



TRI-STATE G&T

A Touchstone Energy[®]
Cooperative



ssp innovations
GIS • Work Management • Customization • Systems Integration

Provisioning Bandwidth & Logical Circuits **Using Telecom-Based GIS**

Jonathan Hager | Tri-State G&T
Skye Perry | SSP Innovations

Agenda

- § Introductions
- § Business Drivers
- § The Current System & Telecom Assets
- § Fiber Manager & The Physical Network
- § Custom Requirements
- § The Data Model
- § Business Justification & Benefits

Introductions

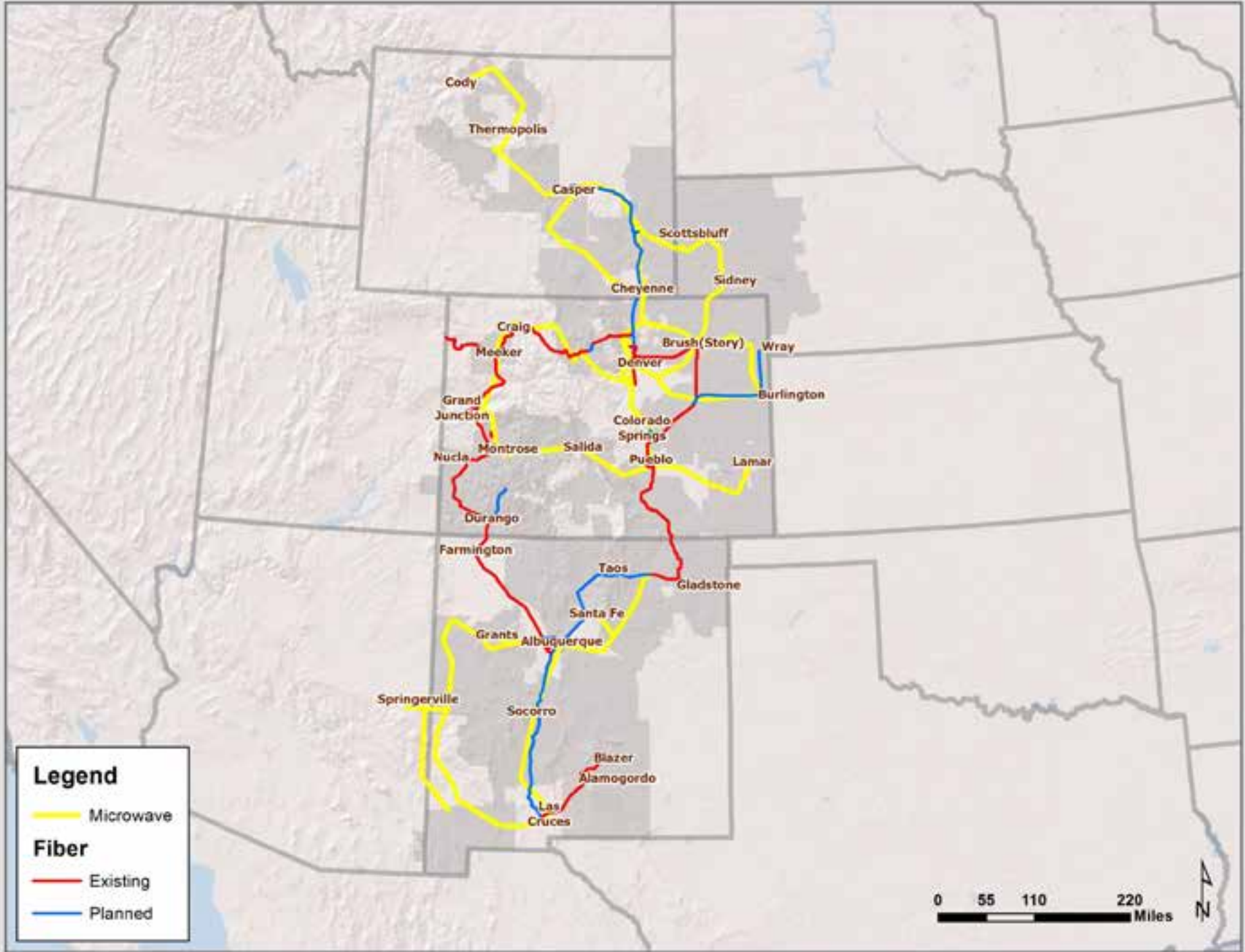
Jonathan Hager | Tri-State G&T

- § Fiber Project Coordinator
- § Responsible for All New Capital Fiber Projects
- § Tri-State for 5 years
- § Extensive experience with carrier telecom (*Level 3, Century Link*)

Skye Perry | SSP Innovations

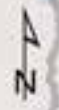
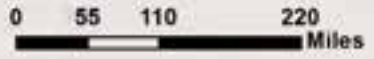
- § Principal Consultant
- § Esri & Schneider Electric Technical Architect
- § Led the current system assessment and technical design @ Tri-State
- § Certified Fiber Manager Implementer





Legend

- Microwave
- Fiber**
- Existing
- Planned



Telecom Staff

§ 5 Telecom Engineers

- Sit at Tri-State HQ building
- Responsible for engineering and design of telecom network
- Primarily microwave and equipment

§ 1 Telecom Projects Coordinator

- Manages installation of fiber optic cables
- Manages 3rd party users of Tri-State's telecom network
- Manages Tri-State's use of 3rd party networks (excluding leased capacity)

§ 1 Leased Circuits Coordinator

- Manages leased capacity on carrier networks

§ 50+ Telecom Maintenance Techs

- Distributed across the 4 state region
- Manage installation and maintenance of all telecom assets and equipment

High Volume of Telecom Assets

§ Grand Junction to Albuquerque:

- 440 miles, 11 segments, 144 fibers per segment, 2 ports per segment = approx **4800** fiber records.

§ One OC-48 Grand Junction to Albuquerque

- 11 segments, 48 STS's per segment, 28 T1's per STS, and 24 DS0's per T1 = approx **355,000** circuit records.

§ Adding 100 to 200 miles of fiber per year

§ Adding 150+ circuit requests per year

Frame Format	Optical	Bit Rate	Maximum DS0s
STS-1	OC-1	51.84 Mb/s	672*
STS-3	OC-3**	155.52 Mb/s	2,016
STS-12	OC-12**	622.08 Mb/s	8,064
STS-24	OC-24	1.244 Gb/s	16,128
STS-48	OC-48**	2.488 Gb/s	32,256
STS-192	OC-192	9.953 Gb/s	129,024

Current System ~ CSMGMT

- § Originally Access Database with VBA Front End 1996
- § Converted to Oracle 9i Forms in 2004
- § Tracked logical infrastructure of circuits including SONET timeslots/channel designation

Circuit Data

Circuit ID: C-04801.00
Create a new version of this circuit

Updated: 01/03/2013 By: DARSPI

Sponsor: Tri-State Generation and Transmission Assoc. Inc. List

Usage: COMMUNICATIONS List

Origination: Westminster OPS List

Description: Cortez Field Facility DS1-1B

Notes: This is a second DS1 to back up the Cortez Field Facility DS1-1A routed to IT's routers in Rio Rancho. See circuit # C-04445.00

Issued: 08/04/2010 By:

User: Tri-State Generation and Transmission Assoc. Inc. List

Other:

Destination: Cortez Field Facility List

Status: Inservice

Replaced By:

Next Circuit
Next Version
Previous Circuit
Previous Version

Channel
Service
Other ID's
Cable
Cards
Drawing

Segment	Designator:		Descriptor:	Route:		Ch Loopback	Ch Notes	User
1	D01-01-02-00	List	CTZO-MW	Lost Canyon Sub-Cortez Field Fac	List			MBOWL
2	S00-01-04-00	List	LOCY-FI	Empire Regen-Lost Canyon Sub	List			MBOWL
3	S00-07-03-00	List	CONN-048	Grand Junction POP-Empire Regen	List			MBOWL
4	D01-01-01-00	List	GRJT-IT	Grand Junction POP-Grand Juncti	List			MBOWL

Business Drivers

§ Current System Issues:

- No longer supported by Oracle
- Slow and not user friendly
- No GIS component
- Not scalable
- Missing needed features (trace circuits, manage fiber routes, link to documentation, track financial information, etc.)



