Inter-utility packet handoff without TDM or SONET while keeping cyber happy

Shaun Skidmore P.E.
Idaho Power Company
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Utilities Technology Council™

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Idaho Power Company Background

- Founded in 1916
- 640,000 customers in a population of 1.4 million people
- 24,000 square mile service area
- 17 Hydroelectric generation plants
- 4 Natural gas generation plants
- 1 Coal generation plant – no coal by 2030
- 8 Company owned and operated BESSes, with more planned
- 4800 miles of transmission and 29,000 miles of distribution
- 2200 Employees
- Hundreds of externally owned utility-scale wind, solar, BESS, hydro, geothermal, biomass systems connected

Our Service Area

More than 640,000 customers

Idaho Power's Communications Infrastructure

- Full conversion from TDM and SDH/SONET to MPLS completed in summer 2015 – now grown to over 490 MPLS nodes
- Internal transport network is primarily fiber and microwave based
- Private internal satellite and telecommunications carrier packet-based services from telecom providers for smaller stations, using IPC MPLS transport across layer 2 leased services
- All internal services are packet based – NO TDM or SDH/SONET
  - Teleprotection/Relaying
  - Remedial Action Schemes
  - SCADA
  - DMR two-way radio
  - BESS monitoring and control
  - 700 MHz Field area network
  - Synchrophasors
  - Physical Security Video
  - Metering
  - Telemetry
  - IT Wide area network
  - VoIP for station phones

Background

Many utilities have neighbors they must interchange information with. Typical applications are:

- Relaying
- SCADA
- MW/MVAR Telemetry
- Automatic ringdowns
- PBX Trunk lines

Background, continued

The circuit types typically needed to interchange these applications are:

- IEEE C37.94
- RS-232
- G.703
- 4 wire and 2 wire analog
- DS1/E1 and DS3/E3
- SONET/SDH

Background, continued

All types of circuits could be a direct interface hand off, such asa cable through a wall to another entity or a cable between entity buildings

They could also be nested within another circuit.

- e.g., a DS0 in a DS1 or a DS1 in an OC-3

But what about packet based services?

Background, continued

Inter-AS options B and C (RFC4364) requires unique system IDs and sharing network information between entities

- Not desirable from a cyber security perspective
- Many entities use private address spacing for system IDs which presents a possibility of address overlap

None of the methods support redundancy without complications

A new approach is needed

Goals for a new approach

- Hand off circuits/services in the best possible cyber secure manner
  - No network topology information exchanged (i.e., IGP routing protocols)
  - No interior node IP addresses exchanged (far-end IP addresses)
  - Bare minimum of protocols running on handoff link(s) (ideally just one, max)
  - Ability to put firewall/IPS/IDS inline with the link(s)

Goals for a new approach, continued

- Support standards-based hand offs
  - Standards based protocols can be more easily inspected by security devices
    - Segment Routing and Binding SID (RFC 8402) and BGP (RFC 4271)
  - Including standards based encapsulated services
    - e.g., C37.94 via CESoPSN (RFC 5086)
- Support wavelength based leased services for inter-utility handoffs
- Reduce reliance on TDM technologies, at least at circuit handoff locations
- Support better for redundancy and resilience handoffs

