20 Years of Reliable Service: Revisiting a Distribution Automation Scheme After 2 Decades

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Presentation Overview

- Background
- Original Scheme Refresher
- Results over the years
- Present Topography and Schemes
- Future outlook
- Conclusion

Implementation of a High-Speed Distribution Network Reconfiguration Scheme

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***Abstract*—Traditionally, when a permanent fault occurs on a radial distribution line, all load located downline from the protecting device is lost until sectionalizing and network reconfiguration can be done either locally, by personnel responding to the event, or remotely, by a dispatcher (if SCADA is present). In many instances, a substantial amount of load may be lost and a significant number of customers may be impacted until sectionalizing is performed. With much emphasis now being placed on reliability, there is a need to automate sectionalizing and network reconfiguration to speed up service restoration to as many customers as possible, in order to minimize the impact of a fault.**

Recently Coweta-Fayette EMC, an electric cooperative in Newnan, Georgia, near Atlanta, implemented a high-speed automatic network reconfiguration scheme on a distribution circuit to quickly restore service to unfaulted line sections de-energized by the clearing of a permanent fault. The scheme uses intelligent microprocessor recloser controls and a communications channel between adjacent reclosers to quickly reconfigure the distribution network following a fault.

This paper examines the implementation of the reconfiguration scheme by the utility. Specific settings and operational details of the scheme are given. Additionally, a review of the operational history highlights the impact the scheme has had on the reliability of the utility's distribution network.

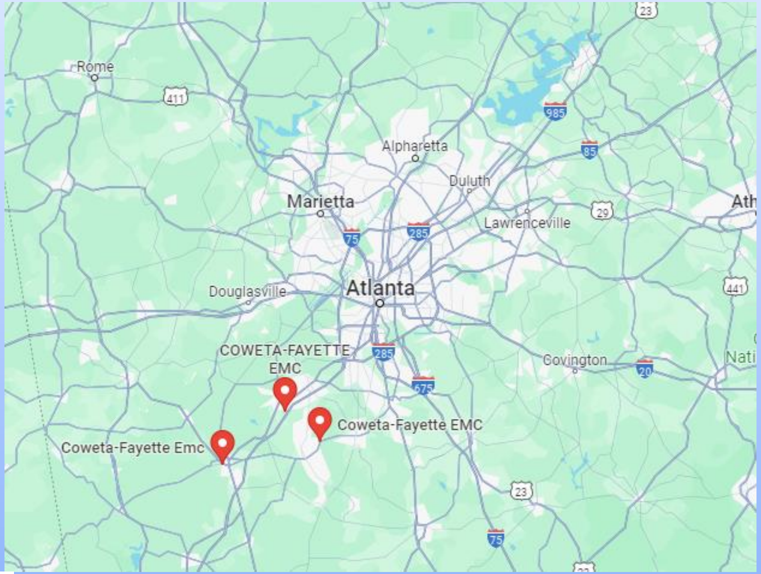
sector of restaurants, big box retailers, and other support businesses. The CFEMC ten-year forecast predicts serving 102,000 members with a capacity requirement of 665 megawatts.

To meet the need of its continued growth, CFEMC has power contracts with Oglethorpe Power Corporation and Southern Power, Inc. (a Southern Company subsidiary). Oglethorpe Power is a generation and transmission company, owned by 39 of Georgia's EMCs. Formed in 1974, this supply cooperative has met the needs of the Georgia cooperatives through the 1990s. Oglethorpe jointly owns generating facilities with Georgia Power Company and the Municipal Electric Authority of Georgia (MEAG Power). They currently own 30% of two nuclear facilities—Plant Hatch and Plant Vogtle, a 30% ownership in Plant Wansley (a coal-fired facility), 60% of Plant Scherer (coal), 75% of a pumped storage hydro facility, and full ownership of approximately 1200 megawatts of combustion turbines.

In the late 1990s, Oglethorpe's all-requirements contracts were changed, and the EMCs were allowed to negotiate for future energy requirements with other power suppliers, provided they agreed to be responsible and continue to own their

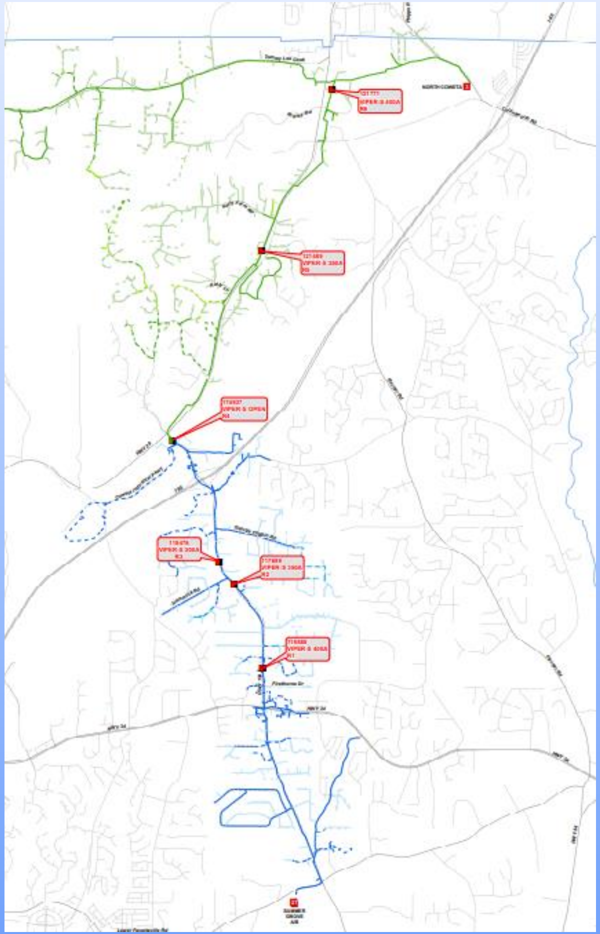
Coweta-Fayette EMC

- Mostly residential.
- 6-8% commercial accounts.
- Service territory roughly 800 square miles.
- Largely typical suburban setting.
- Load includes 2 movies studios.