Proposed Solution

- § Create a GIS database and web-based interface to:
- Identify, review, analyze, and update key attributes of the telecom network
 - Include collocation buildings, equipment locations, fiber optic routes, microwave radio systems, MAS radio systems, USAT, and UHF radio systems
 - Provide ability to track logical provisioning with similar capabilities as current home grown system to the DS0 level
 - Geospatial database with robust mapping capabilities

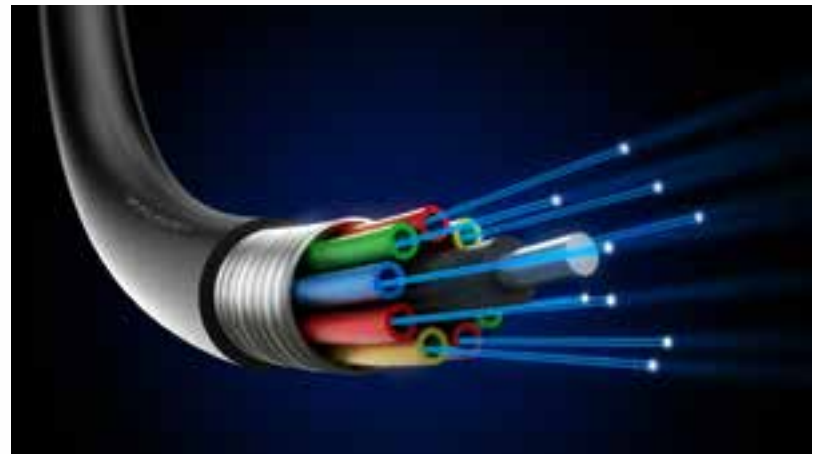


Requirements ~ Larger Than Fiber

- § Initially a new GIS telecom OTS software to satisfy fiber management needs

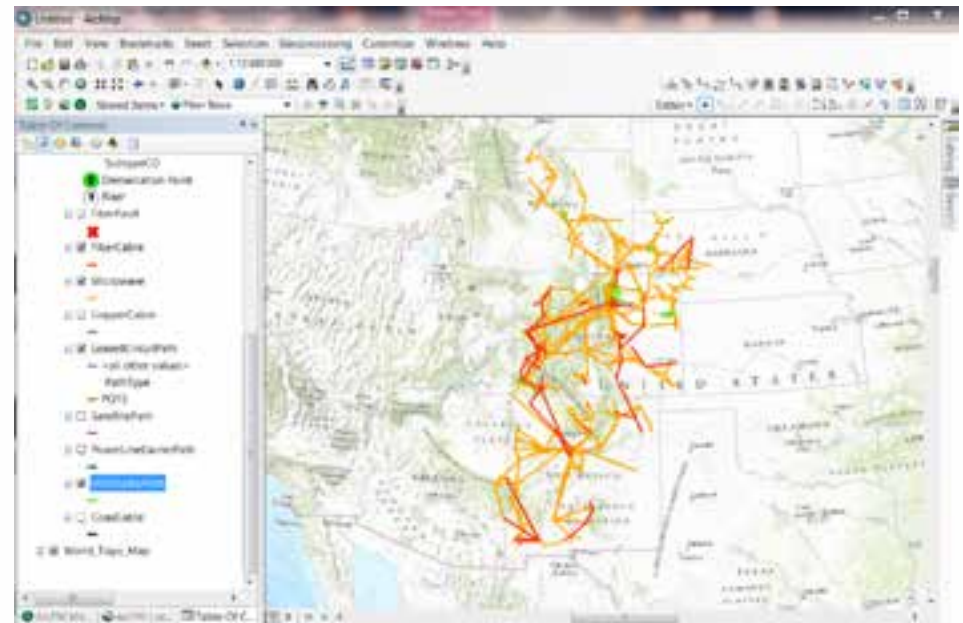
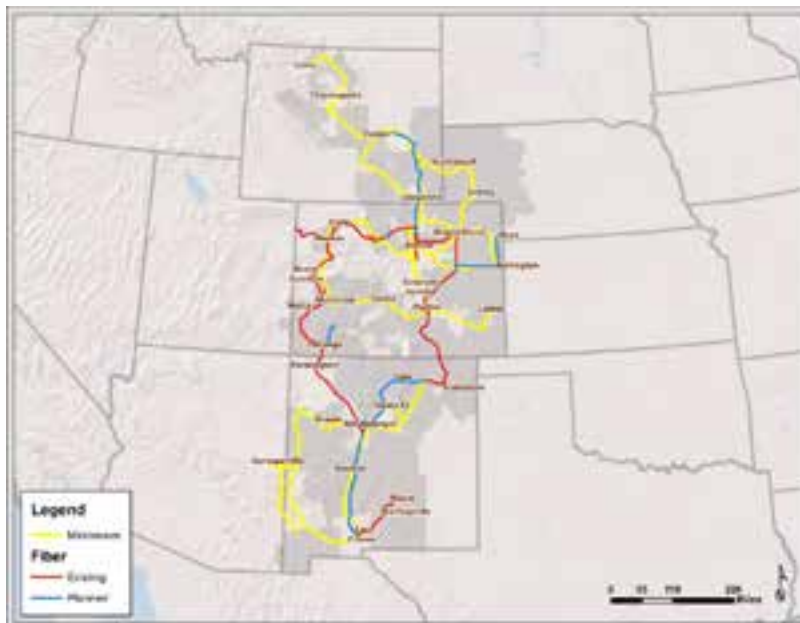
- § Leadership Approved New Circuit Management Solution
 - Add customized software interface to OTS fiber software
 - Migrate Telecom database and fiber data to customized GIS telecom software

- § Ideally tie telecom *circuits* to GIS software



Final Solution

- § Reviewed numerous software providers
- § Interview / demo 4 leading OTS software vendors
- § Selected ESRI/Schneider and Fiber Manager



Informal Poll

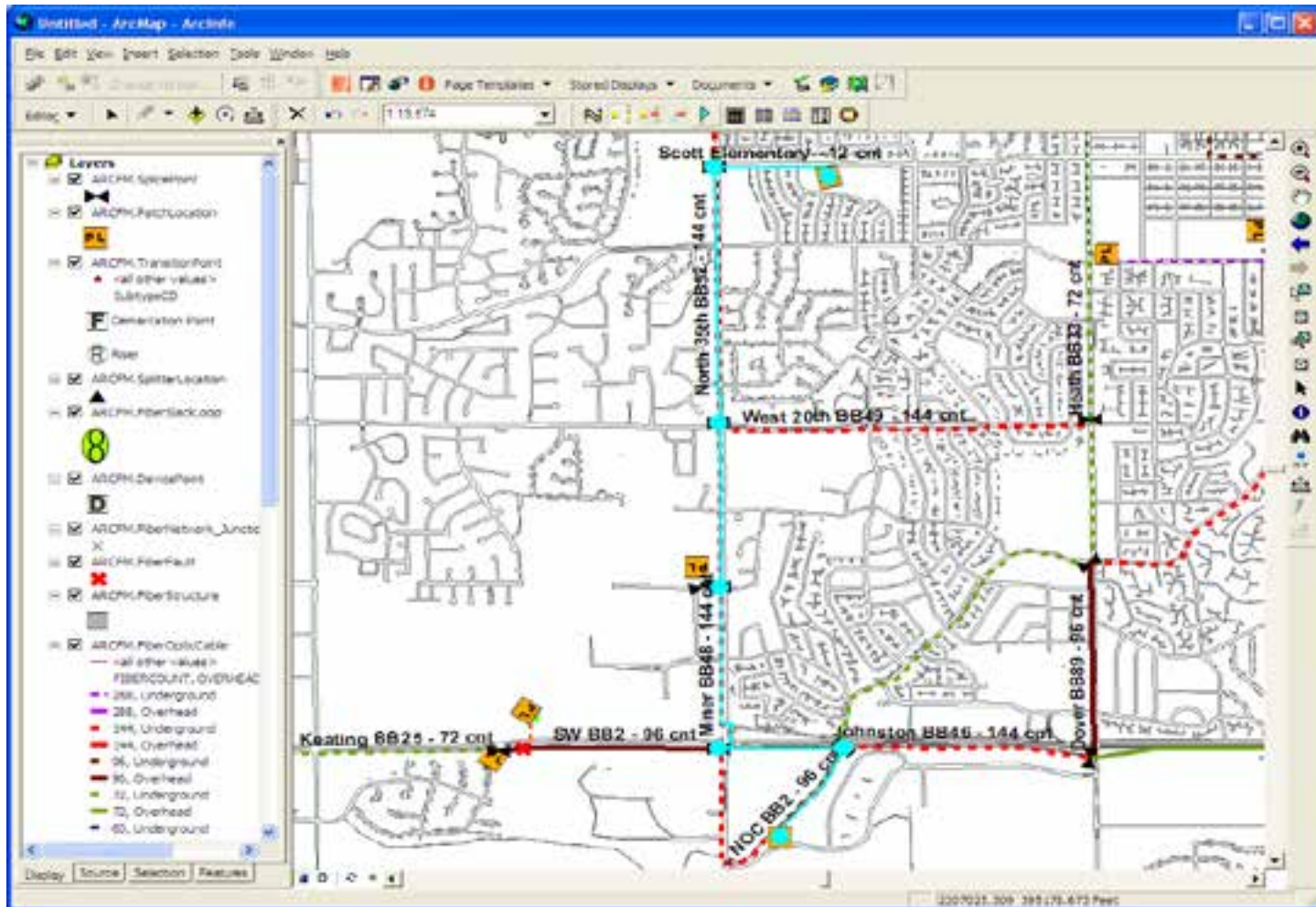
§ How many folks in the room use GIS to track their telecom assets?

