRC-A

Video:

- MOS-V (Mean Opinion Score – Video), VSTQ
- Supported Video Codec: H.263, H.263+

DTMF Tone Support:

- RFC 2833 support - Spectra2 supports the method defined by RFC 2833 for carrying DTMF (Dual Tone Multi-frequency) digits in RTP packets.

QoS Application and Configuration

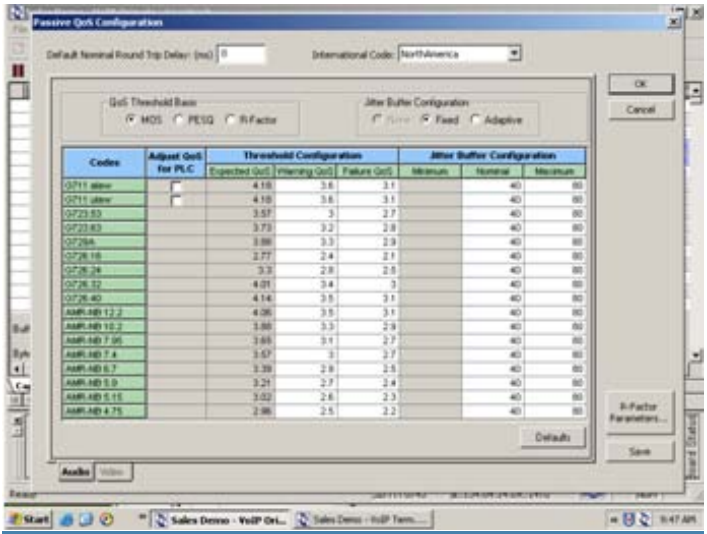
Spectra2 can perform passive QoS analysis anywhere - on a live network or in a lab. The users can easily configure passive QoS parameters before running an analysis. The user can select between a fixed or adaptive jitter buffer and configure the minimum, nominal, and maximum thresholds for each codec.

QoS Measurement Analysis

Spectra2 can measure and analyze captured call quality regardless of how the call data is generated, whether from test tools, live calls, or from Spectra2's Generator application. Passive QoS can be measured in real-time or off-line.

QoS Result Reporting

Spectra2 automatically generates a report in HTML format. Test results can be viewed in either a detailed or summary format for presentation in any web browser. When RTCP is present in the network, Spectra2 can measure the round-trip delay and provide the result as part of the Passive QoS Detail Analysis Report.

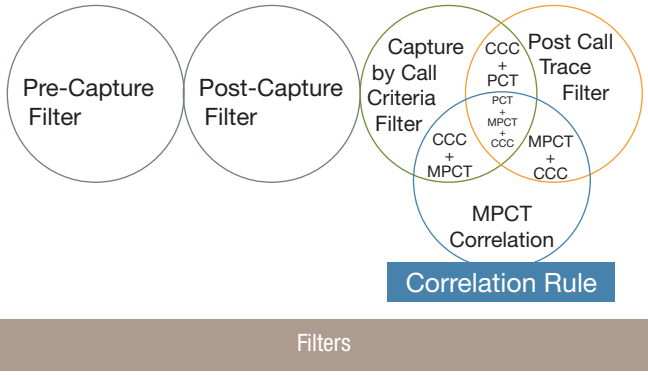


Quality of Service Measurement Report

3.6 Spectra2 Supported IMS/TISPAN Monitoring

Spectra2 supports network monitoring of IMS/TISPAN, VoIP, PSTN/SS7, ISDN and Mobile CS Core nodes, interfaces, and traffic. The monitoring function allows the users to view PDU (Protocol Data Unit: a protocol message) contents, validate protocol functionality, and track communication between different network elements. Spectra2 also supports statistical report generation, and provides multi-protocol analysis tools such as call trace, automated call aggregation, message filtering, and message decode.