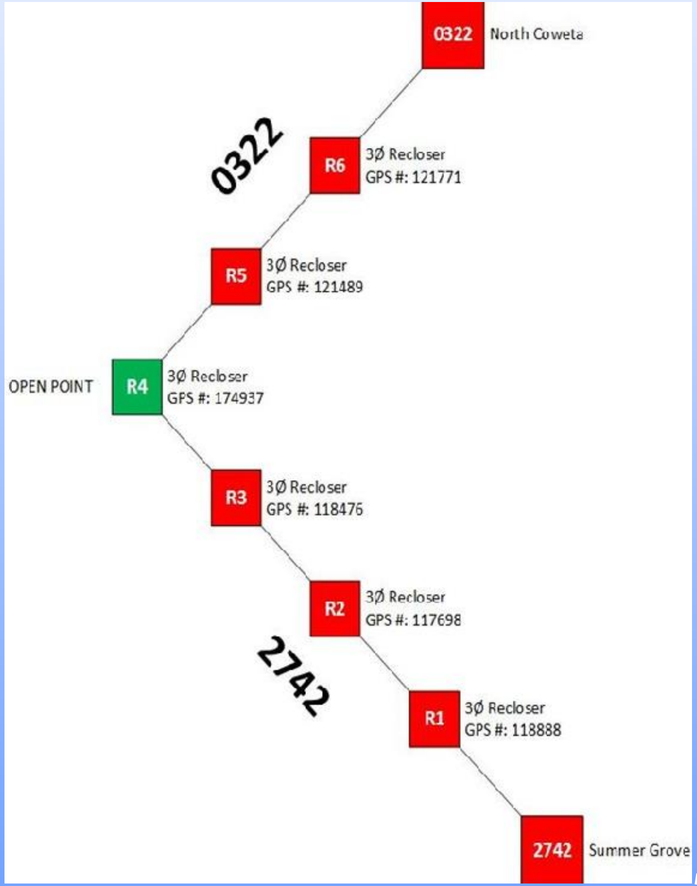
Utility Facts and Growth Over 20 Years

- Peak demand up 28% (450MW).
- Installed meters up 37% (89,667).
- Miles of line up 20% (6,764 miles).
- Underground miles up 41% (4,008 miles).



Original Scheme

- Six Reclosers
- Two Feeders/ NO point
- Fiber Available
- TCC Coordination
- Operates on Lockout of Clearing Device
- Restoration in cycles



Historical Results

- Scheme has operated 46 times since 2011.
- Loss of source accounted for 23 operations.
- On 8 occasions fault occurred adjacent to open point so no restoration.
- Faults occurred in intermediate points on 12 occasions resulting in scheme action to restore un-faulted sections.

Causes of Operations Since 2011

- Scheme has operated 46 times since 2011.

Causes of Outages

Cause	
Tree on Line	13
Storms / Lightning	9
Equipment Failure	8
Transmission Outage	7
Public	5
Animals	4

Reliability Impact

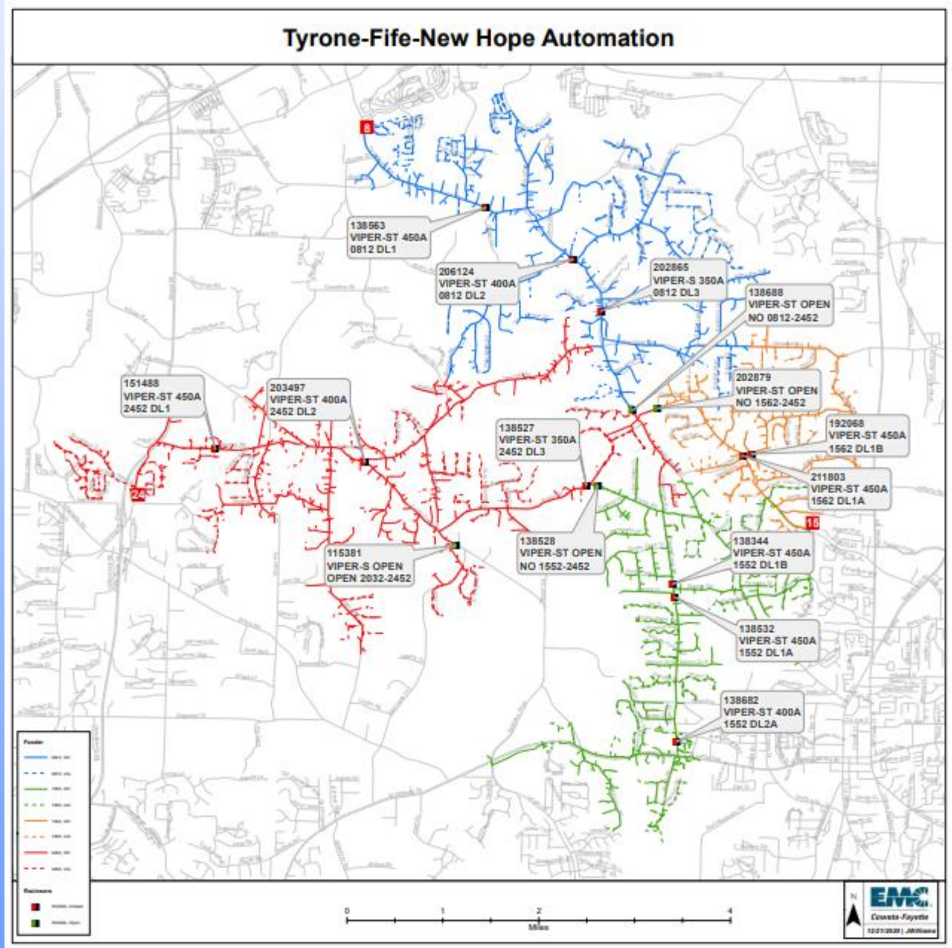
- With scheme, 22.42 minutes of SAIDI contribution.
- Without automated restoration, 22.42 minutes of SAIDI contribution.
- Without sectionalizing functionality, 65.23 minutes of SAIDI contribution.

Reliability Impact

- Scheme serves 4% of utility customers.
- If similar results could be achieved system-wide, yearly SAIDI numbers would be reduced to under 30 minutes.