§ How many track logical circuit provisioning (in GIS or in another system)?



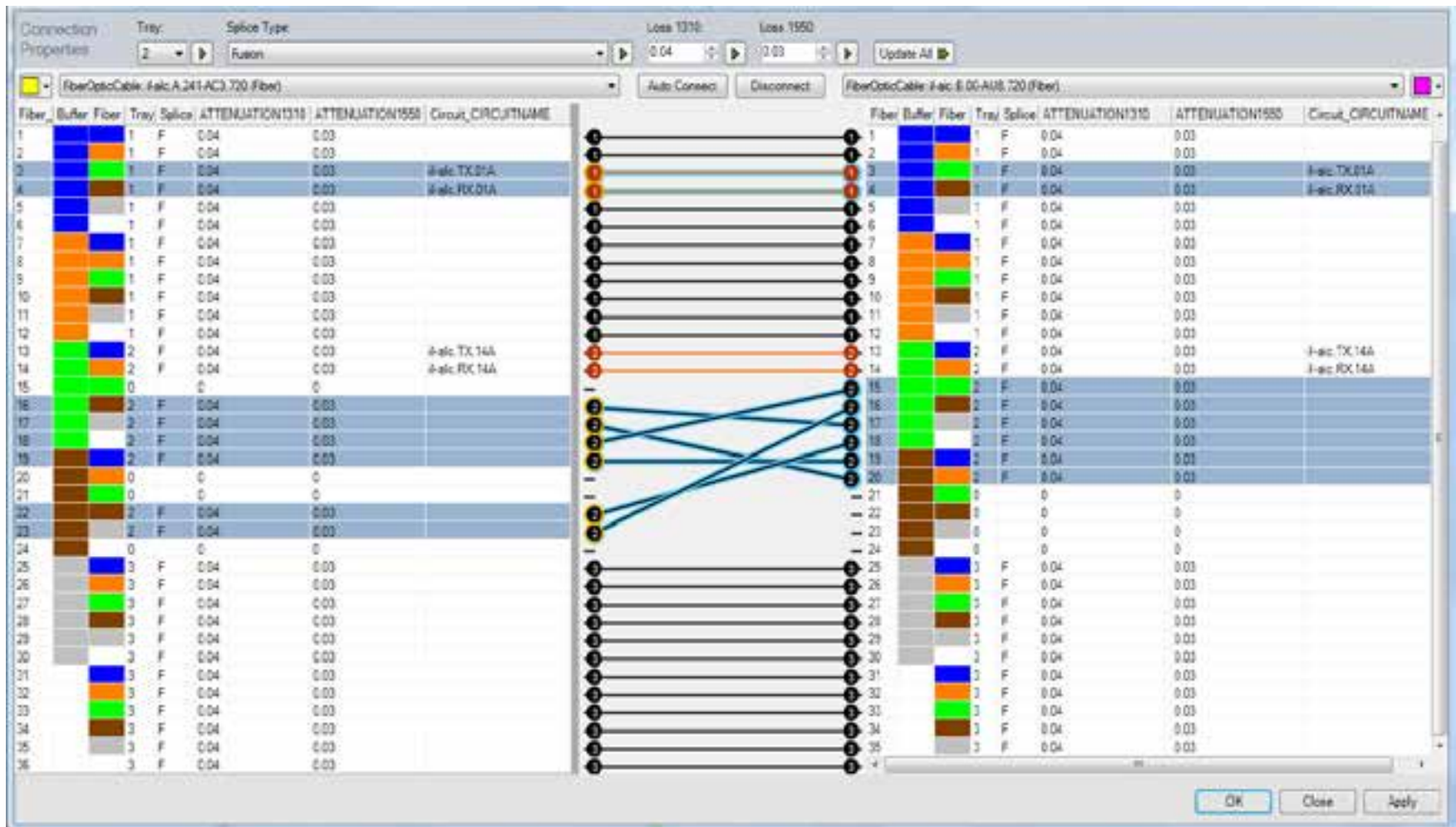
GIS-Based Telecom Asset Management

§ Esri ArcGIS Manages Core Mapping



GIS-Based Telecom Asset Management

§ Schneider Electric Fiber Manager *Manages Connectivity & Assets*

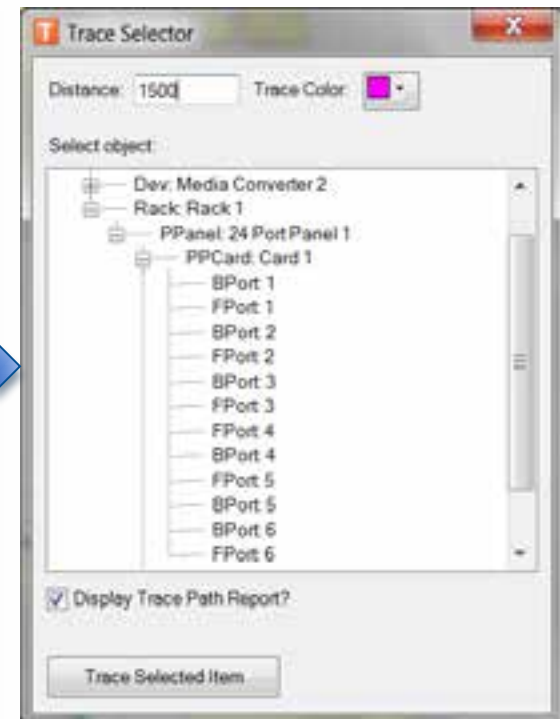
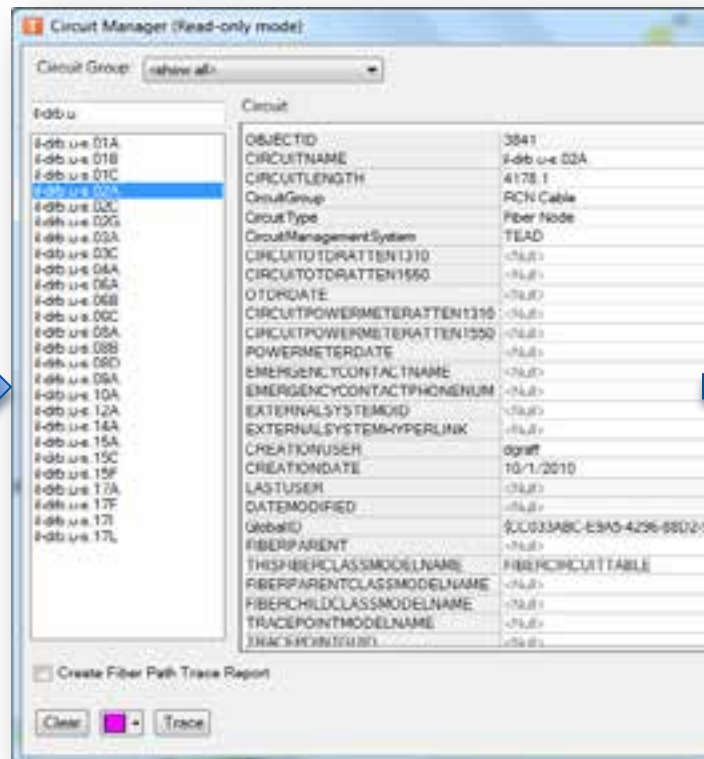


The screenshot displays the Schneider Electric Fiber Manager interface, showing a detailed view of fiber connectivity and attenuation data. The interface is divided into several sections:

- Properties Panel:** Located at the top left, it shows connection properties such as "Tray" (set to 2) and "Splice Type" (set to Fusion). It also displays loss values for 1310nm and 1550nm wavelengths (0.04 and 0.03 respectively) and an "Update All" button.
- Table View:** The main area contains two tables, one for "FiberOptoCable - falc A 241 AC3, 720 Fiber" and another for "FiberOptoCable - falc E 00-AU8, 720 Fiber". Each table has columns for Fiber ID, Buffer Fiber, Tray, Splice, ATTENUATION1310, ATTENUATION1550, and Circuit_CIRCUITNAME. The data is color-coded by fiber type.
- Diagram View:** The central part of the interface shows a visual representation of the fiber connections. Lines connect the fiber IDs in the tables to their corresponding physical locations in the diagram, illustrating the connectivity between the two fiber types.
- Buttons:** At the bottom right, there are "OK", "Close", and "Apply" buttons.

