Next Generation Signaling Transport
Cisco ITP
IP Transfer Point

October 2007
Mobility, Signaling and Control Business Unit
What is an “ITP”? 

- 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 plus next-generation STP with SS7oIP
  - 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 operator needs
  - Strong SMS routing capabilities with MLR
  - Strong partnership with messaging and IN vendors
ITP Market History

- ITP released to the market in June 2001
- ITPs are deployed as either core STPs, Signaling Gateways, or more frequently, in both roles together
- ITPs have been widely deployed in mobile, wireline, cable and CLEC environments worldwide
- Key drivers for ITP deployments include subscriber growth, new services, text messaging, pre-paid, VoIP, transition to IP-based signaling, etc
- Increasingly ITPs are used to deploy applications for the operator: such as number portability; messaging; flexible numbering and application-level routing
## Core Signaling Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Feature</th>
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<tbody>
<tr>
<td>Flexible, evergreen core signaling platforms that quickly adopts to changing industry requirements and standards</td>
<td>ITP supports all current and next generation signaling protocols and easily adopts future signaling protocols</td>
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<td>Network reliability and performance are maintained at expected levels with lower cost</td>
<td>ITP provides industry leading reliability and performance at significant cost savings on a carrier grade platform</td>
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<td>IP routing and signaling protocol functions both required for next generation signaling networks</td>
<td>ITP is a one box solution for both legacy and next generation signaling networks. All other STP vendors need 2 boxes (STP+ router) for next generation networks</td>
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<td>Requirement</td>
<td>Feature</td>
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<tr>
<td>Standards compliance</td>
<td>ITP supports ITU, ANSI, Chinese and Japanese SS7 variants, as well as IETF Sigtran, ATM, HSL, and TDM with industry certification</td>
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<tr>
<td>Flexible network management</td>
<td>High performance provisioning, surveillance, fault isolation, and capacity management capabilities</td>
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<td>Auto-discovery of all SS7 elements</td>
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<td>Commitment to product support, evolution and</td>
<td>Cisco is fully committed to the SS7 market with continuing investment in resources, products and technologies</td>
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<tr>
<td>enhancement</td>
<td>Cisco ITP is the industry leader in SIGTRAN deployments</td>
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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.
ITP Core STP Platform Attributes

- World Class Carrier Grade Platform
  - Feature Rich Platform
  - Non-disruptive Software Upgrades
  - Full hardware redundancy features
  - Hot insertion and removal of cards

- High Capacity Platform
  - Support for LSL, ATM, HSL, IP links
  - Integrated IP, MTP and SCCP routing

- Any ↔ Any Routing
  - M2PA, M3UA, SUA, TDM, ATM

- Integrated IP Routing Protocols
  - OSPF, BGP, EIGRP, HSRP, IGRP, NHRP
  - Configurable QoS Per Connection

- Dedicated Network Management
  - Auto Discovery, Multiple Network Views, Route/GTT Editor
ITP - Key Features

- Investment Protection
  
  Traditional STP vendors are imposing expensive end-of-life upgrades which will require forklift upgrades.

  ITP supports traditional TDM and ATM signaling as well as combining with IP signaling in a single platform.

  ITP supports mixed link types within a linkset to allow smooth network migrations to IP.

  ITP includes required features (e.g. GTT) in the base price.

- Scalable SS7 Applications

  Traditional STP devices are not able to scale their applications because they use proprietary or embedded hardware.

  Investment constraints means their applications are limited in both scalability or richness of features.
ITP - Key Features

- Industry Leading Value
  - Best price/performance for legacy and IP based signaling
  - Low power consumption, small footprint, affordable services
  - ITP is only STP to support both SS7 and IP routing protocols

- Network Management and Flexibility
  - Flexible “any-to-any” as well as application layer routing
  - Easily add capacity for new revenue-generation service deployment using MLR and an ITP signaling gateway
  - Implement “triggerless” services by the use of MLR
  - IP-based network monitoring and provisioning improve operational efficiencies over traditional approaches
ITP as a Next Generation Core STP
Legacy STPs require a large footprint, have large power requirements and are expensive to upgrade.