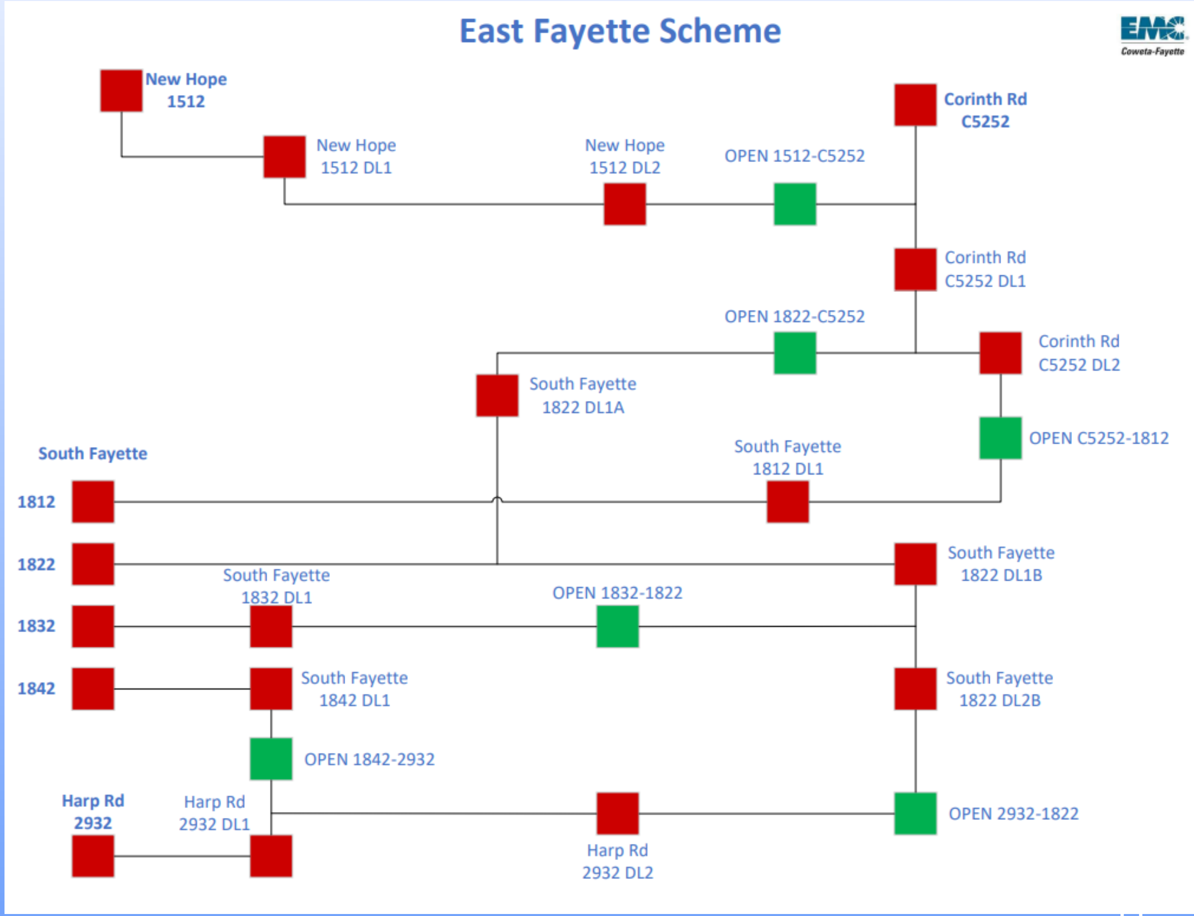
Present Schemes in Place

- SCADA based FLISR.
- Restoration in seconds to minutes.
- Multiple sources and feeders.
- Smart switching to account for loading.



