

Application of Distributed Intelligence to Automatic Distribution Reconfiguration for Reliability Improvement

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Advanced Distribution Circuit Reliability Techniques

SCADA	Standard Source Transfer	IntelliTEAM II	HRDS Open-Loop	HRDS Closed-Loop	Power Electronic Switching
5-60 min	2-5 sec	10-60 sec	3 sec	No-Outage	No-Outage
Extended Outage Impacts SAIDI, SAIFI, CAIDI	Spot Solution	Spot Area Strategic	Only Customers Beyond Fault Impacted	No-Outage	Tactical Power Quality
Dispatcher Required	Self-Powered or Battery Powered	Distributed Intelligence	Unlimited Units - Universal Application	Unlimited Units - Special Application	UPS - 30 sec Ride-through



Overview

- High-Reliability Distribution System
- IntelliTEAM II

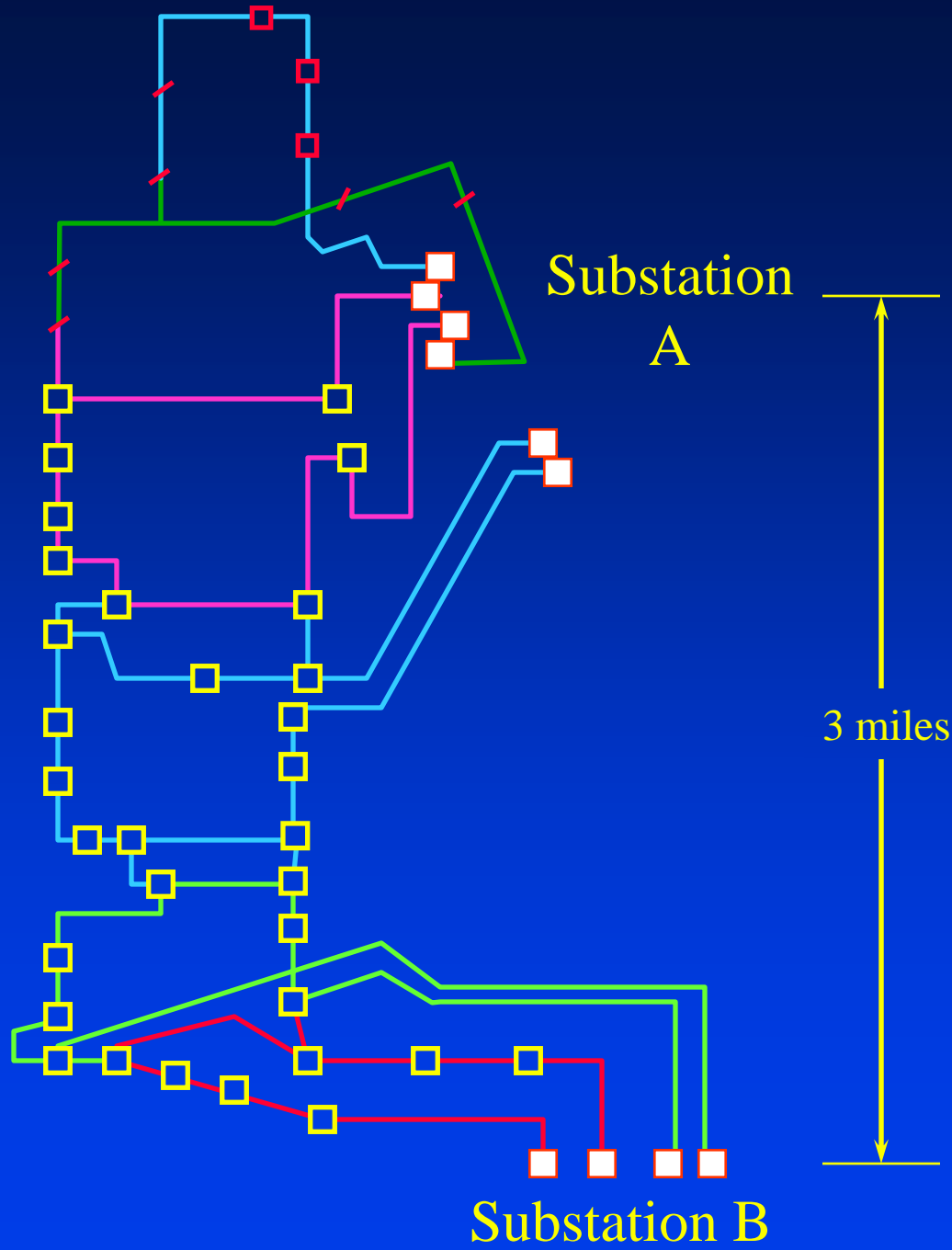


High-Reliability Distribution System

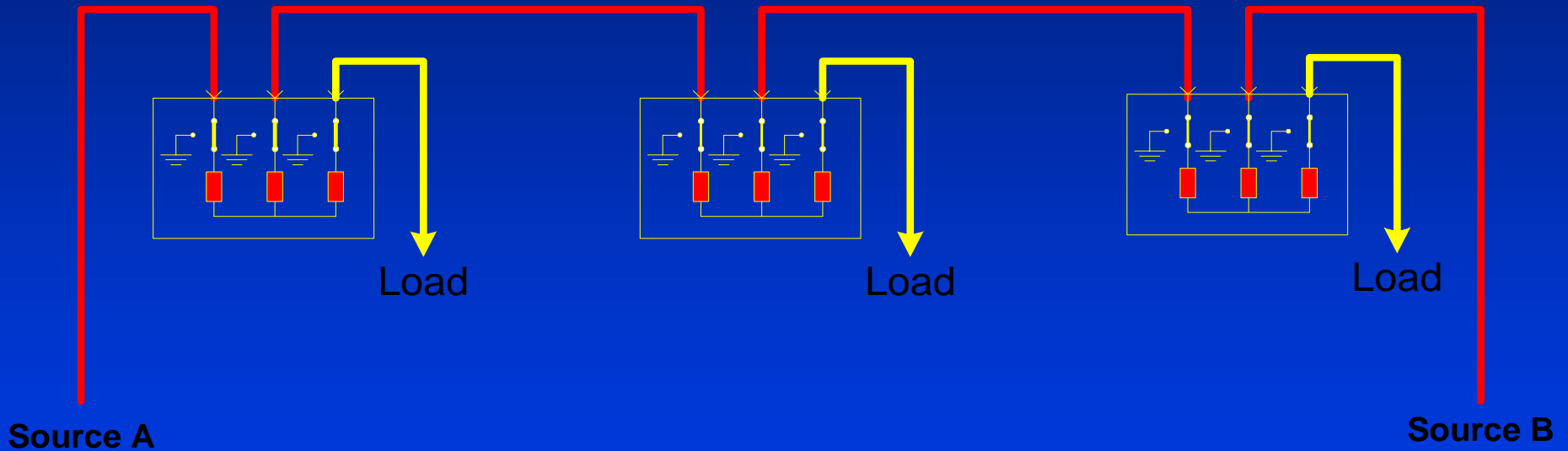
- High-speed fault clearing
- Open or closed loop application
- “No outage” operation in closed loop mode
- Up and running
 - International Drive – Orlando
 - UCSB – California
 - Danvers – Virginia
 - Greater Toronto Airport



