Transport and services for SS7 signaling over IP

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Legacy STP SS7 Deployment

- Legacy STPs are becoming EOL and are expensive to upgrade
- Legacy STPs do not provide a seamless migration to IP networks
- Legacy STPs have limited scalability of on-board applications
Networks will continue to evolve and converge to an IP centric model

The speed of this evolution and convergence is debatable and it will happen at speeds which will vary per operator

SS7oIP Benefits

- **Cost Efficiencies**
  - More efficient network for SS7 transport
  - Operationally simpler and more efficient to manage
  - Affordable people are easier to hire

- Enables a variety of IP-based revenue-generating services/applications
  - Further enhanced bandwidth efficiencies
  - Lower barriers to entry for application vendors
  - Seamless operation over network generations

- Smooth transition from 2G to 3G
IETF SIGTRAN Working Group

- Multi-vendor group that is designing SS7oIP standards
  Group includes Cisco, NT, Lucent, Alcatel, Ericsson, Nokia, Siemens, Tekelec, etc.
  http://www.ietf.org/html.charters/sigtran-charter.html
- Developed based on the RFC process, such as created the Internet and Web standards
- Includes SCTP, M2PA, M3UA, SUA and M2UA
  Cisco is a co-author on all of the above except SUA
  Continues to evolve with changing operator requirements

Sigtran Protocols

- **SCTP** (Stream Control Transmission Protocol, RFC2960) – transport layer that provides reliable data transfer over IP
- **M2PA** (MTP2-User Peer-to-Peer Adaptation, RFC 4165) – provides MTP3 with equivalent transport layer services as MTP2
- **M3UA** (MTP3-User Adaptation, RFC3332, 4666) – client/server protocol providing a gateway to legacy SS7 network for IP-based applications that interface to the MTP3 layer
- **SUA** (SCCP-User Adaptation, RFC3868) – client/server protocol providing a gateway to legacy SS7 network for IP-based applications that interface to the SCCP layer.
- **M2UA** (MTP2-User Adaptation, draft status) – client/server protocol providing a gateway to legacy SS7 network for IP-based applications that interface to the MTP2 layer (not supported with Cisco ITP)
- **Security Considerations for SIGTRAN Protocols** – specifies an Internet security protocol standards track (TLS/IPSEC)
An ITP is:

- IP-enabled core STP (SS7 router) & Signaling Gateway
- Integrated high-capacity IP and SS7 routing in one box
- A core STP with:
  - Carrier Grade reliability with Low Power/Small Footprint
  - Traditional TDM-based STP and Next-generation STP
  - Supports integrated applications such as Number Portability and Flexible Numbering and Equipment Identity Register (EIR)
- A Signaling Gateway with:
  - Flexible range of platforms to suit all needs
  - Strong SMS routing capabilities with MLR
  - Strong partnership with messaging and IN vendors
Legacy STP SS7 Deployment

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Cisco SS7 Deployment

- Cap and grow legacy STPs with high density/low cost ITPs
- Migrate legacy STP/SCP functionality to an SCP function
- ITP provides the foundation and flexibility to migrate to 3G or 3G+ networks as the carrier needs warrant

Cisco SIGTRAN Deployment

- ITPs are native IP devices and allow the operator maximum flexibility in both SS7 and IP routing capabilities in one device
- Cisco has the IP expertise to properly deploy IP networks
- ITPs can be deployed with integrated IP routing
**Signaling Infrastructure Migration to IP**

Legacy

SS7 to IP

![Diagram showing signaling infrastructure migration to IP](image)

**M3UA Deployment Architecture**

Before

After

![Diagram showing M3UA deployment architecture](image)
ITP as a Signaling Gateway

Signaling Gateway Problem Statement

- Expensive links (US$5-10 K per link) on the STP side
- Huge footprint and power consumption
- A new element means new point-codes and network changes
**ITP Signaling Gateway Solution**

- High performance gateway between legacy (ATM/TDM) SS7 and SIGTRAN signaling
- SIGTRAN protocol support for M2PA, M3UA and SUA
- True appliance architecture → OPEX reduction
- Signaling gateway AND Cisco IOS-based router in a single system

**SS7 Offload Network**

- Save money on the expensive legacy equipment.
- Transport bulk SCCP traffic (e.g. SMS) over IP
IP Enabled Messaging Network

- Increased bandwidth to application (Ethernet)
- Improved performance of application nodes
- Decreased signaling costs (commoditized)

MLR & SMS Router Architecture

- Route Determination
- MAP Parsing
- TCAP Parsing
- Advanced MTP & SCCP Routing
MLR Controlled Messaging

- MLR allows for optimization of messaging nodes for specific traffic types (e.g. voting messages)
- Differentiation of SLA and QOS per traffic type or user group
- (Re)-direct traffic to anti-spam/virus engine