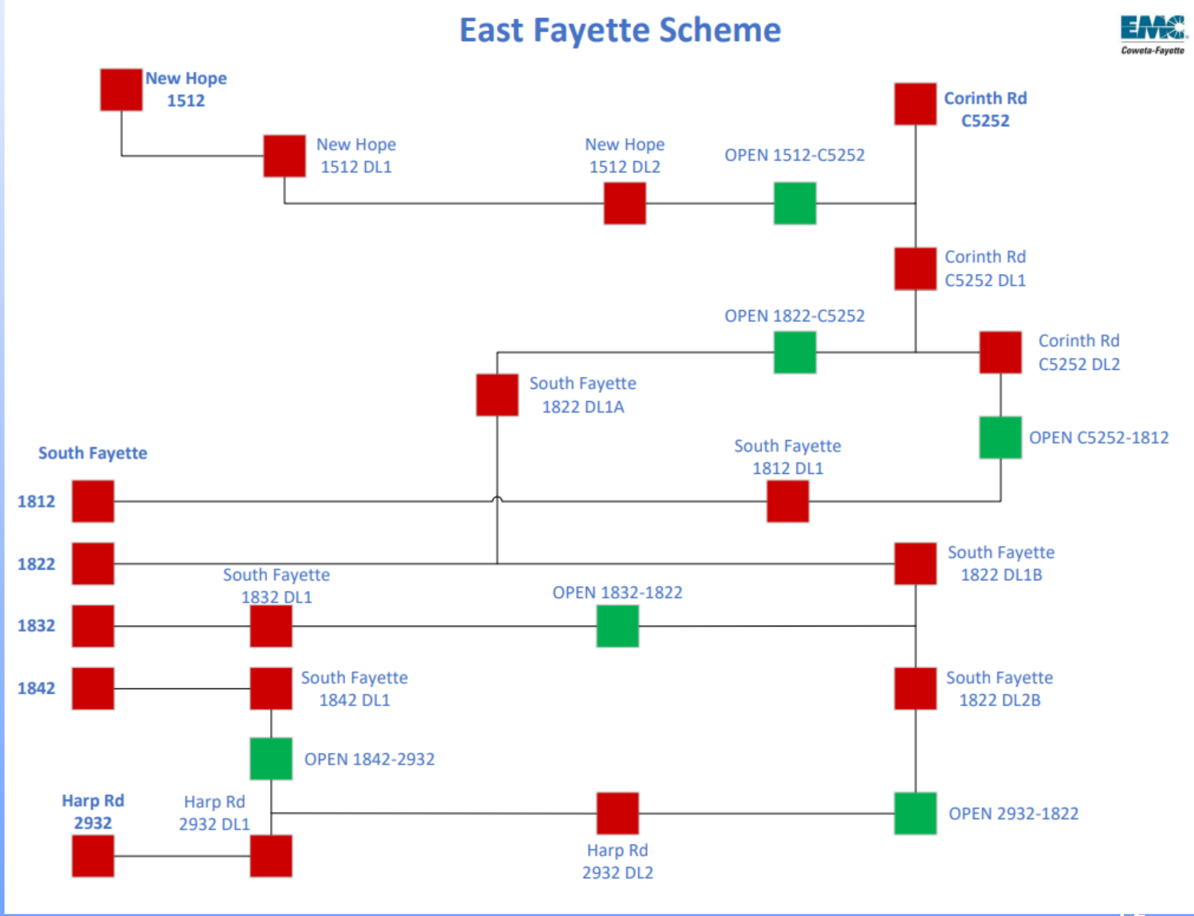
FLISR Operation

- Scheme measures load at various points.
- Device locks out for fault.
- Isolation performed.
- Load switched to one or more feeders depending on loading and margins.



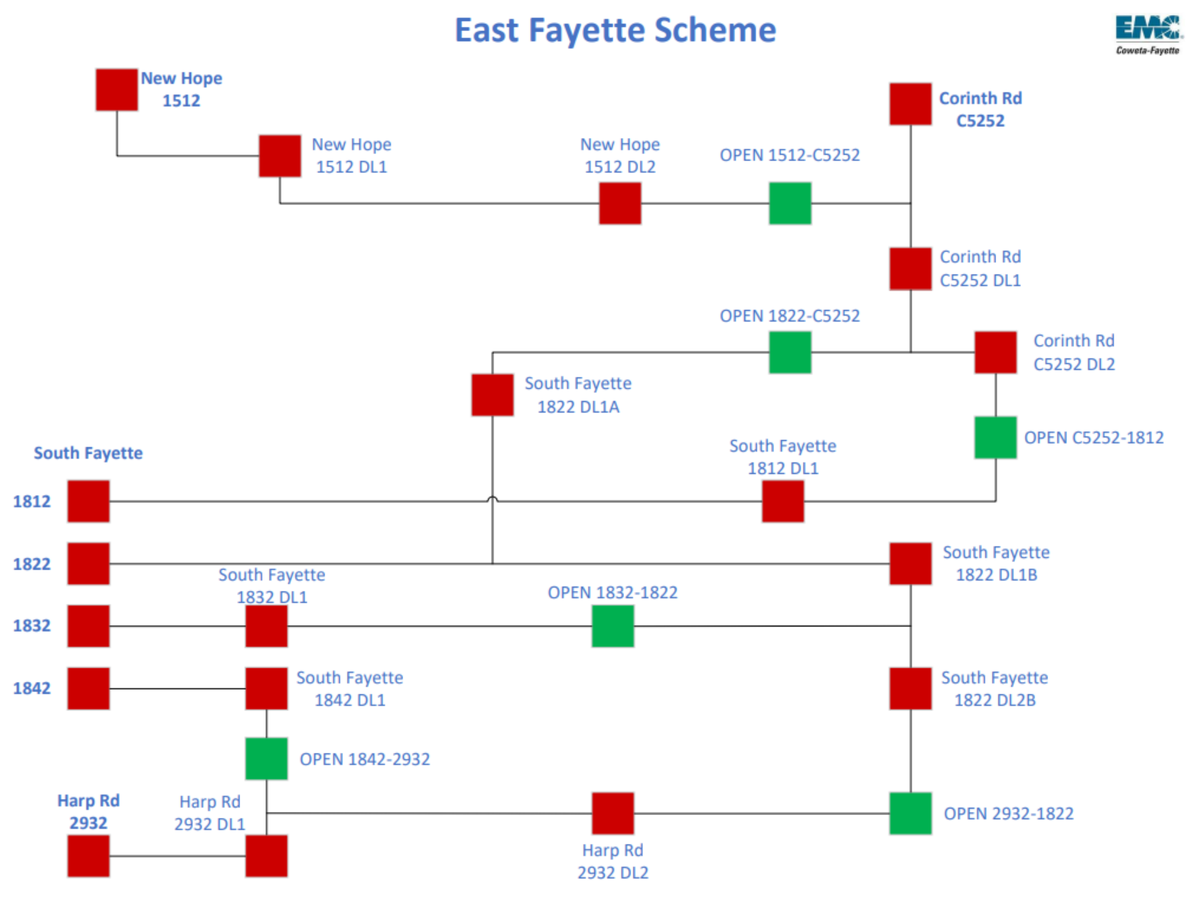
FLISR Advantages

- Centralized system, goes where SCADA is in place.
- Relatively easy to implement.
- Typically fast enough to minimize sustained outages.
- Easy to add additional devices.



