SFTI®

SECURE® FINANCIAL TRANSACTION INFRASTRUCTURE

The Art of SFTI

A Financial Industry Network

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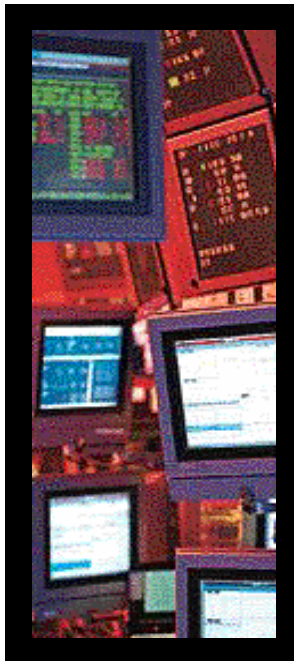
Agenda



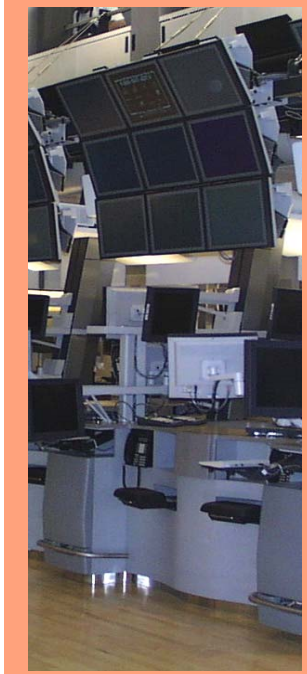
- Introduction
- Design Objective
- Design Overview
- Multicast Design

What is SFTI?

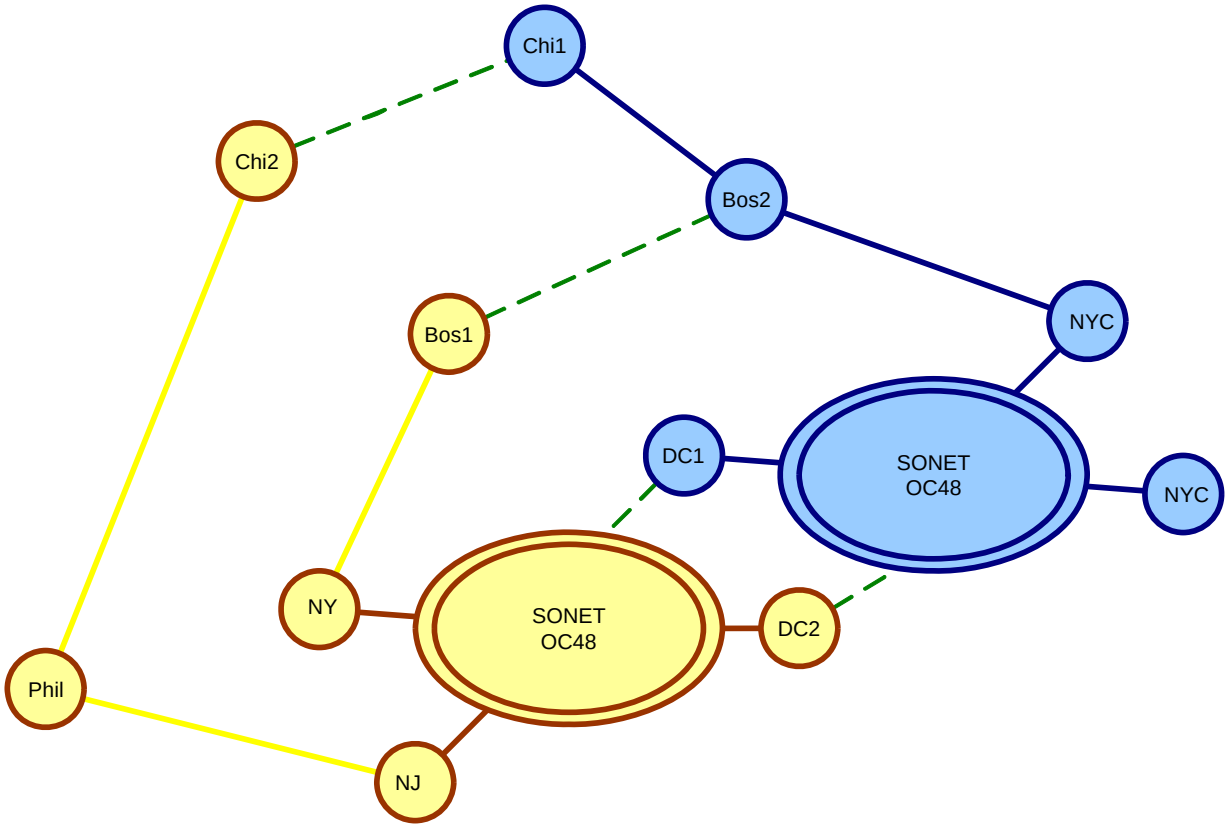
- Secure Financial Transaction Infrastructure
  - Pronounced *"safety"*
  - A direct result of the September 11, 2001 impact on leased line connectivity throughout the USA
  - Developed to help the **financial services industry** substantially improve the **resilience** of **telecommunications connectivity**
  - Spans multiple cities (New York, New Jersey, Chicago, Boston, and Philadelphia)
  - Over 700 member firm connections
  - Web site: *http://sfti.siac.com*