- **Call Trace:** Quickly reconstruct all captured calls, including call status and associated messages. The users can view PDU content, and monitored PDUs can be saved and used in test cases and generator models.
- **Message Filtering:** real time and off-line filters have complete user flexibility to capture the desired calls or filter out the undesired calls.
- **Statistical Analysis:** Analysis can be performed in real time or post capture. Easily export call trace information and PDUs in an open text format, such as CSV or text for further analysis with 3rd-party tools.
- **Media Stream Capture and Playback:** Spectra2 collects your media stream data, correlates all packets into individual streams and provides a point and click playback function for audible validation of audio quality.
- **MPCT** (Multi-Protocol Call Trace): Thread together one session containing multi-protocols based on the correlation rules



Filter Profile Type		Functions	Filter Profile Name	Protocols Supported
Capture	Pre-Capture Filter Profiles	Real-time filtering based on user specified criteria	PSTN Filter	MTP2, MTP3, M3UA, SAAL, SCTP, ISUP, SCCP, TCAP
			Media IP Filter	SIP, H.323 (H.225 CS, H.225 RAS, H.245), Megaco, MGCP, RTP, RTCP
			ISDN Filter	Q.931, LAPD
	Post-Capture Filter Profiles	Non real-time filtering based on collected data	PSTN Filter	MTP2, MTP3, M3UA, SAAL, SCTP, ISUP, SCCP, TCAP, Linksets
			Media IP Filter	SIP, H.323 (H.225 CS, H.225 RAS, H.245), Megaco, MGCP, RTP, RTCP, DIAMETER
			ISDN Filter	Q.931, LAPD, Links
Call Trace	MPCT Correlation	Marry common fields across protocols to create single correlated call	Correlation Rules	ISUP, SIP, H.323, DIAMETER, H.248, MGCP, Media
	Post-Call Trace Filters	Extremely detailed filtering to dive deep into test results		
	Capture by Call Criteria Filters	Filters designed to identify specific problems during long time traffic runs		

Spectra2 Hardware Platform Overview

Platform		Software Only	Spectra2u (Portable or Rackmount)	Rackmount	
				Standard Chassis	Extreme Chassis/XL
Value		Cost Effective Functional Testing	High Capacity Signaling, Moderate Media	High Capacity TDM Signaling and TDM Media	High Capacity Signaling and Media
Supported Technology		IMS / TISPAN / VoIP PSTN / SS7 / Mobile CS Core	IMS / TISPAN / VoIP / PSTN / SS7 / ISDN / Mobile CS Core	IMS / TISPAN / VoIP / PSTN / SS7 / ISDN / Mobile CS Core	IMS / TISPAN / VoIP / PSTN / SS7/ ISDN / Mobile CS Core
Config.	CPU		Dual Quad Core Intel Xeon Processors	Intel Pentium 4 2.40GHz	Dual Intel Xeon 2.0GHz
	RAM		8GB	2GB	4GB
	Power		600 W	300 W	300 W
	# of Slot		2 PCIx, 3 PCI	16 PCI	16 PCI
Physical Interface		Ethernet	4 x Gigabit Ethernet, E1/T1/J1, DS3, OC3/STM1	Ethernet, E1/T1/J1, DS3, OC3/STM1	Ethernet, E1/T1/J1, DS3, OC3/STM1
User License		Single User	4 Active Testers, Unlimited Passive Users	4 Active Testers, Unlimited Passive Users	4 Active Testers, Unlimited Passive Users
Hardware Specifications			**Height** 3.45 inches (87.6 mm) **Width** 17.14 inches (435.3 mm) **Depth** 20 inches (508 mm)	22.7 kg (50.5 lb) (not including optional monitor) 43.26W x 46D x 26.5H cm 17W x 18D x 10.5H in -48 VDC Available 110-220 VAC	

Flexible configurations tailored to fit your test needs

Hardware Boards

NSI Boards

A new PCIe 4 x Gigabit Ethernet that supports shared usage across multiple users. All IP protocols and media may be supported on this board including SIGTRAN based protocols.

WTI Boards

A powerful family of Wideband Trunking Interface (WTI) boards with OC-3, STM-1, Gigabit Ethernet, DS3 and T1/E1 interfaces work in combination with Spectra2 software to deliver a state-of-the-art load generation tool for IMS/TISPAN and VoIP converged networks and video telephony.

WTI OC-3

- Media Large-Scale Load Solution
- OC-3 or STM-1 interface
- OC-3 trunk testing
- 2,016 simultaneous calls with media per board.
- Scales to 7 boards for a total of 14,112 timeslots per system.