Barriers

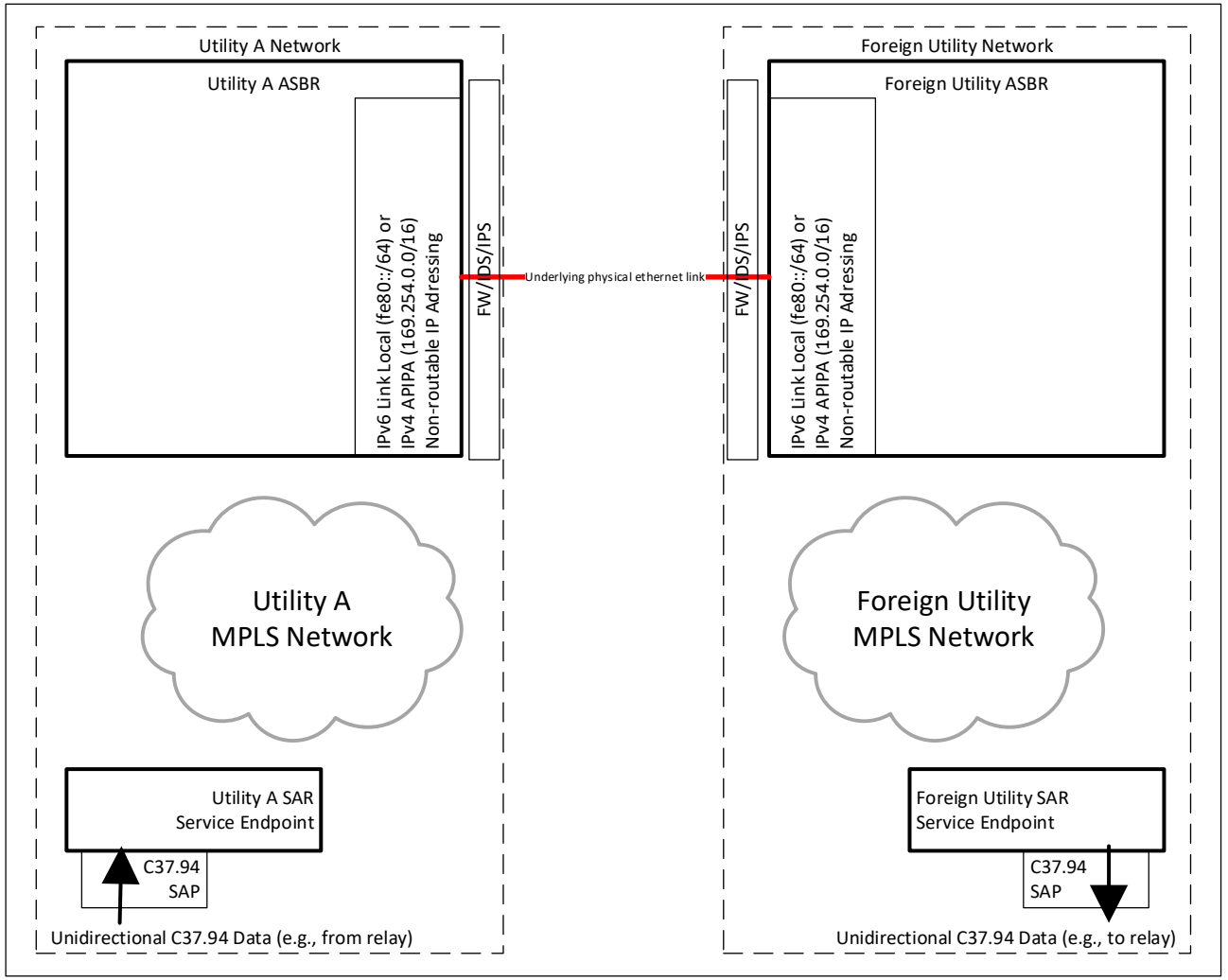
- Inter-entity circuit/service handoffs regularly occur in the telecommunications industry today, but they are done between telecommunications carriers using globally unique node system addresses and an assumption that the services will be delivered between node system addresses that are known to each carrier (Inter-AS options B and C).
  - This goes directly against the cyber secure goal
  - Many utilities use RFC1918 addressing for system IPs in their networks leading to potential IP addressing conflicts

Barriers, continued

- Support from manufacturers to change the status quo of only the above model
- Firewall/IPS/IDS being able to interpret and understand traffic types being handed off
  - Layer 2 operation is likely needed, this is supported by some firewall/IPS/IDS equipment