§ Network Analysis and Tracing

- Connection Management
- Fiber Connectivity Traces
- Define circuit paths
- OTDR Trace





Fiber Manager

§ Reporting on Fiber, Splices, Traces, Devices, Patch Locations

Fiber Manager: Allocation Report

Name	SubFiber_Color	Strand_Name	Strand_Color	The SplicePack	Strand_Num	SubFiber_Color	Strand_Name	Strand_Color	The SplicePack	Strand_Num	SubFiber_Color	Strand_Name	Strand_Color
Name: North 300 6512 Floor 10th - Cat6a	Blue	1	Blue	The SplicePack	100	Blue	1	Blue	The SplicePack	100	Blue	1	Blue
Name: North 300 6512 Floor 10th - Cat6a	Orange	2	Orange	The SplicePack	100	Orange	2	Orange	The SplicePack	100	Orange	2	Orange
Name: North 300 6512 Floor 10th - Cat6a	Green	3	Green	The SplicePack	100	Green	3	Green	The SplicePack	100	Green	3	Green
Name: North 300 6512 Floor 10th - Cat6a	Brown	4	Brown	The SplicePack	100	Brown	4	Brown	The SplicePack	100	Brown	4	Brown
Name: North 300 6512 Floor 10th - Cat6a	Yellow	5	Yellow	The SplicePack	100	Yellow	5	Yellow	The SplicePack	100	Yellow	5	Yellow
Name: North 300 6512 Floor 10th - Cat6a	Pink	6	Pink	The SplicePack	100	Pink	6	Pink	The SplicePack	100	Pink	6	Pink
Name: North 300 6512 Floor 10th - Cat6a	Black	7	Black	The SplicePack	100	Black	7	Black	The SplicePack	100	Black	7	Black
Name: North 300 6512 Floor 10th - Cat6a	Red	8	Red	The SplicePack	100	Red	8	Red	The SplicePack	100	Red	8	Red
Name: North 300 6512 Floor 10th - Cat6a	White	9	White	The SplicePack	100	White	9	White	The SplicePack	100	White	9	White
Name: North 300 6512 Floor 10th - Cat6a	Grey	10	Grey	The SplicePack	100	Grey	10	Grey	The SplicePack	100	Grey	10	Grey
Name: North 300 6512 Floor 10th - Cat6a	Cyan	11	Cyan	The SplicePack	100	Cyan	11	Cyan	The SplicePack	100	Cyan	11	Cyan
Name: North 300 6512 Floor 10th - Cat6a	Magenta	12	Magenta	The SplicePack	100	Magenta	12	Magenta	The SplicePack	100	Magenta	12	Magenta
Name: North 300 6512 Floor 10th - Cat6a	LightBlue	13	LightBlue	The SplicePack	100	LightBlue	13	LightBlue	The SplicePack	100	LightBlue	13	LightBlue
Name: North 300 6512 Floor 10th - Cat6a	DarkBlue	14	DarkBlue	The SplicePack	100	DarkBlue	14	DarkBlue	The SplicePack	100	DarkBlue	14	DarkBlue
Name: North 300 6512 Floor 10th - Cat6a	LightGreen	15	LightGreen	The SplicePack	100	LightGreen	15	LightGreen	The SplicePack	100	LightGreen	15	LightGreen
Name: North 300 6512 Floor 10th - Cat6a	DarkGreen	16	DarkGreen	The SplicePack	100	DarkGreen	16	DarkGreen	The SplicePack	100	DarkGreen	16	DarkGreen
Name: North 300 6512 Floor 10th - Cat6a	LightYellow	17	LightYellow	The SplicePack	100	LightYellow	17	LightYellow	The SplicePack	100	LightYellow	17	LightYellow
Name: North 300 6512 Floor 10th - Cat6a	DarkYellow	18	DarkYellow	The SplicePack	100	DarkYellow	18	DarkYellow	The SplicePack	100	DarkYellow	18	DarkYellow
Name: North 300 6512 Floor 10th - Cat6a	LightCyan	19	LightCyan	The SplicePack	100	LightCyan	19	LightCyan	The SplicePack	100	LightCyan	19	LightCyan
Name: North 300 6512 Floor 10th - Cat6a	DarkCyan	20	DarkCyan	The SplicePack	100	DarkCyan	20	DarkCyan	The SplicePack	100	DarkCyan	20	DarkCyan
Name: North 300 6512 Floor 10th - Cat6a	LightMagenta	21	LightMagenta	The SplicePack	100	LightMagenta	21	LightMagenta	The SplicePack	100	LightMagenta	21	LightMagenta
Name: North 300 6512 Floor 10th - Cat6a	DarkMagenta	22	DarkMagenta	The SplicePack	100	DarkMagenta	22	DarkMagenta	The SplicePack	100	DarkMagenta	22	DarkMagenta
Name: North 300 6512 Floor 10th - Cat6a	LightRed	23	LightRed	The SplicePack	100	LightRed	23	LightRed	The SplicePack	100	LightRed	23	LightRed
Name: North 300 6512 Floor 10th - Cat6a	DarkRed	24	DarkRed	The SplicePack	100	DarkRed	24	DarkRed	The SplicePack	100	DarkRed	24	DarkRed
Name: North 300 6512 Floor 10th - Cat6a	LightWhite	25	LightWhite	The SplicePack	100	LightWhite	25	LightWhite	The SplicePack	100	LightWhite	25	LightWhite
Name: North 300 6512 Floor 10th - Cat6a	DarkWhite	26	DarkWhite	The SplicePack	100	DarkWhite	26	DarkWhite	The SplicePack	100	DarkWhite	26	DarkWhite

Schneider Electric

Fiber Manager: Splice Report: 322

Fiber Color	SubFiber Color	Strand Color	Length	Loss	Total	Loss	Total	Additional Information
1	Blue	Blue	0	0.00	0.00	0	0.00	
2	Orange	Orange	0	0.00	0.00	0	0.00	
3	Green	Green	0	0.00	0.00	0	0.00	
4	Brown	Brown	0	0.00	0.00	0	0.00	

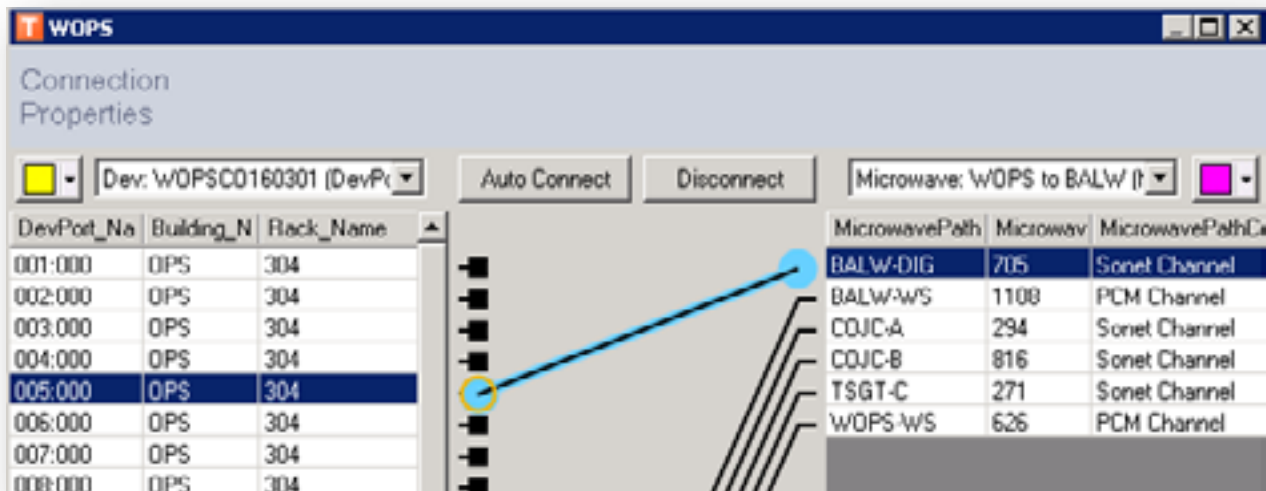
Name	FiberColor	SubFiber_Color	Strand_Color	Strand_Num	SubFiber_Color	Strand_Color	Strand_Num
Name: FiberColor: 900 Street 1820 (Strand)	Blue	Blue	Blue	12	Blue	Blue	12
Name: FiberColor: 900 Street 1820 (Strand)	Orange	Orange	Orange	14	Orange	Orange	14
Name: FiberColor: 900 Street 1820 (Strand)	Green	Green	Green	17	Green	Green	17
Name: FiberColor: 900 Street 1820 (Strand)	Brown	Brown	Brown	18	Brown	Brown	18
Name: FiberColor: 900 Street 1820 (Strand)	Yellow	Yellow	Yellow	34	Yellow	Yellow	34
Name: FiberColor: 900 Street 1820 (Strand)	Pink	Pink	Pink	36	Pink	Pink	36
Name: FiberColor: 900 Street 1820 (Strand)	Black	Black	Black	38	Black	Black	38
Name: FiberColor: 900 Street 1820 (Strand)	Red	Red	Red	40	Red	Red	40
Name: FiberColor: 900 Street 1820 (Strand)	White	White	White	44	White	White	44
Name: FiberColor: 900 Street 1820 (Strand)	Grey	Grey	Grey	44	Grey	Grey	44
Name: FiberColor: 900 Street 1820 (Strand)	Cyan	Cyan	Cyan	17	Cyan	Cyan	17
Name: FiberColor: 900 Street 1820 (Strand)	Magenta	Magenta	Magenta	17	Magenta	Magenta	17
Name: FiberColor: 900 Street 1820 (Strand)	LightBlue	LightBlue	LightBlue	17	LightBlue	LightBlue	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkBlue	DarkBlue	DarkBlue	17	DarkBlue	DarkBlue	17
Name: FiberColor: 900 Street 1820 (Strand)	LightGreen	LightGreen	LightGreen	17	LightGreen	LightGreen	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkGreen	DarkGreen	DarkGreen	17	DarkGreen	DarkGreen	17
Name: FiberColor: 900 Street 1820 (Strand)	LightYellow	LightYellow	LightYellow	17	LightYellow	LightYellow	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkYellow	DarkYellow	DarkYellow	17	DarkYellow	DarkYellow	17
Name: FiberColor: 900 Street 1820 (Strand)	LightCyan	LightCyan	LightCyan	17	LightCyan	LightCyan	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkCyan	DarkCyan	DarkCyan	17	DarkCyan	DarkCyan	17
Name: FiberColor: 900 Street 1820 (Strand)	LightMagenta	LightMagenta	LightMagenta	17	LightMagenta	LightMagenta	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkMagenta	DarkMagenta	DarkMagenta	17	DarkMagenta	DarkMagenta	17
Name: FiberColor: 900 Street 1820 (Strand)	LightRed	LightRed	LightRed	17	LightRed	LightRed	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkRed	DarkRed	DarkRed	17	DarkRed	DarkRed	17
Name: FiberColor: 900 Street 1820 (Strand)	LightWhite	LightWhite	LightWhite	17	LightWhite	LightWhite	17
Name: FiberColor: 900 Street 1820 (Strand)	DarkWhite	DarkWhite	DarkWhite	17	DarkWhite	DarkWhite	17