FLISR Disadvantages

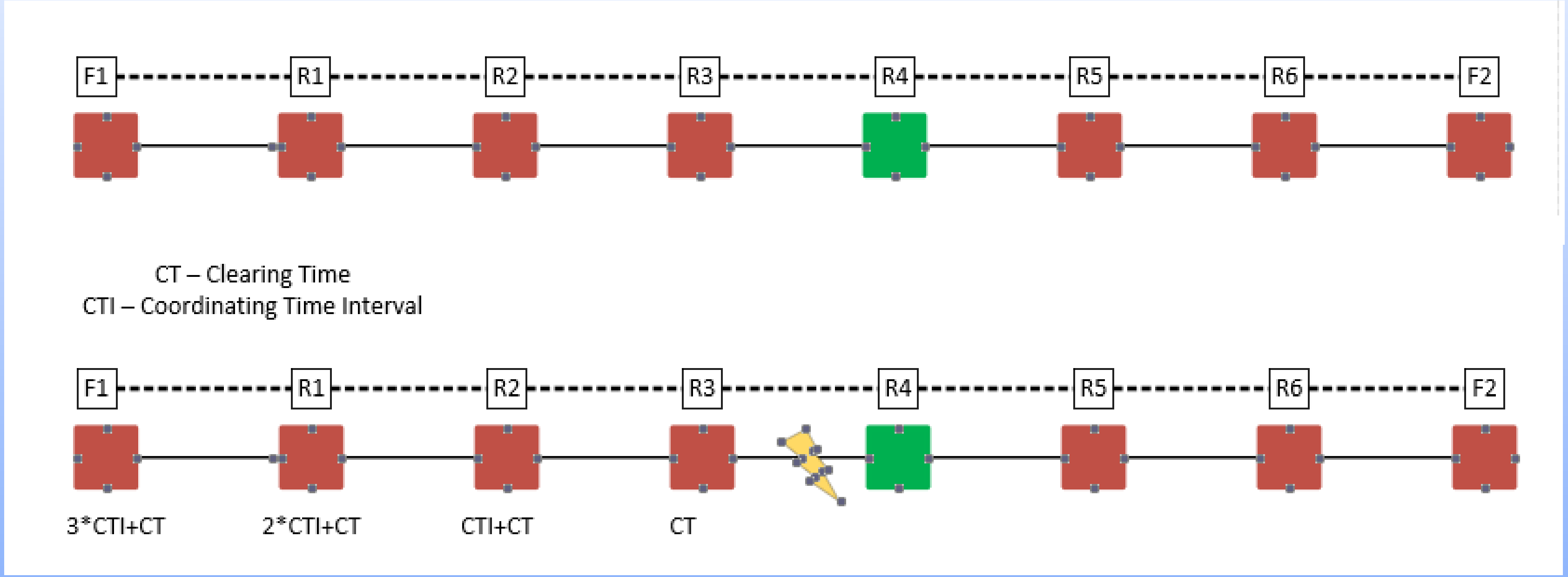
- Can be expensive.
- Restoration can take minutes.
- Communications problems or mis-configuration can stop operation.



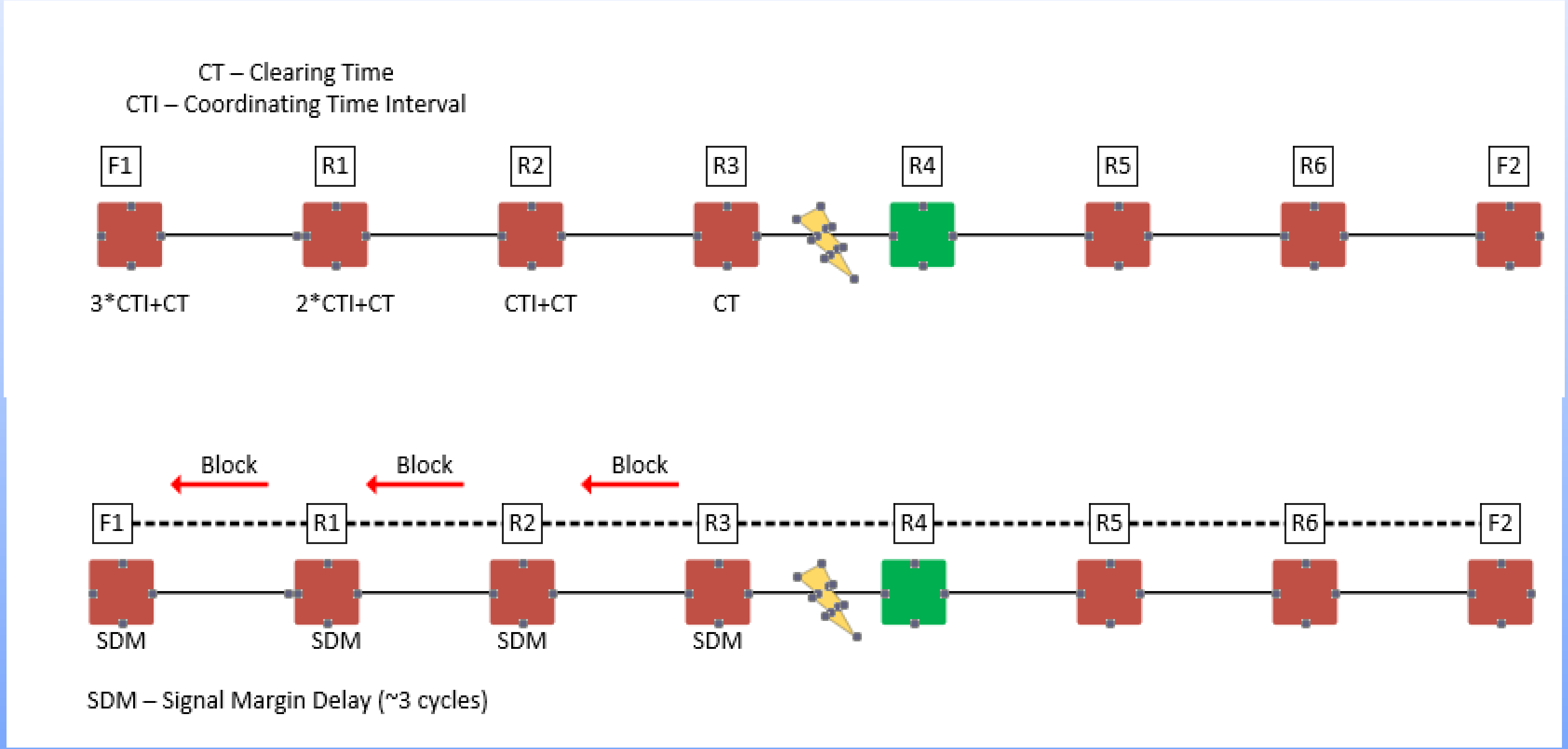
Areas for Improvement

- Fiber becoming more prevalent on distribution feeders.
- Network based protocols available (IEC-61850).
- Install more protective devices per feeder to lower segment customer count and exposure.
- Lower tripping times to reduce voltage sag experienced by sensitive loads.
- Fast restoration not needed everywhere.
- A mix of FLISR and high-speed tripping and fault isolation can be achieved.