SFTI Design Objective

- No single point of failure
  - Fiber, access point, data center, router, link
- Resiliency and fast recovery
- Low end to end latency
- Redundant Multicast delivery



SFTI High Level Diagram



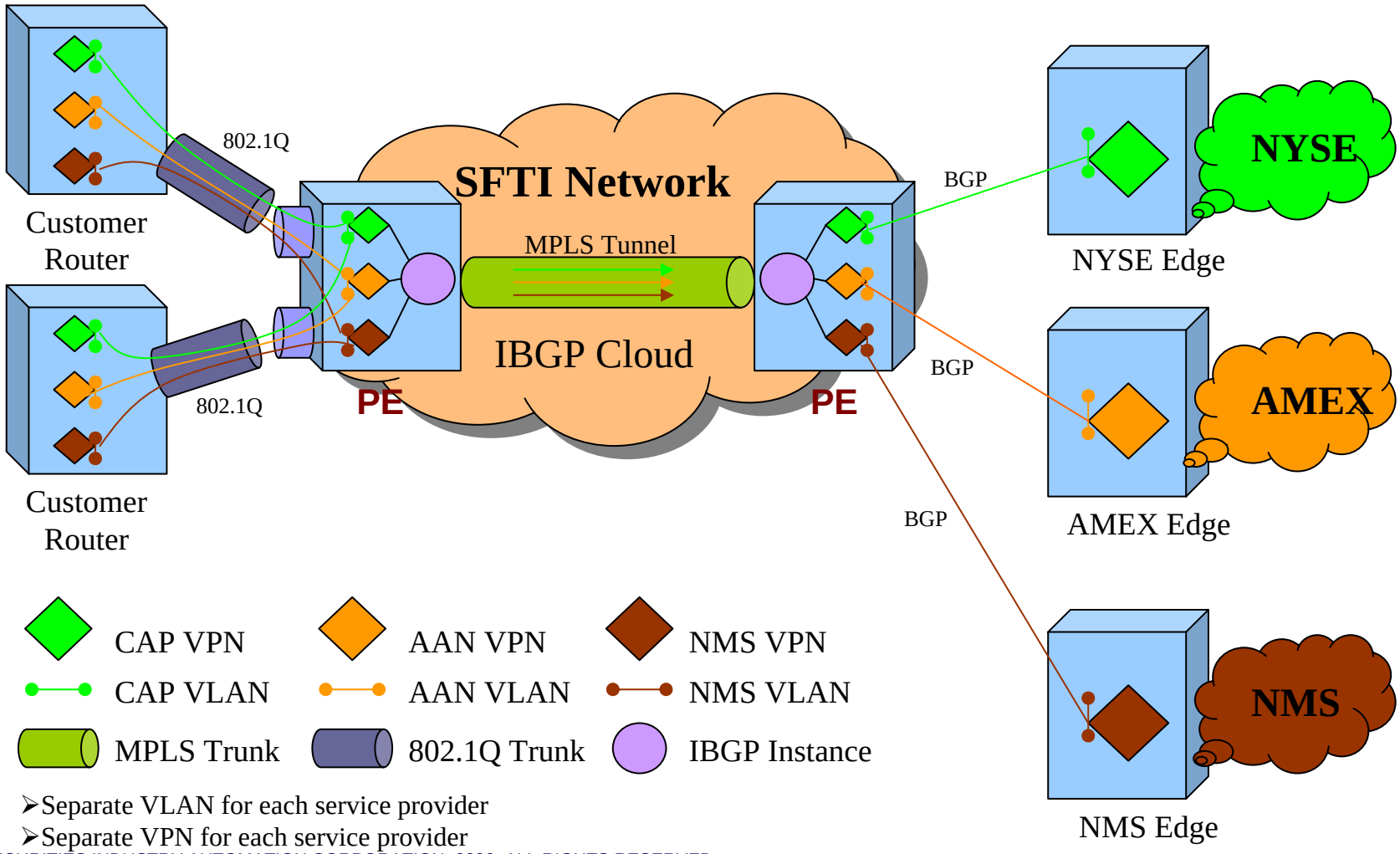
SFTI Connectivity Requirement

- Each customer / service provider required to connect to a minimum of two Access Centers
  - At least one connection to each logical network
- Only Ethernet connectivity is accepted
  - 100BT or Gigabit
  - Customer can co-locate its access routers in SFTI Access Center
  - SFTI partners with extranet to handle other type of connections
- Customer edge router is expected
  - EBGP for unicast
  - PIM for multicast

SFTI Design

- Utilizes MPLS Layer 3 VPN technology (*RFC 2547bis)* to create virtual backbones for financial service providers
- Uses VLAN trunking (ieee 802.1q) to connect to the customers
- One VLAN associates with one service provider’s virtual backbone

SFTI Network Overview



- Separate VLAN for each service provider
- Separate VPN for each service provider

Multicast in Financial Industry

- The benefit of using Multicast as a financial market data distribution method:
  - Efficient bandwidth usage
  - Minimum server resources
- Industry-level multicast applications on SFTI
  - Consolidated Trade and Quote (CT & CQ)
  - Options Price Reporting Authority (OPRA)
  - NYSE Openbook