WTI RTP

- Media Large-Scale Load Solution
- Gigabit Ethernet interface
- 4,000 simultaneous calls with RTP streams per WTI RTP board.

WTI for Signaling

- Gigabit Ethernet interface
- Signaling combined with RTP media testing capability

WTI DS3

- Media Large-Scale Load Solution
- DS3 interface
- DS3 trunk testing

WTI T1/E1

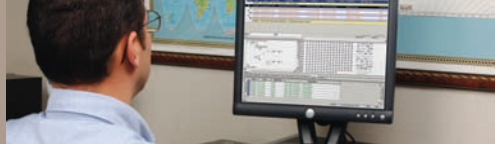
- Media Large-Scale Load Solution
- 8 x T1/E1 trunk testing

STI - Signaling and Media Interface

- 10/100BaseT Ethernet for IP protocols
- DS3
- Quad DS1/E1

Signaling Network Interface (SNI) MTP or SIGTRAN signaling interface supporting

- ISUP
- TCAP
- BICC
- ISDN



Spectra2 Supported Protocols

AIN	
AIN 0.2, T1.660- 6/4/1998, GR-1299-CORE	
BICC	
ITU-T Q. 765.5	(2004) Signaling system No. 7 – Application transport mechanism: Bearer Independent Call Control (BICC)
ITU-T Q.1902.1	(2001) Bear Independent Call Control (Capability Set2): Functional description
ITU-T Q.1902.2	(2001) Bear Independent Call Control (Capability Set2) and Signaling System No. 7 ISDN User Part: General functions of messages and parameters
ITU-T Q.1902.3	(2001) Bear Independent Call Control (Capability Set2) and Signaling System No. 7 ISDN User Part: Formats and codes
ITU-T Q.1902.4	(2001) Bear Independent Call Control (Capability Set2): Basic call procedures
ITU-T Q.1902.5	(2001) Bear Independent Call Control (Capability Set2): Extensions to the application transport mechanism in the context of BICC
ITU-T Q.1902.6	(2001) Bear Independent Call Control (Capability Set2): Generic signaling procedures for the support of the ISDN user part supplementary services and for bearer redirection
ITU-T Q.1950	(2002) Bear independent call bearer control protocol
ITU-T Q.1970	(2001) BICC IP Bearer control protocol
ITU-T Q.1990	(2001) BICC Bearer Control Tunneling Protocol
ITU-T Q.2150.0	(2001) Generic signaling transport service
ITU-T Q.2150.3	(2001) Signaling transport converter on SCTP
ANSI T1.BICC.1-7, (2000)	
ETSI EN 302 213	v.1.1.2, January 2004 Services and Protocols for Advanced Networks (SPAN); Bearer Independent Call Control (BICC) Capability Set 2 (CS2); Protocol specification [ITU-T Recommendations Q.1902.1, Q.1902.2, Q.1902.3, Q.1902.4, Q.1902.5, Q.1902.6, Q.765.5 Amendment 1, Q.1912.1, Q.1912.2, Q.1912.3, Q.1912.4, Q.1922.2, Q.1950, Q.1970, Q.1990, Q.2150.0, Q.2150.1, Q.2150.2, Q.2150.3, modified]
CAMEL Phase 3	
3GPP TS 29.078 version 5.9.0 (2004-09) 3GPP TS 29.078 version 4.8.0 (2003-03)	
CLASS, LIDB, 800	
CLASS:	Bellcore TR-NWT-000215 (1993) Bellcore TR-NWT-000220 (1993) Bellcore TR-NWT-000275 (1993) Bellcore TR-TSY-000217 (1992) Bellcore TR-TSY-000218 (1992)
LIDB:	Bellcore GR-1149-CORE (1997)
LIDB:	Bellcore GR-1428-CORE (1995)
LATA:	Bellcore TR-NWT-001188 (1991)
Diameter	
Diameter Based Protocol IETF RFC 3588	
Diameter Cx/Dx Interface	ETSI TS 129.228/3GPP TS 29.228 v.7.0.0 Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signaling flows and message contents ETSI TS 129.229/3GPP TS 29.229 v.7.0.0 Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS);Cx and Dx interfaces based on the Diameter protocol; Protocol details
Diameter Sh Interface	ETSI TS 129.328/3GPP TS 29.328 v.6.8.0 Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS);IP Multimedia Subsystem (IMS) Sh interface; Signaling flows and message contents ETSI TS 129.329/3GPP TS 29.329 v.6.6.0 Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS);Sh interface based on the Diameter protocol; Protocol details