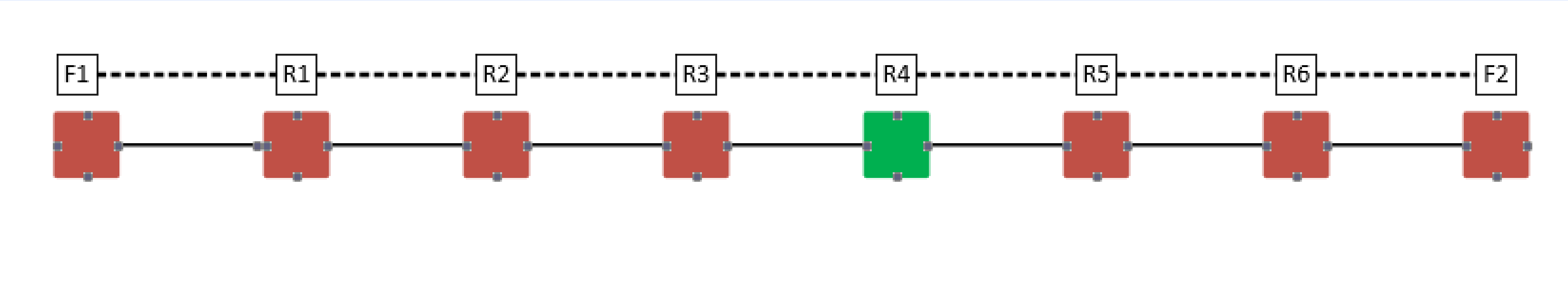
Original Scheme Operates on TCC Margins

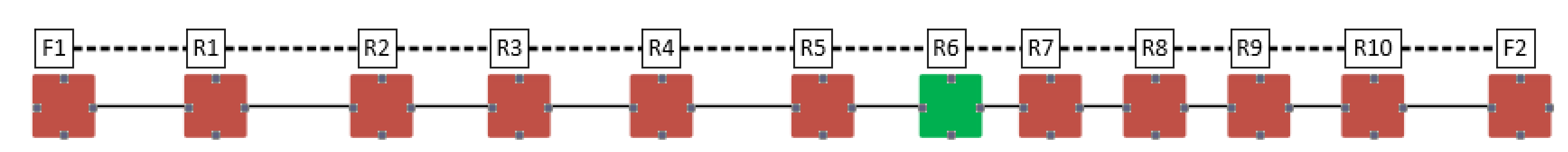


Improvement #1 Add Blocking Scheme



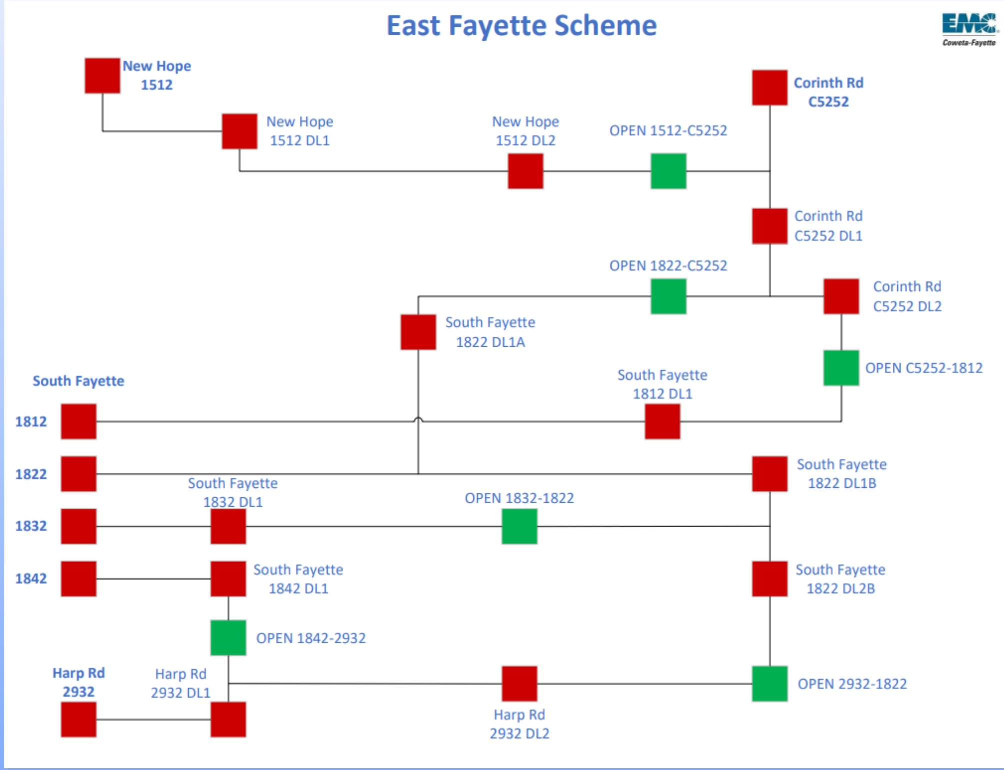
Improvement #2 Minimize Segment Sizes





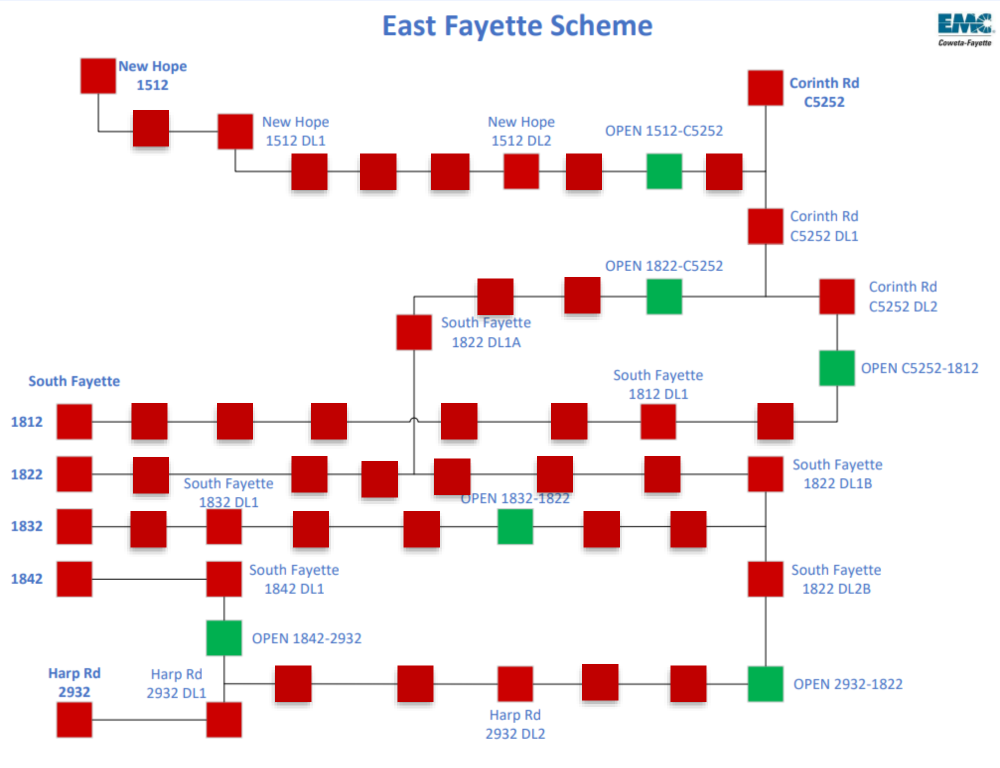
Improvement #3 Add Network Comms (IEC-61850)