Legacy STPs do not provide a seamless migration to IP networks.
Legacy STP SIGTRAN Deployment

- Legacy STPs require an Edge router to connect to an IP network for SIGTRAN (2 box solution)
- Legacy STP vendors may not have the IP expertise to deploy an end to end IP network
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
SS7 Offload Network

- Save money on the expensive legacy equipment.
- Transport bulk SCCP traffic (e.g. SMS) over IP
Signaling Infrastructure Migration to IP

Legacy

SMSC/HLR/IN

Access TDM

STP1_1

Signaling TDM Transport Network

STP1_2

MSCs/Softswitch

Access TDM

STP2_1

SMSC/HLR/IN

Signaling Over IP, TDM as option

Access-Links TDM

SUA or M3UA

IP Enabled STP

MSCs/Softswitch

Access-Links TDM

SUA or M3UA

SS7oIP

Signaling Over IP, TDM as option

IP or TDM

MTP3b/MTP3

SCCP/ISUP

MTP2

MTP1

AAL5

SSCF-NNI

SCTP

IP

M2PA

M3UA

SUA

SS7oIP with SIGTRAN

MTP3b Stack

HSL
SS7 over IP (SS7oIP)
SS7oIP Benefits

- **Cost Efficiencies**
  - More efficient network for SS7 transport
  - Operationally simpler and more cost-effective to manage

- 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

- Blends the advantages of SS7 and IP together

- Based on a protocol called SCTP (not TCP, not UDP)
ITP Supported SIGTRAN Protocols

- **SCTP**
  - RFC 2960
  - RFC 3309 Checksum

- **M2PA**
  - RFC 4165

- **M3UA**
  - RFC 3332
  - RFC 4666

- **SUA**
  - RFC 3868
SCTP Provides:

- **Acknowledged** error-free, non-duplicated transfer of data within multiple independent streams of data
- **Data fragmentation** to conform to the SS7 Message Transfer Unit (MTU) size restrictions
- **Sequenced delivery** of user messages with an option for order of arrival and delivery of individual user messages
- **Bundling** of multiple user messages into a single SCTP packet allowing more efficient usage of bandwidth
- **Multi-homing** for network fault tolerance of association (multiple source and destination addresses with automatic failover between them)
- **Signaling** reliability and performance at an IP price
STP Peer-to-Peer SS7 Offload (M2PA) Protocol Architecture
M3UA Protocol Stacks

- M3UA
- SCTP
- IP
- SS7
- MTP3
- MTP2
- MTP1

Signaling Gateway

ISUP and SCCP messages

ASP

SCTP/IP

ITP

SEP

ISUP and SCCP messages

SS7 Network

IP Network
SUA Protocol Stacks

**IP Network**

- MAP
- IS-41
- TCAP
- SUA
- SCTP
- IP

**Signaling Gateway**

- SUA
- SCTP
- IP

**SS7 Network**

- MAP
- IS-41
- TCAP
- SCCP
- MTP3
- MTP2
- MTP1

**Connections**

- SUA messages
- SCCP messages
- SCTP/IP
- ITP
- SS7
- SEP

- ASP
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
IP Enabled Messaging Network

- Increased bandwidth to application (Ethernet)
- Improved performance of application nodes
- Decreased signaling costs (commoditized)
ITP Architecture, Platforms and Features
Cisco ITP Platforms Positioning

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<tr>
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<th>2811</th>
<th>7204/6</th>
<th>7301</th>
<th>7600</th>
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<tbody>
<tr>
<td>Core STP</td>
<td>✔</td>
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<tr>
<td>Signaling Gateway</td>
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Cisco 7600 Series Platform
Redundancy, High Availability & Performance

- SUP Management CPU
- Redundant Main Processors
- Enhanced FlexWAN
- Increased port density and capacity
- Port Adaptors
- Same adapters as the 7200 series

- 70+ service / port adapters
- Industry leading features
- Scalable / high performance
- Carrier-class high availability

- 2 Power Supplies for Redundancy
ITP Non Disruptive Upgrade

- Dual supervisors keep state synchronized for redundancy
- Active supervisor can be pulled without service impact
- Supervisors are not involved in packet forwarding
- These features allow an operator to upgrade an ITP to a new version of IOS without loss of service
- Supervisors and line cards are reloaded serially to maintain service and routing of traffic during the upgrade
- Design allows for graceful back-outs

- Supported on the 7600 ITP
ITP Advanced Features
Enhanced Gateway Screening (EGWS)

- Exceeds the requirements of GR-82-Core and ITU Q.705
- Circular GWS rules are prevented by the use of tables
- Screening can be either incoming or outgoing
- Screening can be either on MTP linksets or Sigtran AS
- EGWS can pass packets to MLR for application-level screening
- Screening is based on parameters from the following layers:
  - MTP3
  - ISUP
  - SCCP
  - MAP
  - SMS
  - MTP or SCCP management messages
Multiple Instances-Virtual STP