Open All Collapse All Search Clear

Class Name	Length	Total Length	Loss 1310	Total Loss 1310	Loss 1550	Total Loss 1550	Additional Information
FFPort 1	0	00	0	0.00	0	0.00	PPCard_Position
Class Name	Length	Total Length	Loss 1310	Total Loss 1310	Loss 1550	Total Loss 1550	Additional Information
BPort 1	0	00	0	0.00	0	0.00	PPCard_Position
Conn: 6567	0	00	0.22	0.22	0.21	0.21	PPCard_Position
Fbr 1 - Blue	60.02	60.02	0.02	0.24	0.02	0.23	BT_Color
Conn: 6591	0	60.02	0.26	0.50	0.22	0.45	PPCard_Position
FFPort 1	0	60.02	0	0.50	0	0.45	PPCard_Position
BPort 1	0	60.02	0	0.50	0	0.45	PPCard_Position
Conn: 6415	0	60.02	0.06	0.56	0.05	0.50	PPCard_Position
Fbr 1 - Blue	540.26	600.30	0.22	0.78	0.16	0.60	DT_Color
Conn: 6319	0	600.30	0	0.78	0	0.65	PPCard_Position
Fbr 1 - Blue	476.73	1,077.03	0.10	0.97	0.14	0.80	BT_Color
Conn: 6247	0	1,077.03	0	0.97	0	0.80	PPCard_Position
Fbr 1 - Blue	422.98	1,500.01	0.35	1.32	0.26	1.06	BT_Color

Fiber Manager – It's Physical

- § Connection Manager allows you to connect fiber, microwave, etc. to a physical port on a device on each end
- § No internal connectivity between device ports within a device
- § Circuit Manager allows you to create a named physical path from device to device
- § Does a good job in tracking physical assets and connectivity

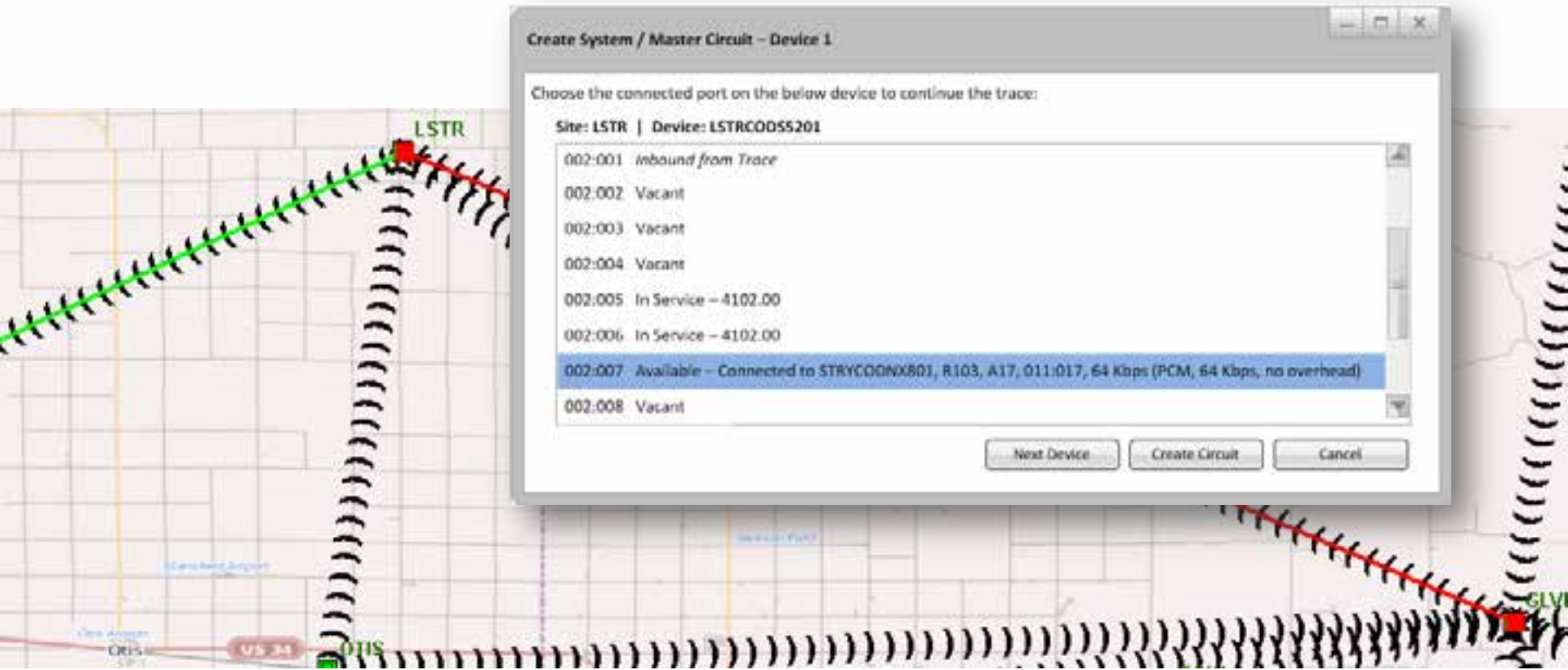


The screenshot shows the 'WOPS Connection Properties' window. It features a table of device ports on the left and a table of microwave paths on the right. A blue line connects a port in the left table to a path in the right table.