Power System One-Line



UG Primary Network (closed loop) Normal Condition

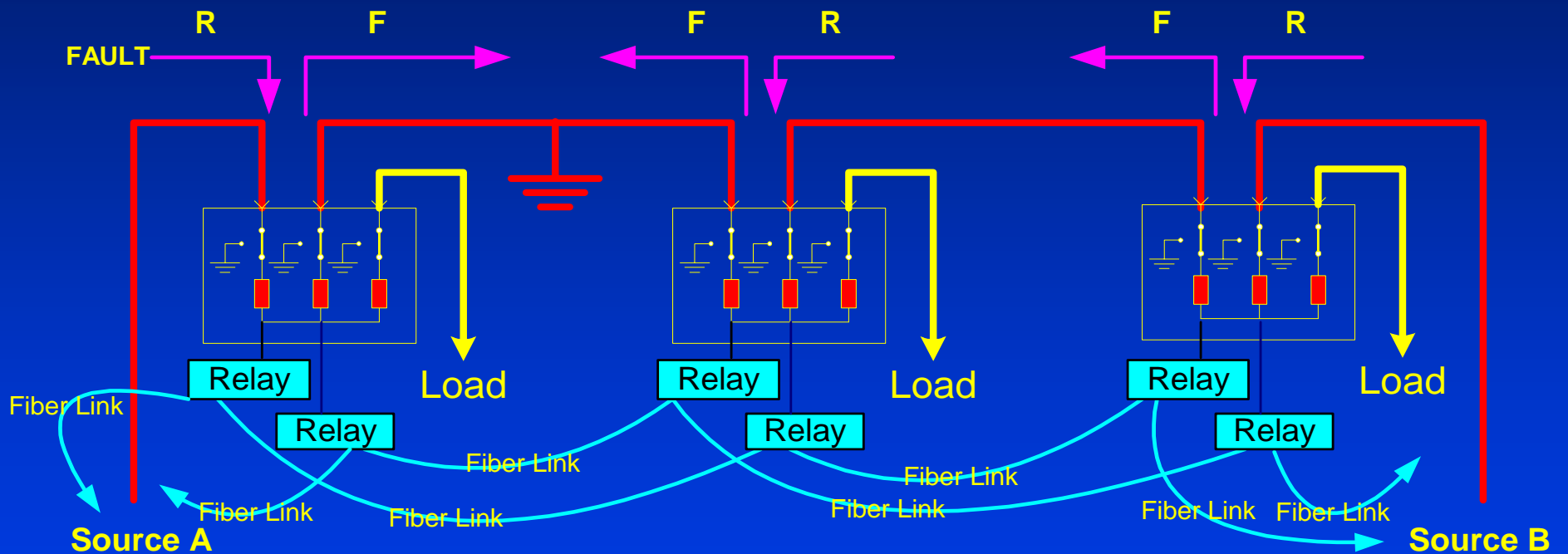


Each loop can have any number of switches

T = 0 sec



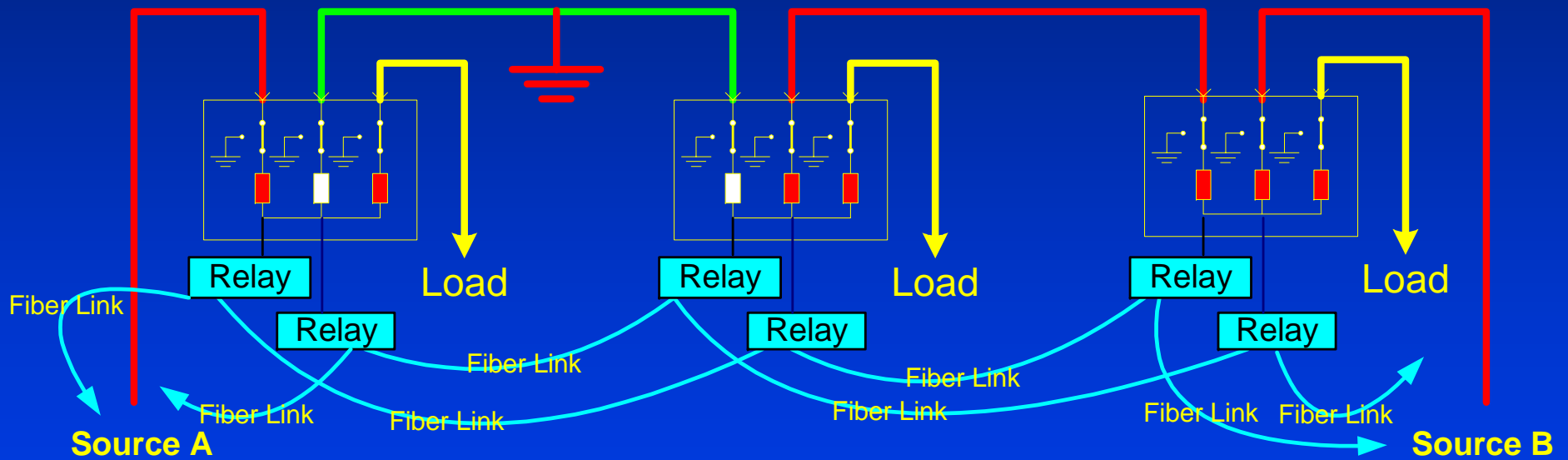