- Implement IEC-61850 based blocking scheme to extend to multiple sources/feeders.
- Allows faster clearing times across the system.
- Fast restoration scheme available in areas where required.
- Use FLISR for standard restoration.



Improvement #4 Reduce Segment Sizes

- Blocking scheme simplifies coordination.
- Generally, 300-400 customers per segment or 2-3 miles.
- Settings may be simplified.
- Clearing times reduced to improve power quality due to voltage sags.

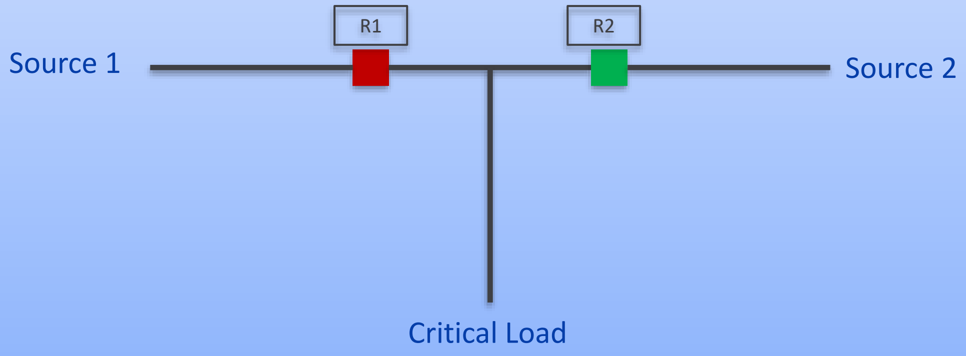


Customized Schemes for Specific Problems

- Customizable logic available in relays/controls.
- Various communication media available (radio/cell/fiber).
- Speed/reliability of communication type is dictated by application.
- In all things, safety is paramount.

Customized Schemes for Specific Problems

- Simple source transfer scheme.



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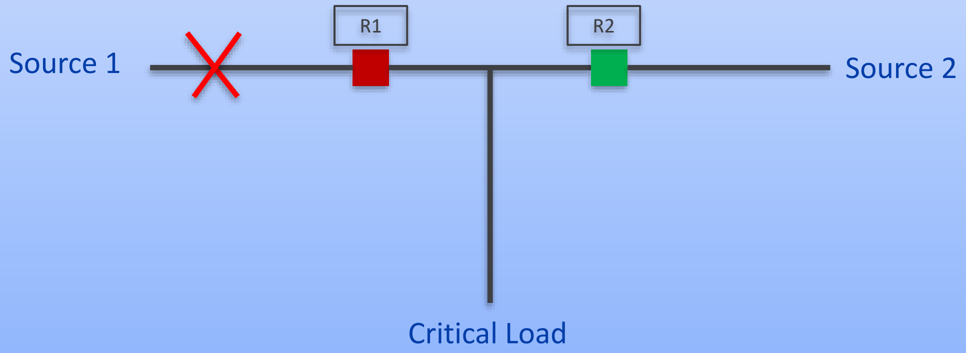

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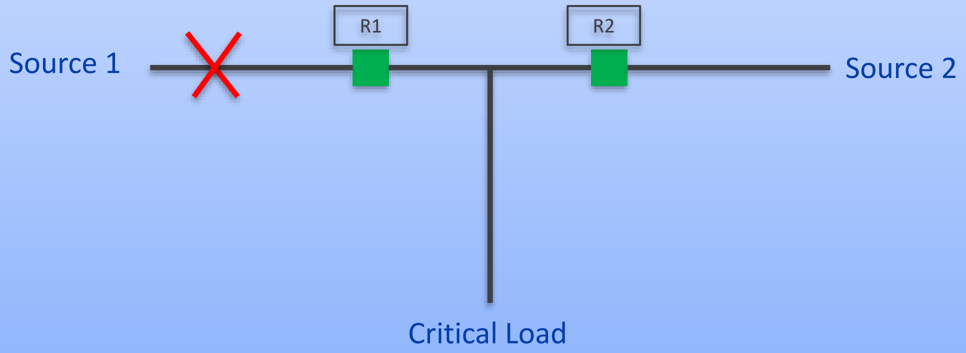