DevPort_Na	Building_N	Rack_Name
001:000	OPS	304
002:000	OPS	304
003:000	OPS	304
004:000	OPS	304
005:000	OPS	304
006:000	OPS	304
007:000	OPS	304
008:000	OPS	304

MicrowavePath	Microwav	MicrowavePathCa
BALW-DIG	705	Sonet Channel
BALW-WS	1108	PCM Channel
COJC-A	294	Sonet Channel
COJC-B	816	Sonet Channel
TSGT-C	271	Sonet Channel
WOPS-WS	626	PCM Channel

- § Track master/header circuits that traverse through devices
- Custom Trace Linking Multiple Fiber Manager Physical Circuits
 - Defines connectivity between internal device ports
 - Establish bandwidth between end points



§ Define a bandwidth hierarchy for each master circuit up to an OC-192 (10 Gb/s)

Create System / Master Circuit – Finalize Circuit

Enter the required details to create the new System & Master circuit:

Origination: LSTR | **Device:** LSTRCODS5201 **Destination:** STRY | **Device:** STRYCODNX801

System Descriptor: **Status:**

Circuit Number: **Bandwidth:**

Sponsor/Owner:

User:

Usage: **Other:**

Description:

Notes:

- § Allocate logical trunk circuits
(reserved bandwidth, ex. a full STS-1 or DS1)
- § Provision logical tributary circuits
(committed bandwidth) down to a DS0
 - Custom Two Point Trace Through Master Circuits

Logical Circuit Provisioning – New Circuit

Enter the required information about the new circuit:

Bandwidth: Count:

Total Bandwidth: DS0s Mbps

Circuit Type: Trunk Tributary

Medium: Radio Cable Satellite MAS
 Fiber Coax PLC WDM

Ownership: Tri-State Third Party Leased

Limit to Systems With Existing Interconnectivity:

Logical Circuit Provisioning – Available Paths

Available Paths between LSTR and STRY for 24 DS0s:

#	Distance (ft)	Systems Traversed
1	4,169	TSGT-C
2	4,521	TSGT-C, DONA-DIG, TEPK-MW
3	7,520	TSGT-C, DONA-DIG, TIAB-PN
4	9,552	TSGT-C, STRY-FI, SUIL-DIG

Path Details:

System	Hops	Capacity	Capacity (DS0s)	Allocated (DS0s)	Allocation %	Proposed Allocation (DS0s)	Proposed Allocation %
TSGT-C	3	OC-48	32,256	20,643	64%	20,667	64.1%
DONA-DIG	2	OC-3	2,016	1,774	88%	1,798	89.2%
TEPK-MW	3	OC-1	672	100	15%	124	18.4%

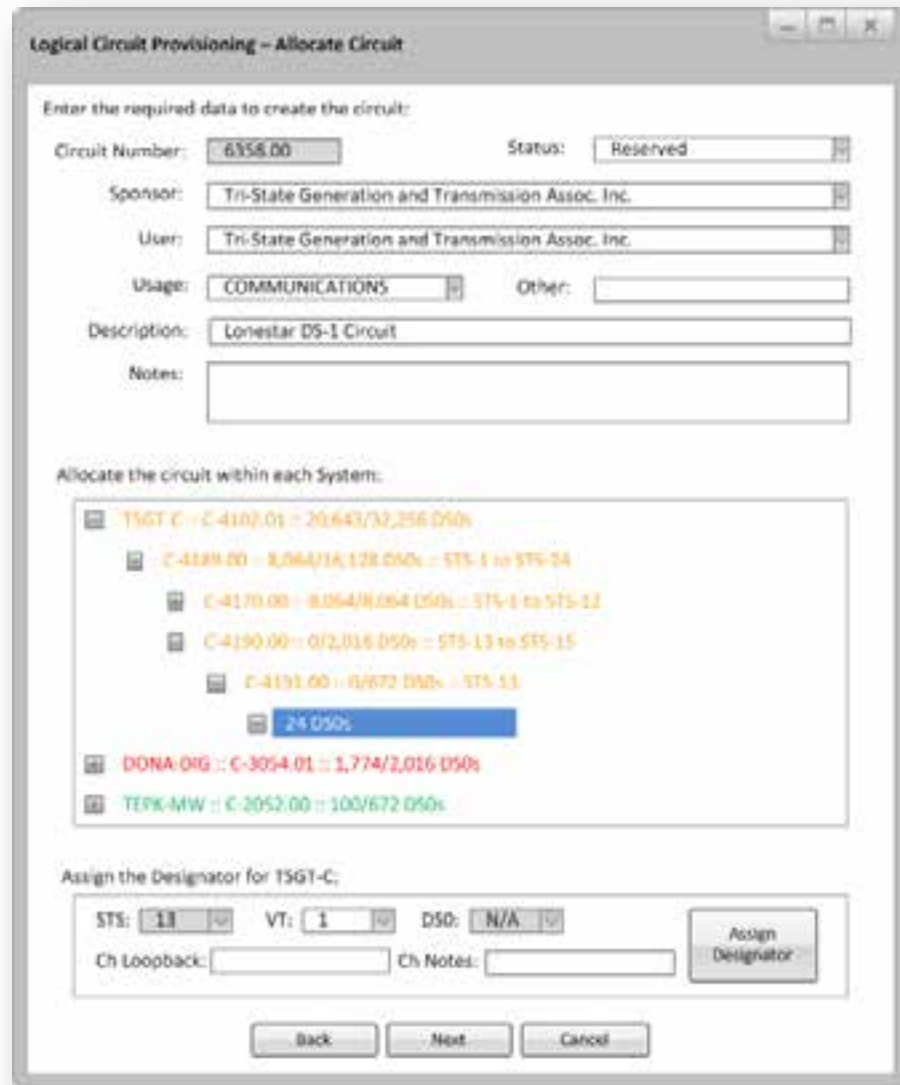
§ Allocate circuits within the master circuit hierarchy

- 24 DS0s = 1 DS1
- Tributary Circuit

§ Ex Hierarchy:

- Consuming the 1st Vir. Tributary
- Within the 13th OC-1 (trunk)
- Within an OC-3 (trunk)
- Within an OC-12 (trunk)
- Within an OC-24 (trunk)
- Within an OC-48 (master)

§ Defines the Timeslot of the circuit



Enter the required data to create the circuit:

Circuit Number: Status:

Sponsor:

User:

Usage: Other:

Description:

Notes:

Allocate the circuit within each System:

- TSGT-C :: C-4102.01 :: 20,643/32,256 DS0s
 - C-4118.00 :: 8,064/16,128 DS0s :: STS-1 to STS-24
 - C-4170.00 :: 8,064/16,064 DS0s :: STS-1 to STS-12
 - C-4190.00 :: 0/2,016 DS0s :: STS-13 to STS-15
 - C-4191.00 :: 0/672 DS0s :: STS-13
 - 24 DS0s
- DDNA-ORG :: C-3054.01 :: 1,774/2,016 DS0s
- TEPK-MW :: C-2052.00 :: 100/672 DS0s

Assign the Designator for TSGT-C:

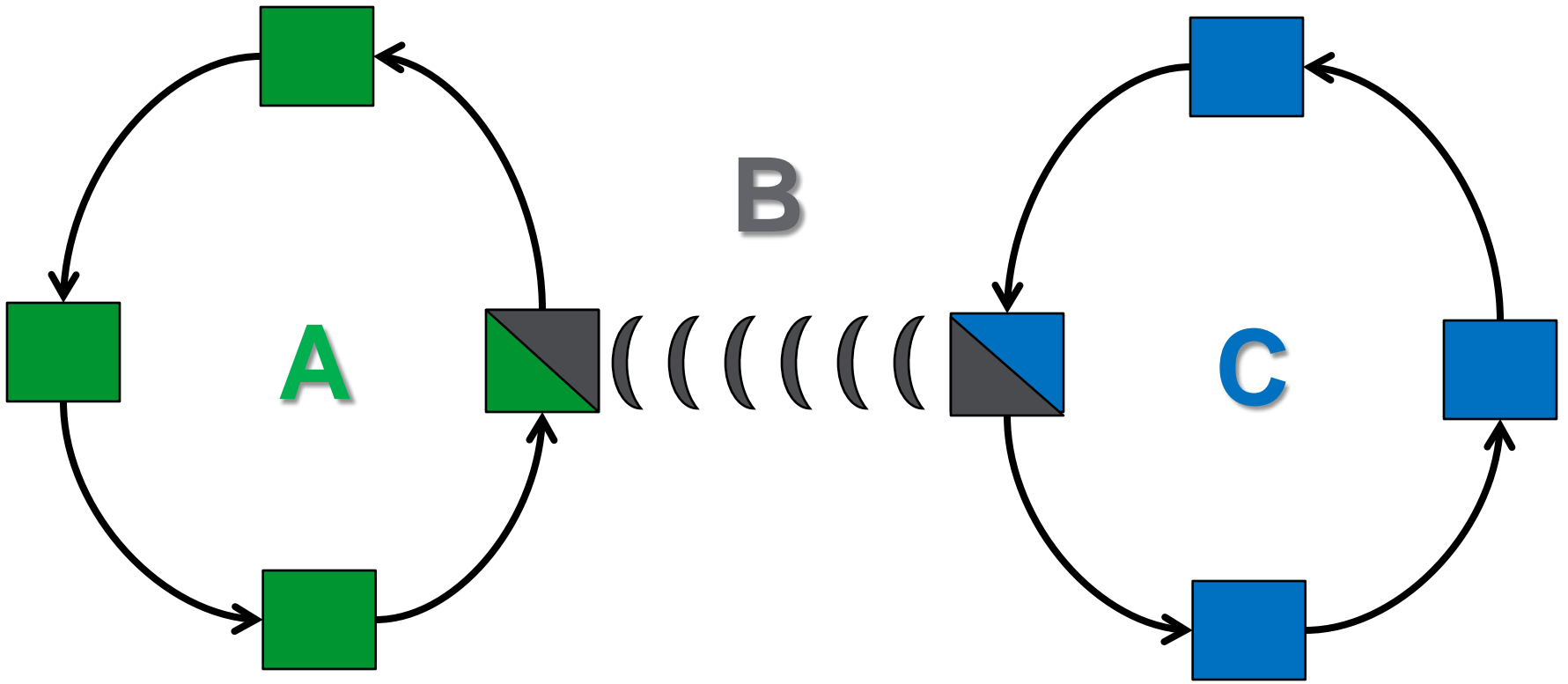
STS: VT: DSO:

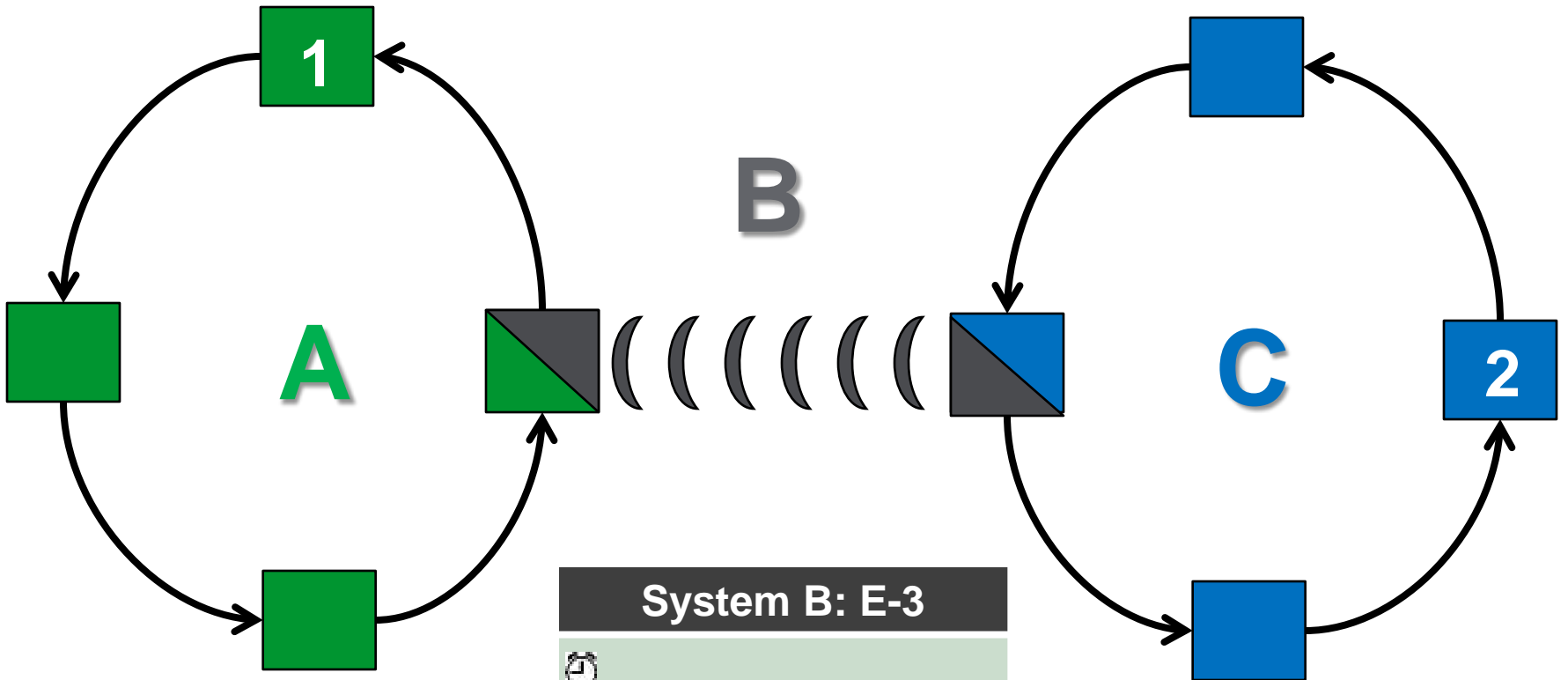
Ch Loopback: Ch Notes:



What can we do with this level of detailed data?

- § Recommend circuit provisioning based on available timeslots
- § Track allocated bandwidth vs. capacity at all points on network
- § Create a GIS heat map showing bottlenecks
- § Drive capital planning for network expansion
- § Poke the network at any point to see:
 - Hierarchy of the master circuit(s)
 - Which logical circuits are present
 - The use of each logical circuit (down to the DS0)
- § Result is a scalable system