UG Primary Network (closed loop) Fault Condition



T < .10 sec



UG Primary Network (closed loop) Fault Cleared



T = .10 sec



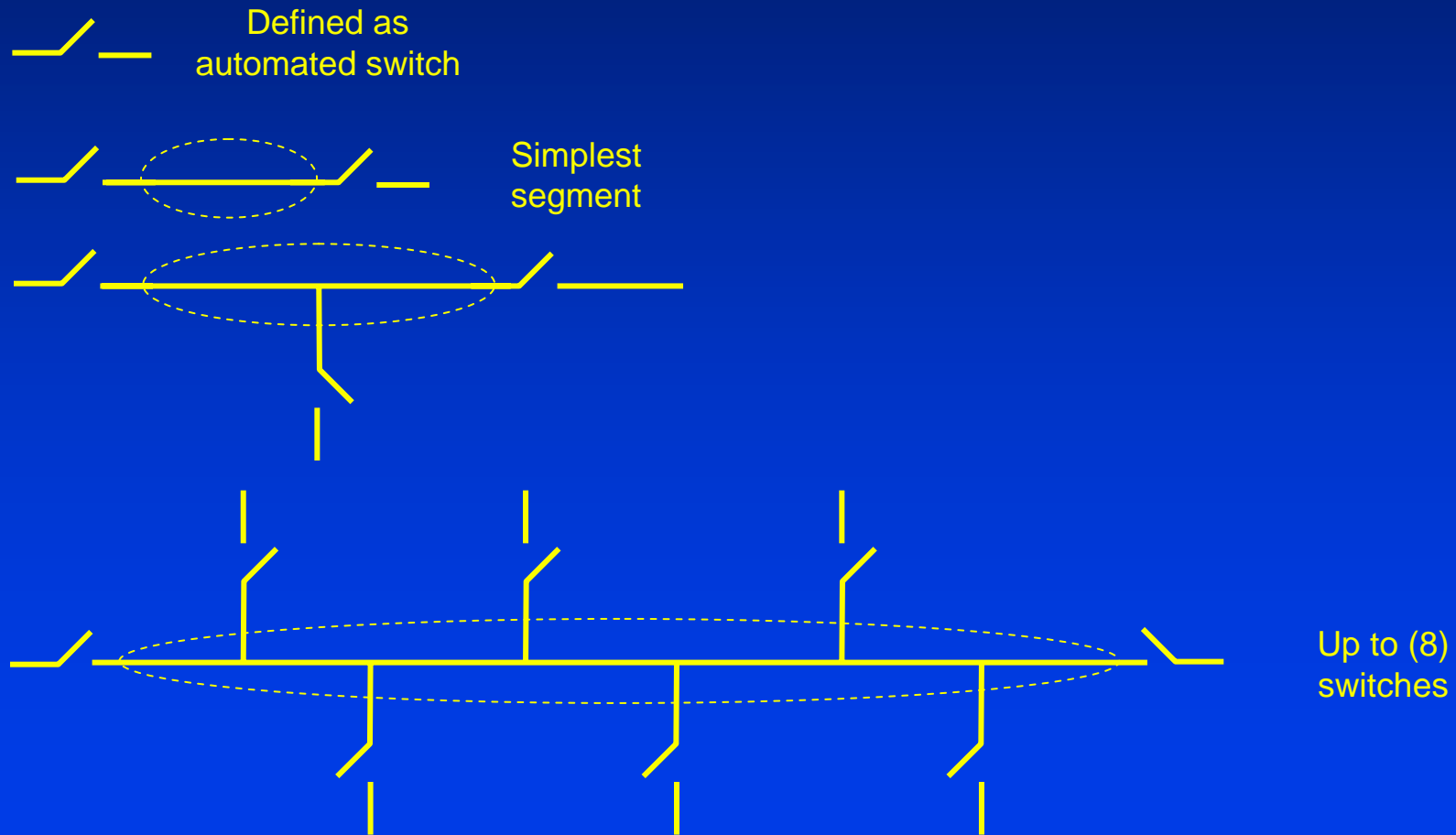
Advanced Feeder Automation IntelliTEAM II