ITP Multi-Layer Routing
ITP Multi-Layer Routing (MLR)

- Select messages with Gateway Screening rules:
  - Destination or Originating point code for MTP3
  - Service Indicator (ISUP or SCCP)
  - SCCP Called Party Address (GT, PC, SSN)
  - SCCP Calling Party Address (GT, PC, SSN), etc

- Route messages based on a combination of:
  - Any MAP Operation code from GSM-MAP
  - SMS specific parameters for MO and MT
  - SRI-SM specific parameters

- Distribute messages to a server group using weighted round-robin or B-address binding hash

- Servers may be connected via TDM, HSL or SIGTRAN links

- Optionally modify SCCP Calling or Called Party addresses (and some MAP addresses)

ITP Multi-Layer Routing (MLR) - results

- Result can be:
  - New SCCP GT, Point Code, SSN, xUA
  - ASNAME, server group
  - Server group can load-shared by weighted round robin or a B-address hash
  - Result Action can be to: BLOCK, CONTINUE or ROUTE

- BLOCK is used for MLR based screening:
  - Example of use is “ITP-only” anti-spam

- ROUTE is used for onward routing:
  - Example of use is SRI interception for flexible numbering
  - Manage roaming traffic or traffic from broadcast events
  - Intercept of INAP, CAMEL, MAP traffic for MNP

- CONTINUE = more rules to process
Messaging User Scenarios

Next-Gen Mobile Service Development

- Internet application model
- Fast time to market
- Open interface
- New process for service

- Open interface northbound (IP)
- Standard SS7 signaling
- Cisco ITP as interface to SS7 network
- One-to-many application scalability

- Voice transport network
- ITP allows uncoupling of signaling from network elements
MLR MTP3 OPC-DPC Routing

Subscriber A in home network

Subscriber A in Non-home network

Low Quality Network

High Quality Network

HLR Query
OPC=2.2.2
DPC=6.6.6

MLR selective routes the message from 2.2.2 over the high quality network

MSC 4.4.4

MSC 2.2.2

Special Fraud and Billing

MLR MTP3 OPC-DPC Routing Example: Short Message Service Center

Multi-Layer Routing (MLR)

Broadcast Event

To vote on American Idol, send SMS to 1111
For vote on Big Brother, send SMS to 2222

SS7 Network

ITP distributes messages in a weighted round-robin fashion when multiple servers can handle the same service

ITP inspects SCCP, TCAP, MAP, and MAP-User parameters to route SMS-MO to the correct service center(s) handling the message.
**MAP Op-code Router with MLR**

- **SMS spam Engine***
- **FPLMN**
- **Managed Roaming Node***

* = Partner provided

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**First Delivery Attempt for SMS-MO “FDA” Message Flow**

**Benefits include:**
- Greatly reduces SMS infrastructure $$
- Removes 60-70% of SMS traffic!!

**Drivers:**
- Burgeoning SMS traffic volumes
- Adoption of SMS-based voting events

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- Burgeoning SMS traffic volumes
- Adoption of SMS-based voting events

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**GSMA White Paper**
**Network Vulnerabilities**

1. **Spamming**
   The Operator is spammed by SME having an agreement with him.

2. **Flooding**
   The Operator is spammed by SME connected to Foreign Network’s SMSC.

3. **Faking**
   The Operator is spammed by pirate’s engine simulating a regular SMSC.

4. **Spoofing**
   The Operator is spammed by pirate’s engine simulating Mobiles in roaming situation.

**Side Effects**

- The Home Operator could be accused of Spam relay by his customers or by another operator having a roaming agreement.
- The home operator has to bear relay operator fees and no termination fees can be collected from him.
- Termination fees will not be paid by anyone. The home operator terminates the SMS free of charge.
- The Customer who has their MSISDN faked will be charged inappropriate fees.

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**Case 2 – Flooding**

*Diagram showing the flow of SMS messages from SME to HLR and VLR.*
Case 2 – Flooding Mitigation

- White List for authorized SMSC.
- Black-List for barred SMSC or keywords
- Heuristic detection for abnormal activity coming from specific SMSC. Or message content

Case 3 – Faking Forged SMSC Address
Case 3 – Faking Mitigation

- White List for authorized SMSC
- Black-List MAP/SCCP address inconsistency and keywords
- Heuristic detection for abnormal activity coming from specific source
- Correlate SMSC and MSISDN information

Case 4 – Spoofing
Forged Originator Address

- White List for authorized SMSC
- Black-List MAP/SCCP address inconsistency and keywords
- Heuristic detection for abnormal activity coming from specific source
- Correlate SMSC and MSISDN information
Case 4 – Spoofing Mitigation

**HPLMN**
- SME
- SMSC
- HLR

**FPLMN**
- SME
- SMSC
- HLR

**MSC**

**VLR**

**STP**

**SUBMIT_SM**

**SRI_SM**

**MSISDN 123456789**

**HLR**

**SMSC**

- Black-List for specific keyword in the message body.
- Heuristic detection for repetitive occurrence of message Body or Header.