Diameter Gq/Gq' Interface	ETSI 129.209/3GPP TS 29.209 v6.5.0 Policy control over Gq interface TISPAN ETSI TS 183 017 v 1.4.0 Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control: DIAMETER protocol for session based policy set-up information exchange between the Application Function (AF) and the Service Policy Decision Function (SPDF);Protocol specification
Diameter Rq Interface	TISPAN ETSI ES 283 026 v 1.4.0 Diameter Rq Interface Protocol Details and Signaling Flows
Diameter Rf Interface	ETSI TS 132.299/3GPP TS 32.299 v 7.6.0 Telecommunication management; Charging management; Diameter charging applications ETSI TS 132.240/3GPP TS 32.240 v 6.4.0 Telecommunication management; Charging management; Charging architecture and Principles
H.323	
H.323 v2 (1998), v3 (1999), v4 (2000) Packet-Based Multimedia Communication Systems H.225 v2 (1998) v3 (1999) v4 (2000) v7 (2000) Call Signaling Protocols H.245 v3 (1998) v6 (2000) Control Protocol for Multimedia Communication	
HTTP	
IETF RFC 1945 Hypertext Transfer Protocol--HTTP/1.0 IETF RFC 2068 Hypertext Transfer Protocol--HTTP/1.1 IETF RFC 2616 Hypertext Transfer Protocol--HTTP/1.1	
ICMP	
IETF RFC 792 Internet Control Message Protocol	
IGMP	
IETF RFC 2236 Internet Group Management Protocol V2 IETF RFC 3376 Internet Group Management Protocol V3	
INAP/INCS2	
ETSI INCS2, EN 301 140-1 V1.3.4 (1999-06) EN 300 009-1 v.1.4.3 (2001) EN 300 009-1 v.1.4.1 (2002) ETS 300 134 (1992) ITU INCS2 ITU-T Q.1228 Interface Recommendation for Intelligent network Capability Set 2 Version 1 September 1997 Japan INCS2 JT-Q.1288 IN (Intelligent Network) Inter-Network Interface Capability Set 2 Version 1 April 1999 China INCS2 ITU-T Q.1288 Interface Recommendation for intelligent network Capability Set 2 Version 1 September 1997	
IOS 5.0.1	
3GPP2 A S0011-C, A S0012-C, A S0013-C, A S0014-C v2.0	
IS-41D	
TIA/EIA/IS-J-STD-036 Rev.0, 2000 TIA/EIA/IS-735, 1998 Enhancements to TIA/EIA-41-D and TIA/EIA-664 for Advanced Features in Wideband Spread Spectrum Systems TIA/EIA/IS-751, 1998 TIA/EIA-41-D Modifications to Support IMSI TIA/EIA/IS-756, 1998 TIA/EIA-41-D Enhancements for Wireless Number Portability Phase II TIA/EIA/IS-764, 1998 TIA/EIA-41-D Enhancements for Wireless Calling Name Feature Descriptions TIA/EIA/IS-737, 1998 Intersystem Operations Support for Data Services	
IS-41E	
ANSI/TIA-41.000-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - Introduction to TIA/EIA-41 ANSI/TIA-41.500-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - Introduction to Signaling Protocols ANSI/TIA-41.510-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - X.25 Transport Signaling Protocols ANSI/TIA-41.511-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - ANS/SS7 Transport Signaling Protocols ANSI/TIA-41.520-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - TCAP Application Signaling Protocols ANSI/TIA-41.540-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - MAP Operations Signaling Protocols ANSI/TIA-41.550-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - MAP Parameters Signaling Protocols ANSI/TIA-41.551-E-2004, April 2004 Radiotelecommunications Interystem Operations - Parameter Type Signaling Protocols ANSI/TIA-41.590-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - MAP Compatibility Signaling Protocols ANSI/TIA-41.700-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - Introduction to WIN Functional Plane ANSI/TIA-41.790-E-2004, April 2004 Wireless Radiotelecommunications Intersystem Operations - Annexes	