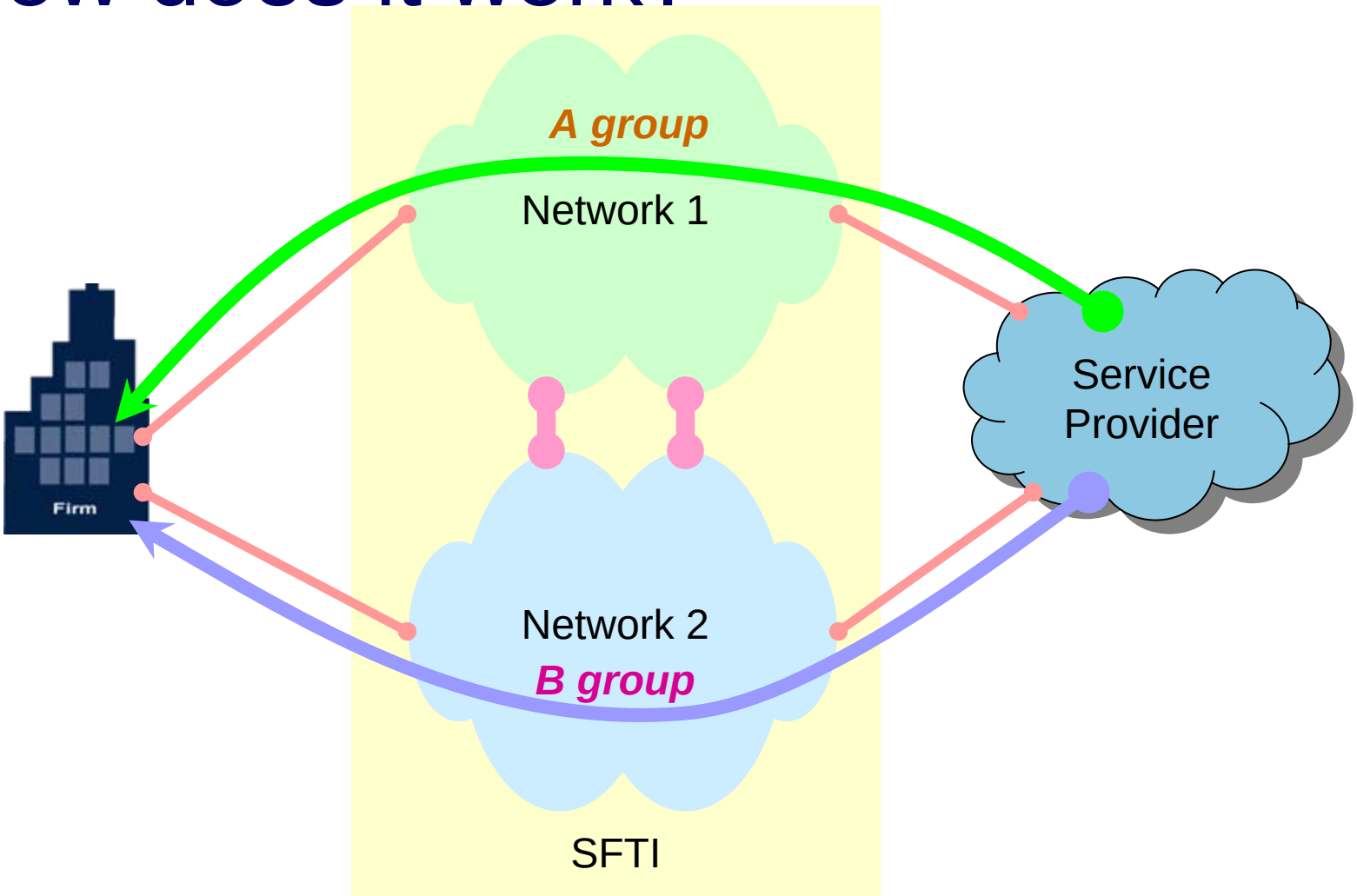
Multicast Requirement

- Highly reliable
  - Every **single** packet counts
  - Very different from delivering video
- Highly available
  - Quick network recovery is not sufficient
  - If a failure occurs in transit network, Multicast packets are not recoverable

Multicast Redundancy

- SIAC is the original inventor and patent holder for providing Multicast redundancy with dual multicast streams
  - Two multicast streams with the same data, delivered to a single receiver simultaneously via two diverse network paths
  - Upon receiving, receivers compare both streams and use the best available
  - *US Patent No. 6,408,000, Multicast Data Distribution System*

How does it work?



Original Multicast Design

- **SFTI delivers NMS, NYSE and AMEX services to the financial industry**
  - **Uses global routing table**
  - **All Multicast source networks are running DVMRP**
  - **Multicast over Layer 3 VPN technology is still in its infancy**

SFTI B2B services

- Delivers unicast and multicast services for other financial market centers / content service providers to SFTI customers

Limitation of Original Model

- Operational changes for one Multicast service can affect other Multicast service providers
  - RP and multicast group association
- IP address and multicast group assignment

Multicast Design for SFTI B2B

- Multicast over Layer 3 VPN via GRE encapsulation
  - Each Market Center/Content Service Provider will have its own virtual backbone on SFTI
  - Each Market Center/Content Service Provider runs its multicast applications in the same virtual backbone as its unicast traffic

How does it work?

- Service provider runs PIM sparse mode with SFTI PE
  - Service provider requires its own RP for both SFTI and customers
- SFTI runs PIM to all customers
  - SFTI provisions customer to use Multicast services with PIM sparse mode
- Multicast VPN via GRE Encapsulation *(draft-rosen-vpn-mcast-06.txt)* on SFTI backbone