- Automatic fault isolation and load restoration
- Distributed intelligence – utilizing “agents”
- Scalable, building block approach
- Supports complex systems of virtually any size
- Does not require SCADA – but supports integration with SCADA systems
- Utilizes peer-to-peer mesh communication network
- Earlier version has been used at utilities since 1997

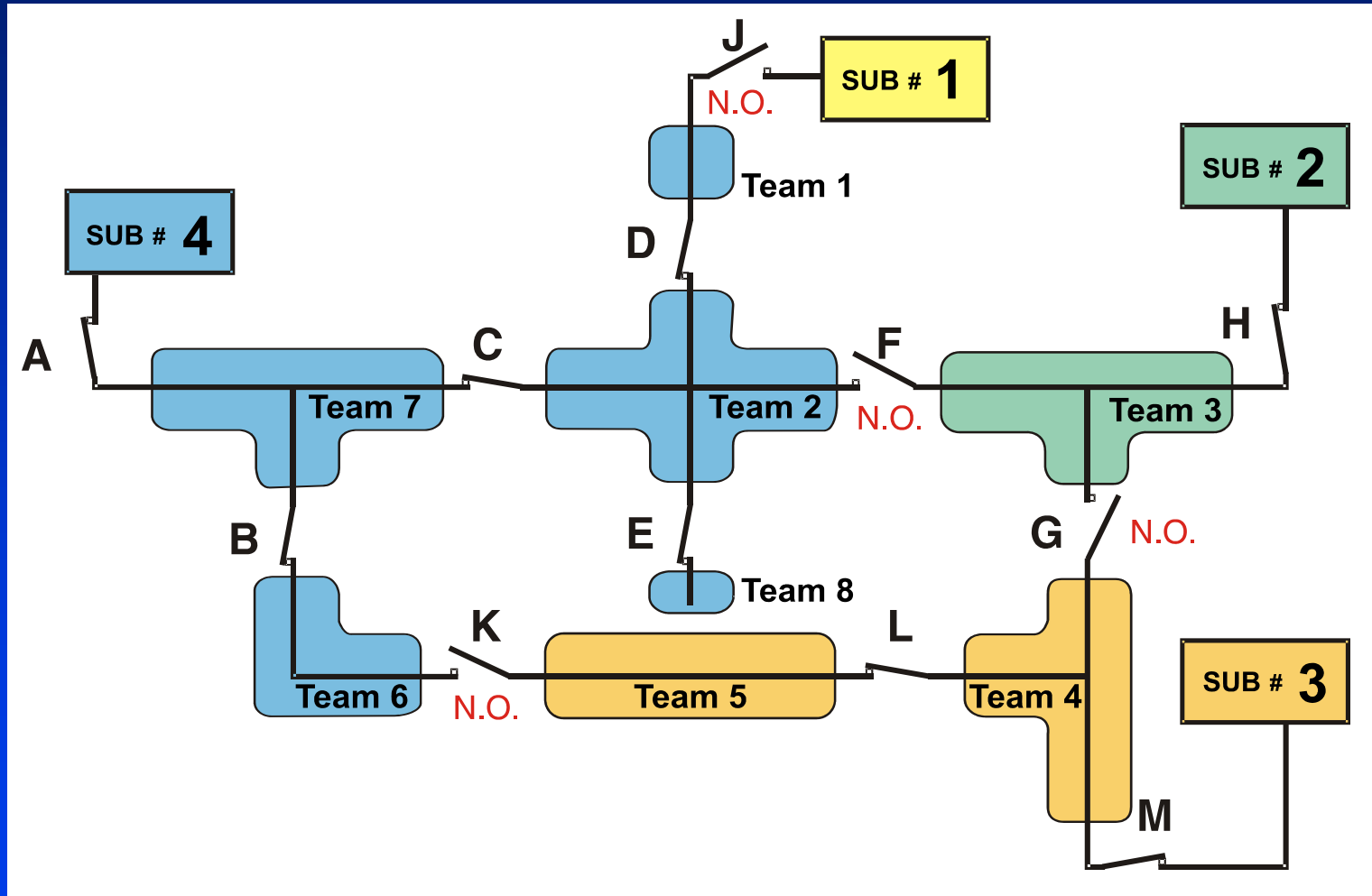


Scalable, Building Block Approach

- From one switch – to eight source line segments
- Build to meet any desired circuit / system configuration