IS-634A	
TIA/EIA/IS-634	1998 MSC-BS Interface for Public Mobile and Personal Communication Systems

IS-771	
TIA/EIA/IS-771	Wireless Intelligent Network, 1999

IS-826	
TIA/EIA/IS-826	1998 WIN Pre-Paid Charging

ISDN

Q.921 (1992) ISDN UNI-Data link layer specification
Q.931 (1996) ISDN UNI layer 3 specification for basic call control
Q.932 (1996) Digital subscriber signaling system No. 1 – Generic procedures for the control of ISDN supplementary services
Q.951 (1996) DDI, MSN, Calling line identification presentation, etc
Q.952 (1996) Stage 3 description for call offering supplementary services using DSS 1 – Diversion supplementary services
Q.953 (1996) Call waiting, Call hold, Completion of Calls to Busy Subscribers (CCBS)
Q.957 (1996) User-to-User Signaling (UUS)
EN 300 403-1 v 1.3.2 (1999) Integrated Services Digital Network (ISDN); Digital Subscriber Signaling System No. one (DSS1) protocol; Signaling network layer for circuit-mode basic call control; Part 1: Protocol specification
EN 300 196-1 v 1.3.2 (2007) Integrated Services Digital Network (ISDN); Generic functional protocol for the support of supplementary services; Digital Sub scriber Signaling System No. one (DSS1) protocol; Part 1: Protocol specification
EN 300 207-1 (1994) Integrated Services Digital Network (ISDN); Diversion supplementary services; Digital Subscriber Signaling System No. One (DSS1); Part 1: Protocol specification
ETS 300 286-1 (1995) Integrated Services Digital Network (ISDN); User-to-User Signaling (UUS) supplementary service; Digital Subscriber Signaling System No. one (DSS1) protocol; Part 1: Protocol specification
ETS 300 058-1 (1991) Integrated Services Digital Network (ISDN); Call Waiting (CW) supplementary service; Digital Subscriber Signaling System No. one (DSS1) protocol; Part 1: Protocol specification
ETS 300 093-1 (1992) Integrated Services Digital Network (ISDN); Calling Line Identification Restriction (CLIR) supplementary service; Digital Subscriber Signaling System No. one (DSS1) protocol; Part 1: Protocol specification
ETS 300 092-1 (1992) Integrated Services Digital Network (ISDN); Calling Line Identification Presentation (CLIP) supplementary service; Digital Subscriber Signaling System No. one (DSS1) protocol; Part 1: Protocol specification

ISUP

ANSI T1.113-2000, August 2001
Brazil ISUP, ISUP 220.250.732, August 1996
ETSI EN 300-356-1, v 4.2.1 (2003)
ETSI ES 201 296 v1.1.1, 2003
ETSI ES 201 296 v.1.1.2, September 1998
China ISUP Digital PLMN Technical Specification of ISUP Ministry of Posts and Telecommunications of the People's Republic of China, 1997
Hong Kong ISUP HKTA 2202, Issue 3, August 2001
Israel ISUP Technical Requirement Specification for Signaling System No. 7 ISDN User Part (ISUP) in BEZEQ's Network for the national interface (1993)
ITU-T Q.763, SS7, ISUP formats and codes, December 1999
ITU-T Q.763, Addendum 1, Coding of the Application Transport Parameter, March 2001
ITU-T Q.763, Corrigendum 1, July 2001
Japan ISUP
NTT/TTC JT-Q.701 - 704, April 1992
NTT/TTC JT-Q.707, November 1990
NTT/TTC JT-Q.761 - 764, November 1999
NTT/TTC JT-Q.850, November 1996
Mexican ISUP Specification E801.04 Edition "C-3"
Integrated Services Digital Network User Part (ISUP) 12/07/97
Singapore ISUP C7: Signaling System No. 7 (SS7) ISDN User Part (ISUP) Attachment 1 Appendix C7-1
UK ISUP PD 6623:2000, PNO-ISC Specification Number 007 ISDN User Part BSI, July 2000