- In addition SRI_SM check is performed for SMS_MO to understand the subscriber’s real VLR location.
Acision and ITP
SMS Voting Offload Architecture using MLR
NextGen Signaling Transport Network
Core ITP (HSL) Deployment – 16 sites

- Driver: E1// STPs do not scale with addition of MNP
- Solution: Inserted ITP signaling plane to carry 70% of SS7 traffic
- Deployment: Network-wide, 16 sites, 9 cities
- Next step: Migrate Core to SoIP

SMS Traffic Explosion
Offload SMS Traffic from Legacy STPs

- Driver: SMS traffic increases
- Solution: ITP SMS offload. MSCs & HLRs retain links to Legacy STPs
- Deployment: Network-wide, ITPs in 6 regions
- Next Step: Add additional SS7 traffic over IP
Telstra Wireline
Nationwide Core SS7 Transport

* Existing STP Planes (interconnected with ITP plane) are not shown in this slide

Custom Ring Back Tone Service

User Experience

“Caller” can listen music, voice, or other any sound registered by “caller” as a ring back tone sound.

Network Architecture

For this service, Infravalley provides a control server that maintains subscribers’ data.

34% of 22M subs using it by end of the year 2002.
Triples the # of SS7 messages for a call – download per call
Core ITP (SS7oIP) Deployment
99% of all Signaling Traffic via ITPs

M2PA Links
SS7oIP Core
SIGTRAN Compliant

MSC
Avrig
(Bucharest)

MSC
Brasov

MSC
DBC
(Bucharest)

SCP

HLR

Core ITP (SS7oIP) Deployment
99% of all Signaling Traffic via ITPs

M2PA Links
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MSC
Avrig
(Bucharest)

MSC
Brasov

MSC
DBC
(Bucharest)

SCP

HLR

Edge ITP SS7 Deployment
STP Services Across 16 sites

MPLS Core
Next Generation Signaling Transport
• M2PA SIGTRAN Core (B/D links)
• 16 MSC sites
• Some SCTP links over VSAT
• 2-hop traversal requirement

MSC
Central Site - Jakarta

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MSC

MWTM

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### SMS Messaging Offload Deployment

**Six Sites with M2PA Core**

- **Next Generation Signaling Transport**
  - M2PA SIGTRAN Core
  - 6 MSC sites
  - SCTP links over VSAT
  - 2-hop traversal requirement

### Country-wide SS7oIP Transport

**Nationwide SS7oIP Transport w/ Six PoPs**

- **Phase 1:** 12 x 7500s
- **Phase 2:** 4 x 7500s for SMSC

- **Centralized ITP:** 60k MSUs Maximum
- **Remote ITP:** 30k MSUs Maximum

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**VAR-CONV, M3UA-SUA**, High-Performance Licenses apply only at Centralized ITPs
ITP M2PA Design for Globe Telecom Philippines / Globe Telecom (Phase 1/2/3)

Any-to-Any IP SCTP Links “Direct SS7 Routing”

Core Routers
T3/E3

Access Routers
FastETH via LAN SW

ITP Overview 55

OpEx Reduction for Leased Lines
SS7oIP and IP-enabled SMSC

• Phase 1: 26 remote sites
• Phase 2: 4 additional central sites
• Phase 3: 26 additional remote sites
• Phase 4: STP phase-out

ITP Overview 56
International Roaming Service
Connections to Operators Worldwide

- Tampa hub w/ 15 remote ITP pairs
- Inter-carrier routing
- Connection to core network
- Point code normalization
- Roaming, 800 service, LIDB, calling name, NP

ITP and eServGlobal
Billing, Messaging & IN Services

- Standard SS7
- SS7/ATM
- SS7/IP

Primary Business of eServGlobal is the Delivery and Integration of Advanced Telecommunications Applications

Pre-Paid
Post-Paid
IP Transport
TDM Transport
Legacy TDM-Based End Nodes

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**ITP M2PA Gateway Deployment**

Schlumberger IP-Enabled SMSC

- With 64 kbps links, some SMSC’s CPU runs at 30% based on transaction rate
- IP VHSL delivers maximum transactions to each SMSC

**3G Signaling Network**

Nation Wide WCDMA 3G Signaling Network

- A-Plane STM-1 HSL
- B-Plane STM-1 HSL
- C-Link STM-1 HSL