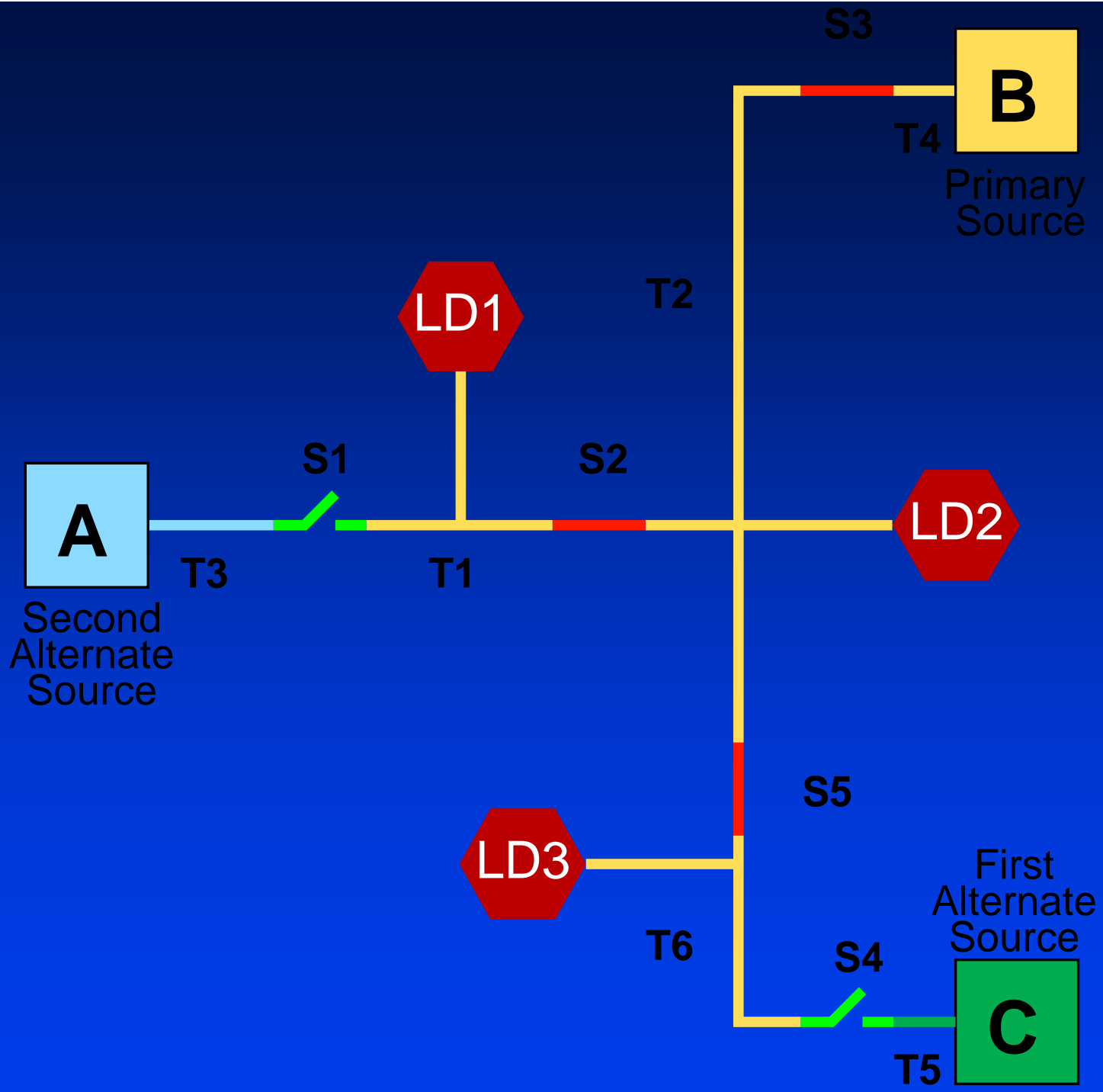
A "Simple" IT-II System

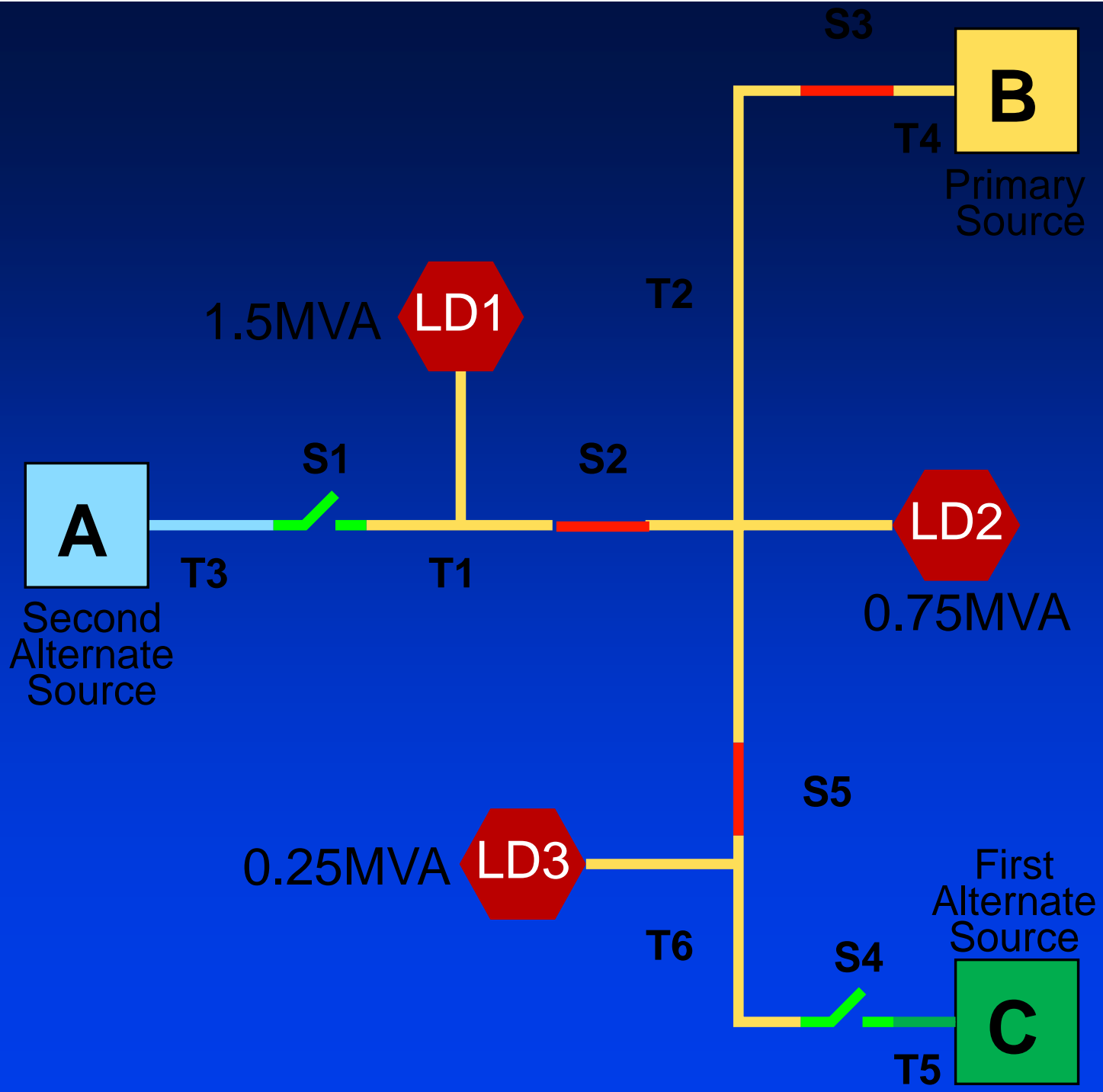


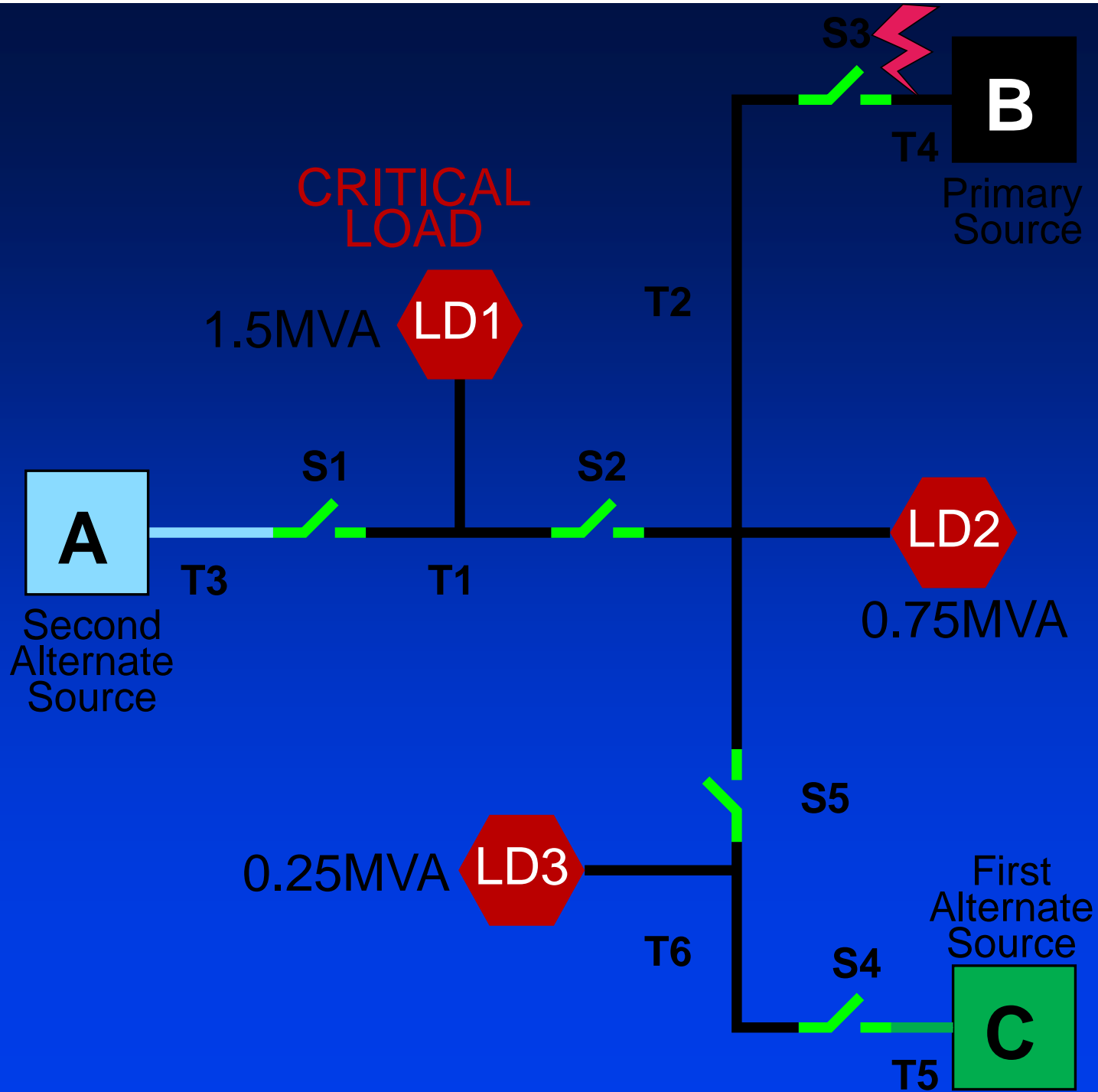
Maximize Assets

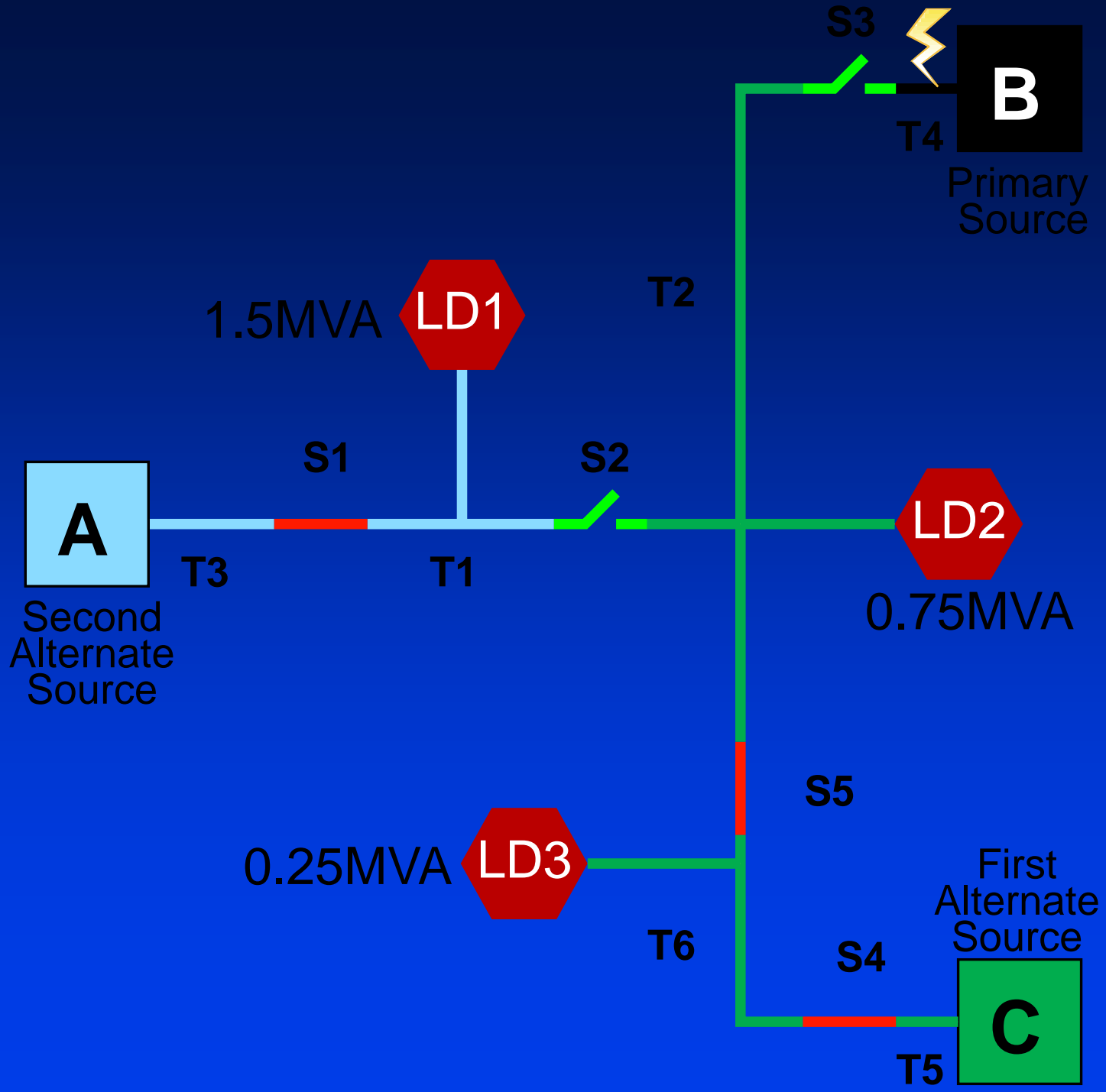
- System uses real-time load monitoring to prevent overloading during restoration switching.
- Enables higher normal circuit loading
- The excess capacity of adjacent sources can be used to restore service to unfaulted segments, helping defer the need for system upgrades and allowing your customer to tie circuits that traditional planning criteria would not permit