M3UA

IETF RFC 3332 (MTP3-User Adaptation Layer)

MAP/PCS3

UMTS MAP 3GPP TS 29.002 v6.7.0 Rel. 6, September 2004
GSM MAP ETSI TS 100 974 v7.1.0 / GSM 09.02 v7.1.0 Rel. 98, August 1999
PCS3 (GSM3 over ANSI) ETSI TS 100 974 v7.1.0 / GSM 09.02 v7.1.0 Rel. 98, August 1999

MEID

TIA-928, August 2004 MEID parameter(s) for associated decodes
TIA-928-1, October 2004 MEID parameter(s) for associated decodes
3GPP.S.R0048-A v.3.0, September 2004

Megaco/H.248 (Binary &Text Encoding)

IETF RFC 3015 Megaco Protocol Version 1.0
IETF RFC 3525 Gateway Control Protocol Version 1
ITU-T H.248, June 2000
ITU-T H.248.1, March 2002 Gateway Control Protocol Version 1
ITU-T H.248.1, May 2002 Gateway Control Protocol Version 2
ITU-T H.248.1 v2 Corrigendum 1, March 2004
ITU-T H.248.1 v3 September 2005 Gateway Control Protocol Version 3
ETSI ES 283 018 V1.1.4 TISPAN Ia interface (Text)
Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN);Resource and Admission Control: H.248 Profile for controlling Border Gateway Functions (BGF) in the Resource and Admission Control Subsystem (RACS);Protocol specification

MGCP

IETF RFC 2705 Media Gateway Control Protocol (MGCP)
IETF RFC 3435 Media Gateway Control Protocol (MGCP) 1.0
Packet Cable PKT-SP-TGCP-I01-991201 PackagtCaboeTM 1.0 Architecture Framework
Packet Cable PKT-SP-EC-MGCP-I03-010620 PackagtCaboeTM Network-Based Call Signaling Protocol Specification

Multi-Protocol Label Switching (MPLS)

IETF RFC 3032 (MPLS Label Stack Encoding)

MPEG-2

ITU-T H.222.0 Information Technology – Generic Coding of Moving Pictures and Associated Audio Information

PESQ

ITU-T P.862 Perceptual Evaluation of Speech Quality

PPPoE

IETF RFC 2516 A Method for Translating PPP over Ethernet

RTP/RTCP

IETF RFC 1889 and IETF RFC 3550 A Transport Protocol for Real-Time Applications
IETF RFC 1890 and IETF RFC 3551 RTP Profile for Audio and Video
IETF RFC 2429 RTP Payload Format for 1998 Version of ITU-T Rec. H.263 Video (H.263+)
IETF RFC 2883 RTP Payload for DTMF Digits and Telephony Tones

RTSP

IETF RFC 2326 Real Time Streaming Protocol (RTSP)

SCCP

ITU-T Q.711 (2001) Functional description of the signaling connection control part
ITU-T Q.712 (1996) Definition and function of signaling connection control part messages
ITU-T Q.713 (1996) Signaling connection control part formats and codes
ITU-T Q.714 (2001) Signaling connection control part procedures
ITU-T Q.715 (1996) Signaling connection control part user guide
ITU-T Q.716 (1993) Signaling System No. 7-Signaling connection control part (SCCP) performance
ANSI T1.112 (2000) Telecommunications – Signaling System No. 7 (SS7) – Signaling Connection Control Part (SCCP)

SCTP

IETF RFC 2960 Stream Control Transmission Protocol), 2000
IETF RFC 3257 SCTP Applicability Statement), April 2002
IETF RFC 3309 Stream Control Transmission Protocol (SCTP) Checksum Change), 2002