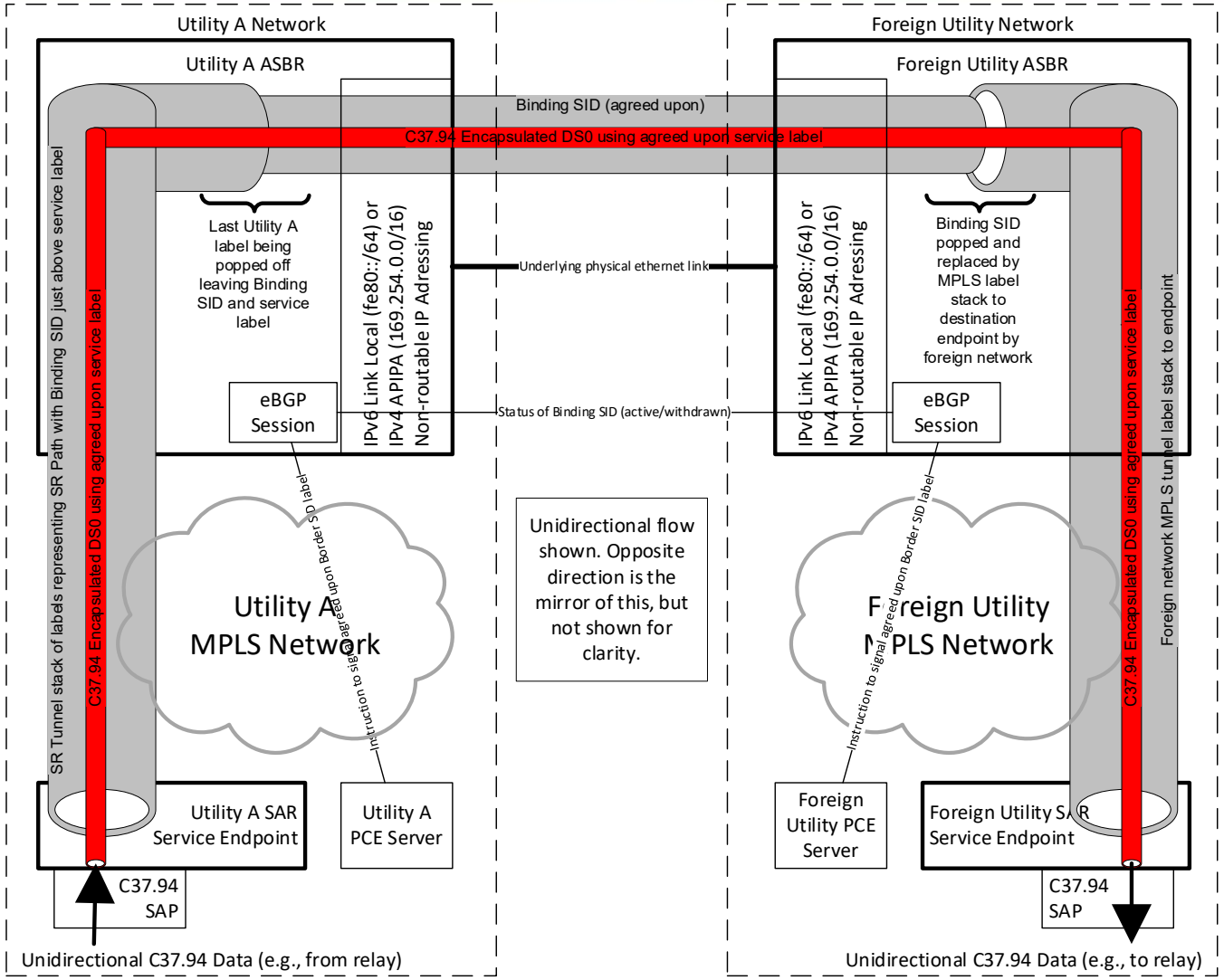
An example network

- Simple two entity network
  - Two autonomous system border routers (ASBRs)
  - Two SARs serving two substations with an IEEE C37.94 service
  - One Ethernet link between the two entities