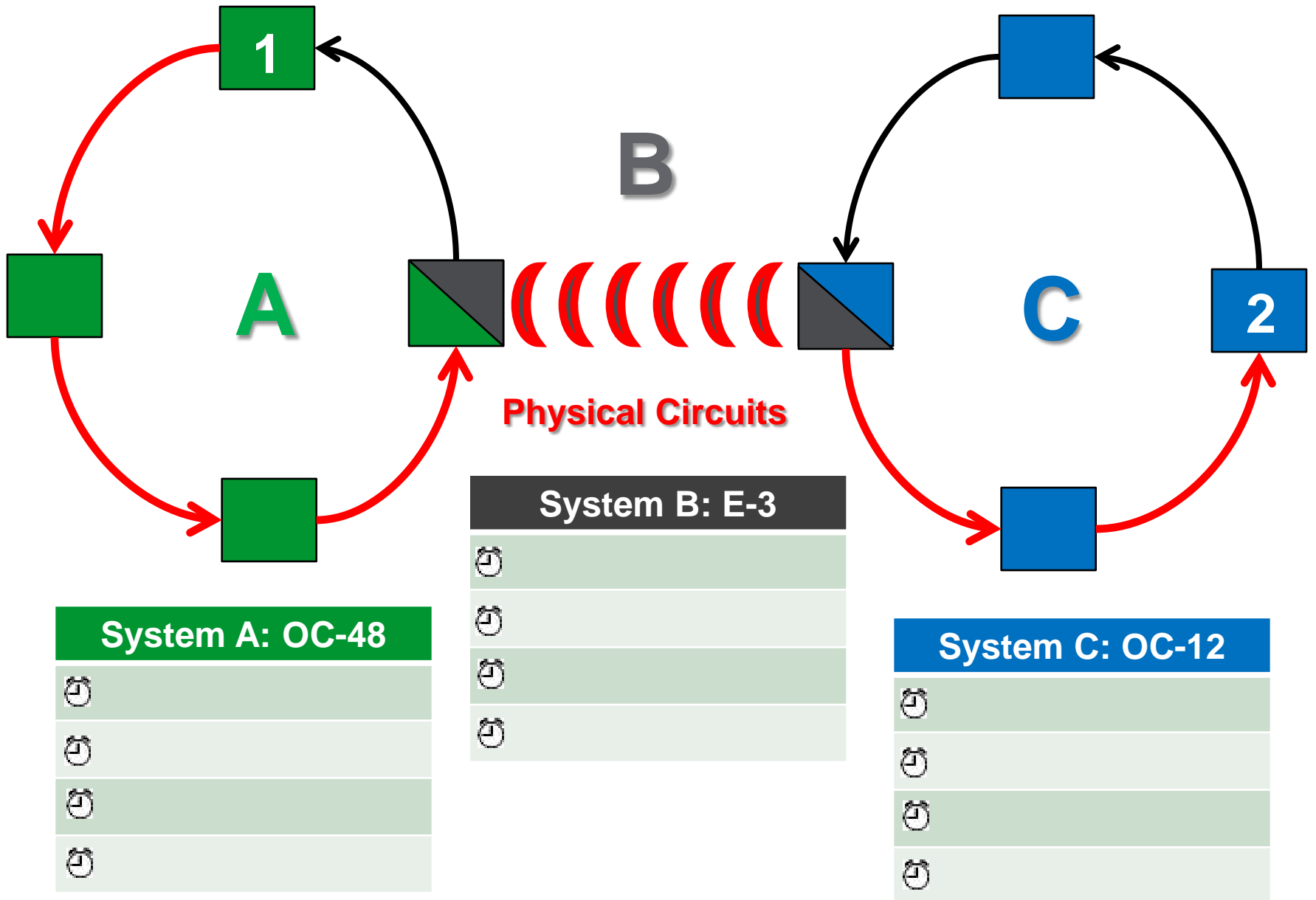


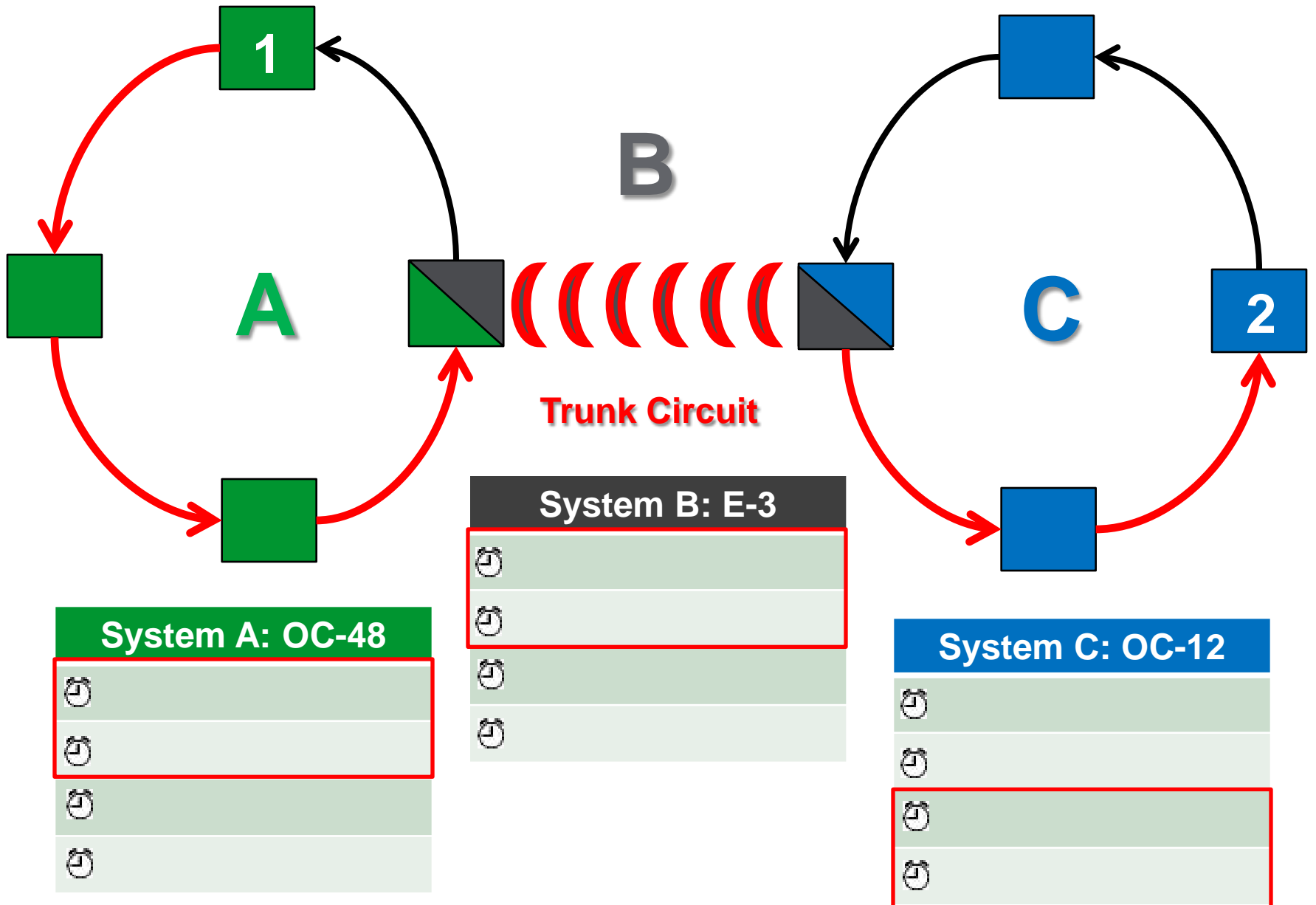


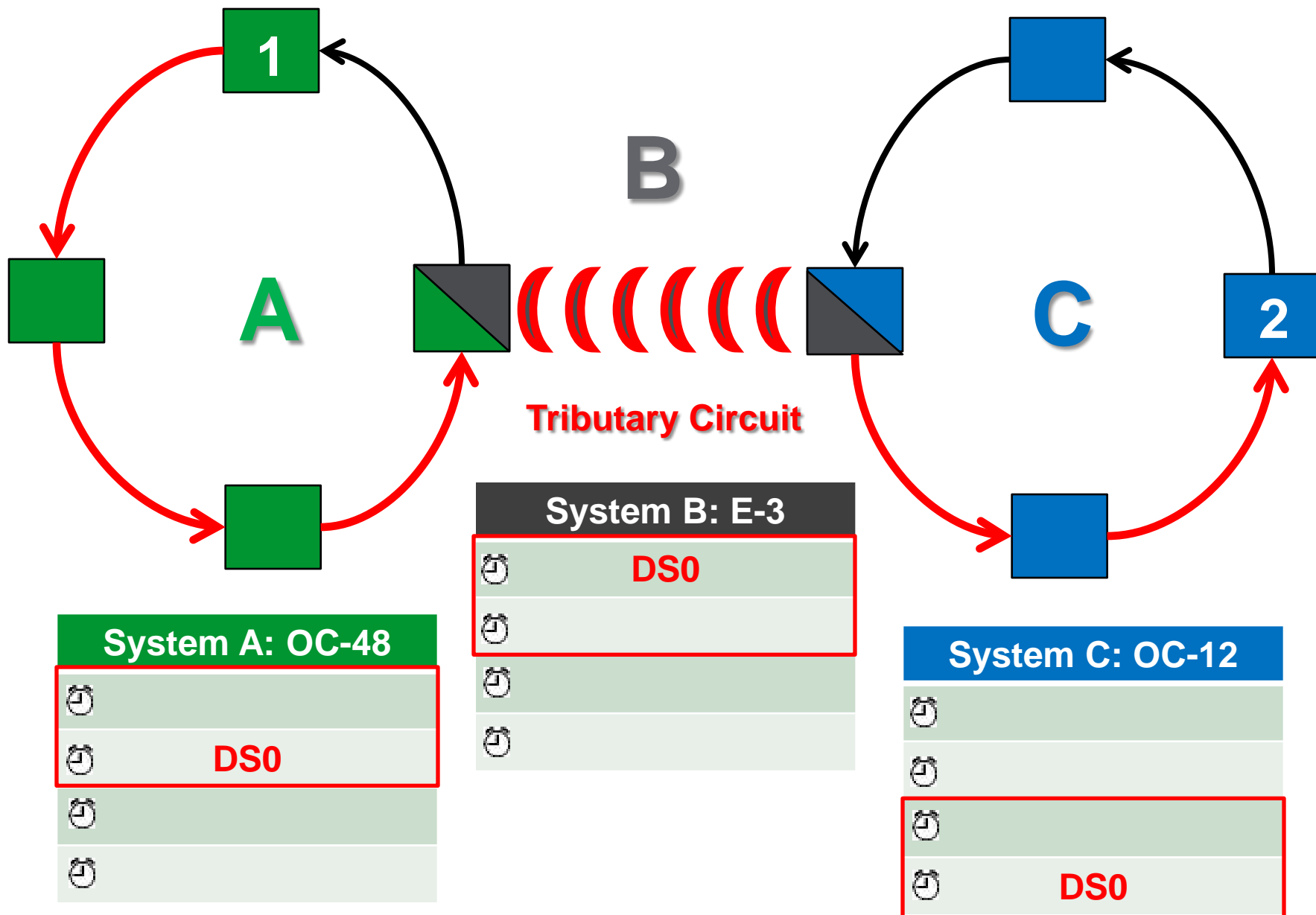
System A: OC-48	
🕒	
🕒	
🕒	
🕒	

System B: E-3	
🕒	
🕒	
🕒	
🕒	

System C: OC-12	
🕒	
🕒	
🕒	
🕒	







Business Justifications

First . . .

“It has to be done!”

And second . . .

“It will save us time and money!”



Business Justifications

- § Current system is not supported by Vendors
- § No significant system upgrades over last 20 years
- § Key personnel are nearing retirement
- § Growing number and complexity of assets
- § \$100M in Capital project over next 5 years
- § Need for spatial analysis of assets
- § Inefficient circuit design and fiber tracking process

Business Benefits

- § Reduces time required to manage circuit/fiber design and installation
- § Replaces existing unsupported system with a GIS based platform
- § Consolidates several systems into one platform (CSMgmt, Telecom Room Database, AutoCAD drawings, Excel Spreadsheets, etc.)
- § Standardizes work flow and processes

Business Benefits

- § Eliminate a portion of drawing packages and paper documentation
- § Reduce time to troubleshoot and locate outages
- § Greater data integrity and access for field mtncce
- § Provide enhanced reporting functions
- § Track 3rd Party usage of the telecom network
- § Provides opportunity to roll to Linux

Questions?

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