**GRE = Generic Routing Encapsulation*

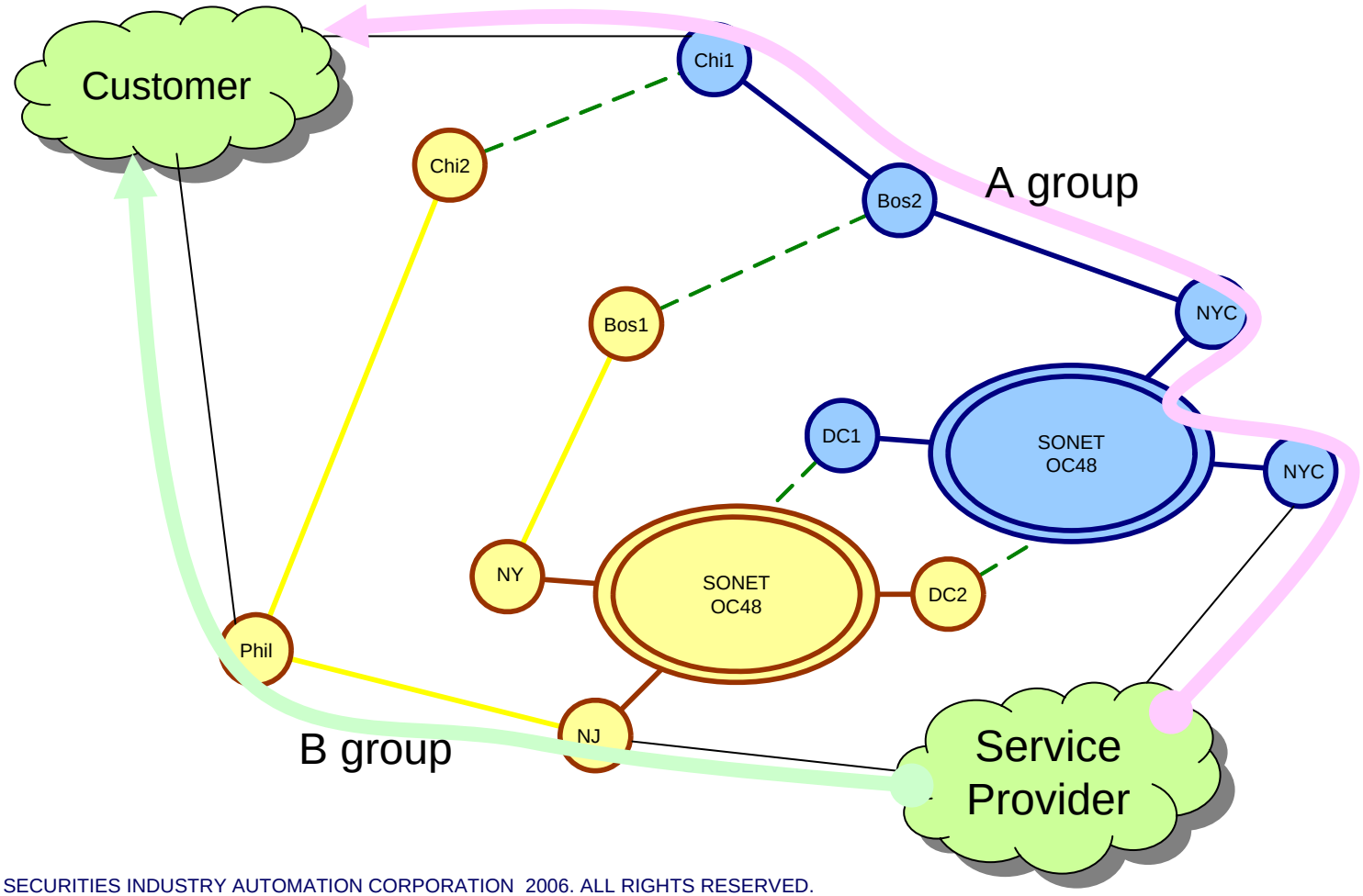
MVPN via GRE Encapsulation

- Multicast GRE tunnels
  - PIM messages among SFTI PE routers
  - Actual Multicast packets
  - Via global routing table
- Utilize the L3VPN virtual backbone for each service provider
  - Source routes are distributed in service provider's virtual backbone
- Dedicated PIM domain for each service provider
  - Individual RP configuration
  - Individual PIM neighbor

Multicast Redundancy

- Routing metric used to steel traffic flows within the same logical network as preferred
  - Raise the OSPF metric for the links between the two logical networks
- Any single point of failure in the network affects only one of the two multicast groups
  - Data gets through uninterrupted

Multicast Flow



Future Direction

- Current limitation
  - GRE encapsulation and de-capsulation introduce additional latency and overhead
  - Lack of PIM RP support
    - MVPN MSDP support on PE routers
  - Troubleshooting complicity
    - Lack of PIM status on virtual tunnel interface

MVPN via P2MP LSP?

- Is MVPN via P2MP LSP the right solution?
  - Vendor support?
  - How long?
  - Industry direction?

Thank You!

- Questions?
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