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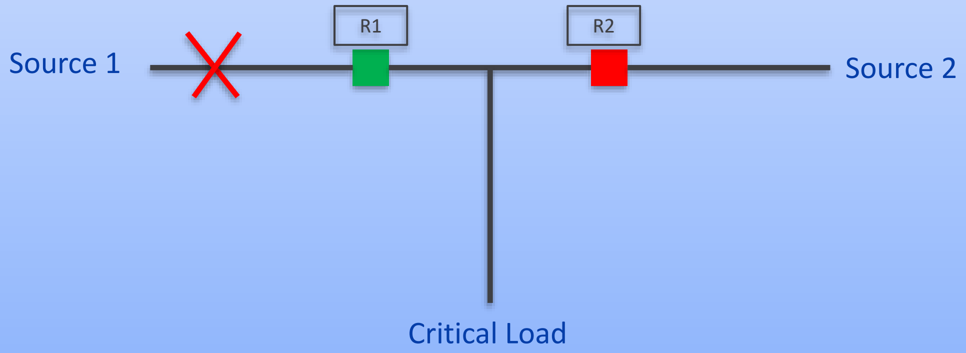
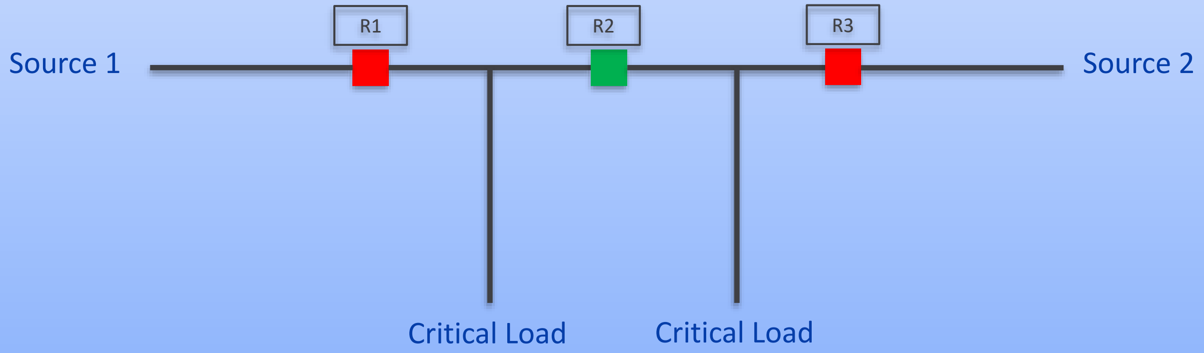


Customized Schemes for Specific Problems

- Main-Tie-Main transfer scheme.



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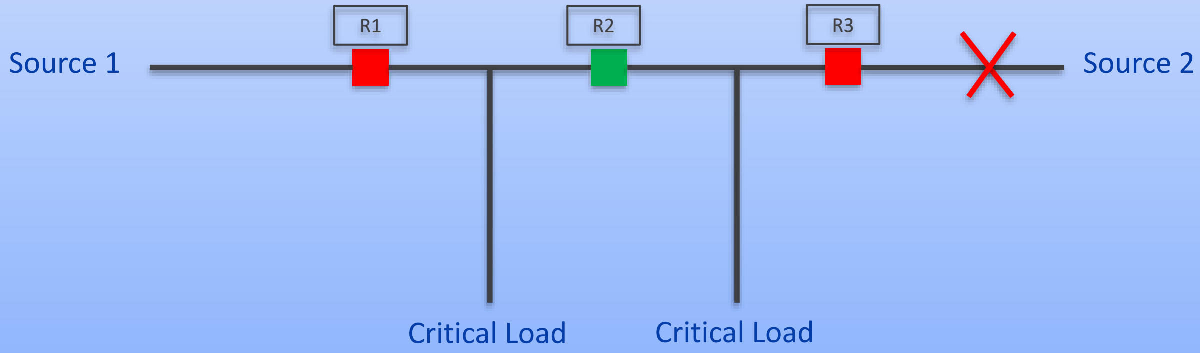

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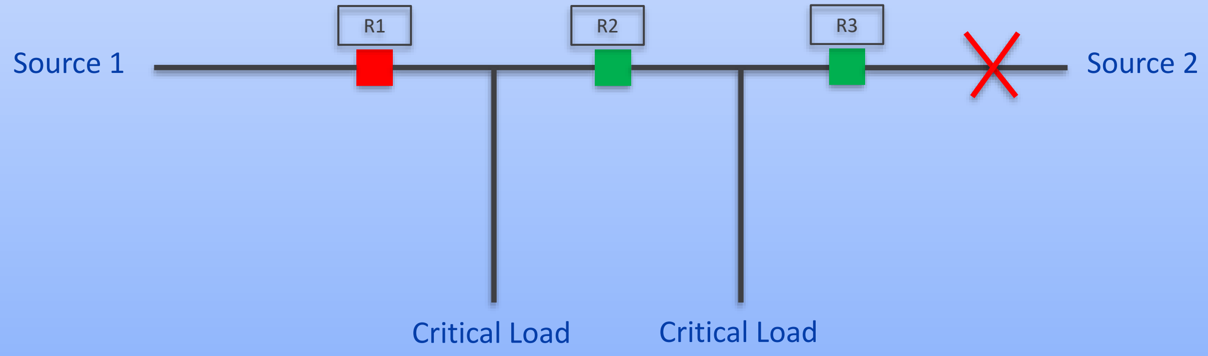

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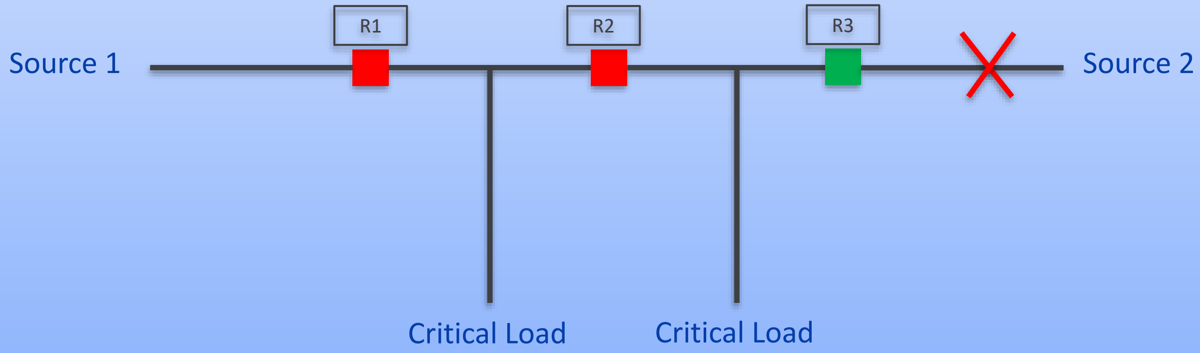

Applicability of Single Pole Tripping (SPT)

- Significant reliability savings with SPT
- Schemes can be implemented with SPT.
- Requires significant increase in logic complexity as well as information communicated between devices.
- Consider operating arrangements well.
- Again, safety is paramount so proper testing and consideration of all possible situations is critical.

References

Thank you Everyone.

Any Questions?