Allows up to 8 separate Virtual STPs to exist in one platform

Instance Translation

The ITP supports conversion when moving between NI and SS7 variants
Instance Conversion with Multiple SS7 Variants

**ANSI Network**

- **HLR Query TT=10**
  - HLR query is converted and then sent to Instance 0 in ANSI format

  **ANSI Instance 0**
  - PC-240.5.6
  - Linksets A
  - Route Table B
  - GTT Table C

**ITU Network**

- **HLR Query TT=10**
  - HLR Query TT=5
  - NP=1
  - NAI=4

  **ITU Instance 1**
  - PC-1.1.2
  - Linksets B
  - Route Table C
  - GTT Table D

**MSC**

- **ANSI Phone**
- **ANSI Roaming Phone**
The ITP can color ITP packets based on SS7 parameters – something no IP router can do.

- Allows an operator to share IP infrastructure and yet still achieve the required latency and bandwidth.
ITP Multi-Layer Routing
MLR & SMS Router Architecture

Route Determination
SMS-SRI Parsing
MAP Parsing
TCAP Parsing
Advanced MTP SCCP Routing

Send back for Routing

TRIGGER

SCCP
MTP3 (b)
SCCF-NNI
MTP2
M2PA
SUA
M3UA
SCTP
IP
AAL5
SSCOP
MTP1
ITP Multi-Layer Routing (MLR)

- Select messages with Gateway Screening rules:
  - Destination or originating addresses for MTP Service Indicator (ISUP or SCCP)
  - SCCP Called Party Address fields
  - SCCP Calling Party Address fields, etc

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

- Distribute messages to a server group connected via TDM, HSL or SIGTRAN links

- Guarantee to send segmented or concatenated SMS to the same server for re-assembly

- Optionally modify SCCP Calling or Called Party addresses (and some MAP addresses)
MLR MTP3 OPC-DPC Routing

Subscriber A in home network

MSC1

MLR selective routes the message from MSC2 over the high quality network

MSC2

MLR MTP3 OPC-DPC Routing

HLR Query OPC=MSC1

Low Quality Network

Special Fraud and Billing

HLR

High Quality Network

Subscriber A in Non-home network
Multi-Layer Routing (MLR)
Example: Short Message Service Center

**Broadcast Event**

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

ITP inspects SCCP, TCAP, MAP, and MAP-User parameters to route SMS-MO to the correct service centers handling the message

ITP distributes messages in a weighted round-robin fashion when multiple servers can handle the same service
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 Applications
Cisco Database for Telecoms
Required Features

- **Capacity**
  Able to increase database capacity to meet subscriber and application needs

- **Throughput**
  Able to scale processing capacity without incurring significant hardware change or incur footprint issues

- **Flexible**
  Able to add or change applications without requiring significant hardware additions or redesigns (meet time-to-market requirements)

- **Reliable**
  Able to meet carrier requirements for uptime and maintenance
Cisco Application Architecture

Flexible numbering, Number portability

Next-generation Portability and service addressing

Common Infrastructure For Many Applications

MSC
SSP
SMSC
MMSC
xCSCF
SRE
AIN 0.2
PCS1900
IN
IS-41
INAP

ENUM/DNS
ENUM/SIP

M3UA

CDT
Edge servers

Master servers

E.164 Assignment
Subscriber Updates
HTTP

Other data sources

Admin console

Query flow
Provisioning/OAM flow
Replication flow
Cisco Telecommunication Database Attributes

- All processing occurs in RAM
- Flexible design allows data for multiple applications to be searched in a single transaction—already supports up to 32 applications
- CDT capacity increased by adding more servers

Application #1
  e.g. Flexible Numbers

Application #2
  e.g. MNP-SRF

Application #3
  e.g. EIR
Application Routing Director (ARD)

ARD is an carrier-grade flexible numbering system that can be used to address databases on a per subscriber number basis.

- Full Digit GTT routing to multiple HLRs based on:
  - IMSI or MSISDN
  - MIN-MSID or MDN

- Carriers can distribute subscribers to any HLR
  - Solve MNP IMSI/MSISDN split
  - Maximize HLR utilization
  - Fill in HLR “holes”
  - Ease HLR migration
  - Facilitates carrier mergers
MNP-SRF

MNP-SRF is a carrier-grade number portability application that provides routing info to route onto the home carrier for that number.