SIP

IETF RFC 2246 TLS Protocol
IETF RFC 2543 SIP: Session Initiation Protocol
IETF RFC 2976 SIP INFO Method
IETF RFC 3261 SIP: Session Initiation Protocol
IETF RFC 3262 Reliability of Provisional Responses in SIP
IETF RFC 3264 An Offer/Answer Model with the Session Description Protocol
IETF RFC 3265 SIP-Specific Event Notification)
IETF RFC 3268 AES Cipher suites for TLS
IETF RFC 3310 Hypertext Transfer Protocol (HTTP) Digest Authentication Using Authentication and Key Agreement (AKA)
IETF RFC 3311 SIP UPDATE Method)
IETF RFC 3323 Privacy Mechanism for SIP
IETF RFC 3325 SIP Asserted Identity
IETF RFC 3326 Reason Header Field for SIP
IETF RFC 3428 SIP Message Extension
IETF RFC 3515 SIP Refer Method
IETF RFC 3546 Transport Layer Security (TLS) Extensions
IEFT RFC 3725 Third Party Call Control
IETF RFC 3903 SIP: Session Initiation Protocol Extensions
IETF RFC 4168 Stream Control Transmission Protocol (SCTP)
IETF RFC 4475 Session Initiation Protocol (SIP) Torture Test Messages

SIP-I

IETF RFC 3312 Integration of Resource Management & SIP
IETF RFC 3323 A Privacy Mechanism for SIP
IETF RFC 3325 Private Extensions to SIP for Asserted ID
IETF RFC 3578 Mapping of ISUP Overlap Signaling to SIP

SIP-T

IETF RFC 2046 (Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types)
IETF RFC 3204 MIME media types for ISUP and QSIG Objects
IETF RFC 3372 Session Initiation Protocol for Telephones (SIP-T): Context and Architectures
IETF RFC 3398 (ISUP to SIP Mapping)
IETF RFC 3578 (ISUP Overlap Signaling to SIP)

TCAP

ITU Q.771, March 2001 Functional description of transaction capabilities
ITU Q.772, July 1996 Transaction capabilities information element definitions
ITU Q.773, July 1996 Transaction capabilities formats and encoding
ITU Q.774, May 2001 Transaction capabilities procedures
ITU Q.775, July 1996 Guidelines for using transaction capabilities
ANSI T1.114-2000 (2000) Telecommunications – Signaling System No. 7 (SS7) – Transaction Capabilities Application Part (TCAP)

Video Telephony

ITU-T H.263 / H.263+ Video coding for low bit rate communication
IETF RFC 2429 (H.263+) RTP Payload Format for the 1998 Version of ITU-T Rec
IETF RFC 3261 SIP: Session Initiation Protocol
IETF RFC 2327 SDP: Session Description Protocol
IETF RFC 3550 RTP: A Transport Protocol for Real-Time Applications
IETF RFC 3551 RTP Profile for Audio and Video Conferences with Minimal Control

Voice Media

IETF RFC 2327 SDP: Session Description Protocol
IETF RFC 2833 RTP Payload for DTMF Digits,Telephony Tones and Telephony Signals
IETF RFC 3550 RTP A Transport Protocol for Real-Time Applications
IETF RFC 3551 RTP Profile for Audio and Video Conferences with Minimal Control
ITU-T G.729 Annex A, November 1996 Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear prediction (CS-ACELP)
ITU-T G.723.1, March 1996 40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)
ITU-G.711, November 1998 Pulse code modulation (PCM) of voice frequencies
ITU-T G.726 40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)
AMR-NB Real-Time Transport Protocol (RTP) Payload Format and File Storage; Format for the Adaptive Multi-Rate (AMR) and Adaptive Multi-Rate Wideband (AMR-WB) Audio Codecs
AMR-WB Real-Time Transport Protocol (RTP) Payload Format and File Storage; Format for the Adaptive Multi-Rate (AMR) and Adaptive Multi-Rate Wideband (AMR-WB) Audio Codecs

Voice Quality

ITU-T P.862, February 2001 Perceptual evaluation of speech quality (PESQ): An objective method for end-to-end speech quality assessment of narrow-band telephone networks and speech codecs
ITU-T G.107, March 2003 The E-model, a computational model for use in transmission planning

XCAP

IETF RFC 4825 The Extensible Markup Language (XML) Configuration Access Protocol (XCAP)
IETF RFC 4826 XML Formats for Representing Resource Lists
IETF RFC 4827 XCAP Usage for Manipulating Presence Document Contents
IETF RFC 5025 Presence Authorization Rules

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Phone:
1-800-833-9200 option 1
+1-469-330-4000

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