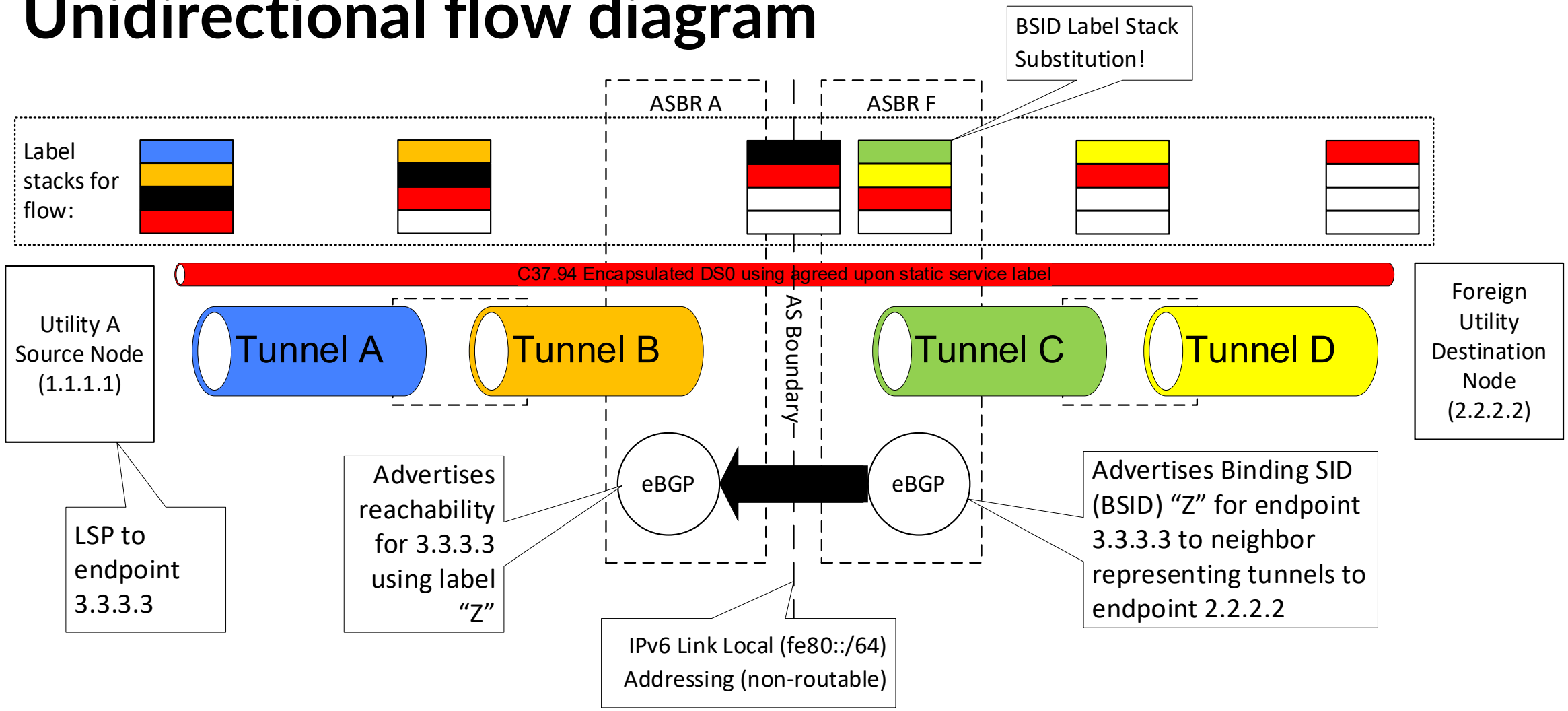


An abstraction approach

- Use MPLS Segment Routing (SR)
  - The key element is the Binding SID for a tunnel between two nodes. The Binding SID would be a static label utilities agree upon in advance
- The link between utilities to use non-routable addressing
  - IPv6 Link Local addressing
  - IPv4 APIPA addressing
- The link between utilities runs just eBGP
  - eBGP can signal if service is live or dead (advertise label or nothing)
  - Can allow for redundant operations
  - May be possible to eliminate?
- Services would be tunneled the between utilities using the Binding SID and agreed upon static service labels
- A PCE may or may not be needed
- ***Agreed upon tunnel and service labels are functionally no different than TDM timeslots***



Unidirectional flow diagram



Questions

Shaun Skidmore, P.E.
Idaho Power Company
+1-208-861-5987
sskidmore@idahopower.com

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