- For call related messages, fetches subscriber data and provides routing number back to the MSC.
- For non call related messages, fetches subscriber data and routes the message on via GTT.
- Compliant to 3GPP TS 23.066.
- Supports many forms of NP, including CAMEL, INAP, LNP and ATI.
Network Management and Monitoring
ITP Network Management Attributes

- Automatic Network Discovery
  Inventory & Topology
- Flexible Topology Maps
  Alarm and event representation
  Device/Port Status
- Detailed Fault Management (Events/Alarms)
  Alarms/Events drill-down to device/port
  Customizable Categories and Severities
  Web based Alarm History Viewing System
- Configurable Web based Reporting
  Real-Time Performance Polling/Graphing
  Network Status Dashboard
  Alarm and Security Logs
- Robust North-bound OSS Interfaces
  ASCII Performance data, Alarm History, Device Status
  SNMP Event/Alarm forwarding
  CiscoWorks LMS integration
Cisco MW™ High-Level Overview

- **Carrier-class product**
  - OSS integration interfaces - SNMP, ASCII/FTP, Java RMI, URL-based queries, command-line tools
  - Workflow-based configuration interface - **Not IOS CLI in a GUI!**
  - High availability, Scalability and Performance

- **Insulation from software and hardware changes**
  - New versions of element software
  - New chassis and line cards

- **Complete abstraction from complexities of CLI & SNMP**
  - First line support doesn't need to be CCIE certified

- **Critical component of any successful ITP deployment**
  - High volume provisioning, fault isolation, and capacity management
Cisco MWTM System Functional View

SP Network Care Center
Remote GUI
Web GUI
Internet
SP Customer Care Center

Security Control
Process Control
Log & Audit Control

Java RMI
Web Server

Configuration
SNMP Trap Receiver
SNMP Data Server

Network Provision Inventory & Topology

SNMP Management Traffic
SS7oIP Traffic
Mobile Wireless Transport Manager
Network Structure for Signaling Gateway Management

- MWTM Client
- MWTM Client
- MWTM Client
- MWTM Client
- MWTM Client

Operation Center1
MWMT Server

Operation Center2
MWMT Server

Secondary
Primary

Active
Standby

Speaker for Sound Alert

SNMP polling
SNMP Traps
Syslog monitoring
MWTM Feature Overview

- **Automatic Network Discovery**
  - Inventory & Topology
  - Seed file and seed network

- **Topology Maps**
  - Logical layer visualization of the network
  - Alarm and event representation
  - Device/Port Status

- **Status Monitoring and Drill-down Analysis**
  - Contextual menus
  - Alarms/Events drill-down to device/port

- **Fault Management (Events/Alarms)**
  - Customizable Categories and Severity
  - Sorting, Filtering, Acknowledgment Forwarding (SNMP)
  - Alarm History

- **Web based Alarm History Viewing System**
  - Sorting, Filtering, Archiving, Metrics

- **Security Services**
  - Multi-Level access for users, SSH, SSL, Audit Trails
MWTM Feature Overview

- **NorthBound Interface**
  - XML/SOAP APIs - programmatically manage MWTM events, access MWTM inventory
  - CSV data exports
  - SNMP – Event/Alarm forwarding, Clear/Ack

- **CiscoWorks LMS integration**
  - OAM&P Functions – SWIM, Netconfig, Inventory Reporting, Configuration Archive

- **Troubleshooting**
  - Customizable troubleshooting tools with integrated, online, context-sensitive help

- **Web based Reporting**
  - Link/Linkset, MLR, Probe statistics
  - AS, ASP, GTT, MTP3 Accounting
  - Q.752 compliant reporting
  - Network Status Dashboard

- **Real-Time Performance Polling**
  - Real-time graphs of key statistics
  - msu-rate graphs

- **Provisioning**
  - GTT, Route Table and MLR provisioning, syntax checking, archiving.
  - Provision Links / Linksets / ASP and more
Cisco MWTM Benefits

- Speeds service delivery
  - GTT and Route Table templates

- Improves efficiency and accuracy of service provisioning
  - Configuration mistakes prevent unnecessary downtime
  - Data consistency in provisioning

- Security
  - Direct device access limited to experienced personnel
  - Audit trail and access control

- Proactive Network Monitoring
  - Capacity management using collected statistics
  - Threshold warnings triggered early on
Cisco MW TMTM Benefits

- Rapidly Troubleshoot End-to-end SS7oIP Issues
  - Detailed topology maps
  - Inventory – Logical and Physical characteristics
  - Real-time device view – configuration, alarms, performance
  - Drill-down for faults and alarms

- OPEX
  - Reduce overhead associated with training Level 1 support
  - Minimize fallout from faulty provisioning
  - Time-to-Resolution drastically reduced