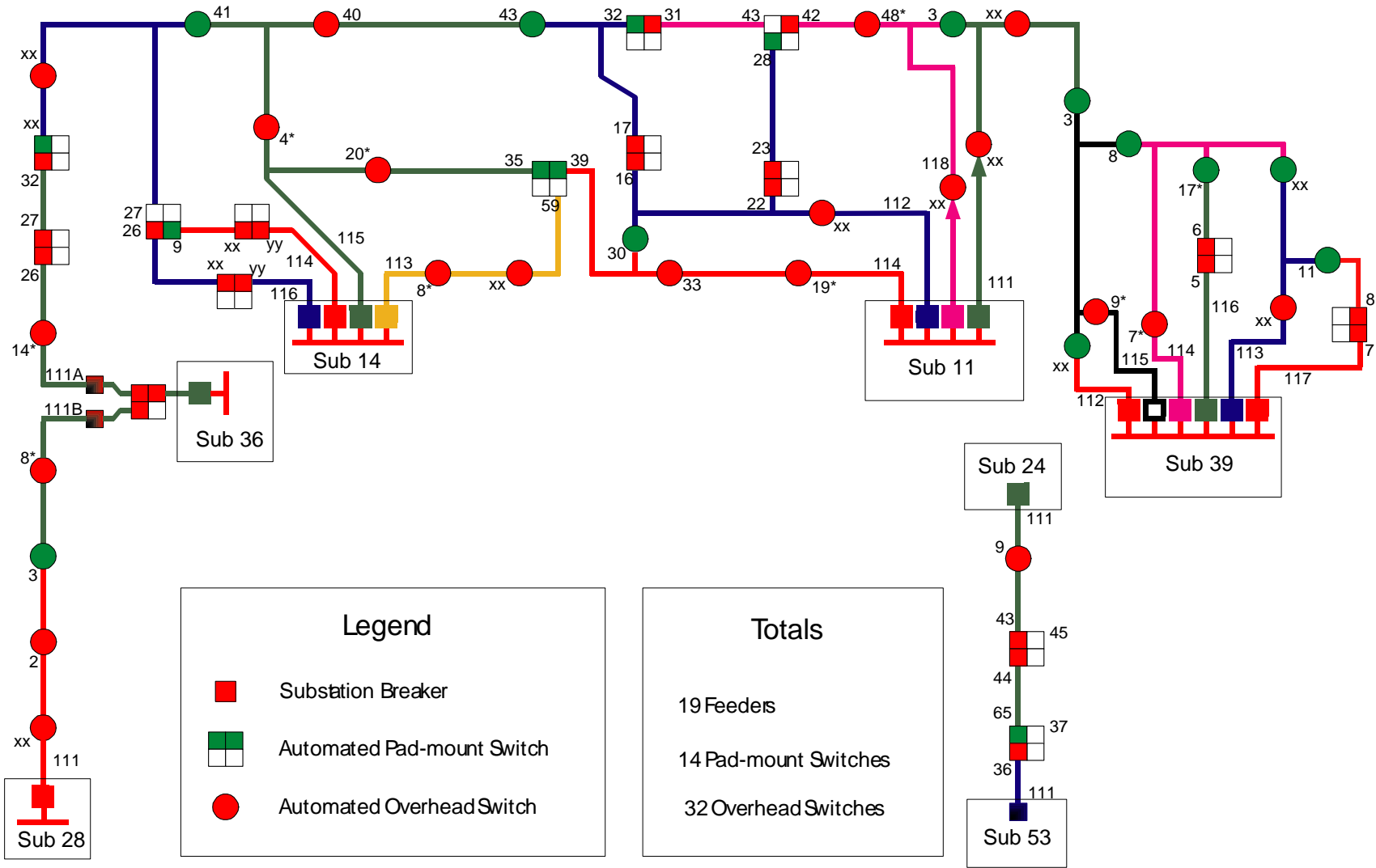


Fully Scalable

- IntelliTEAM II monitors real-time current and voltage throughout the system and uses this information to make smart switching decisions
- Accommodates tie points from multiple sources to assure a restoration solution.



An Installed System



Safety

- Multiple blocking methods ensure that automatic operation is prevented when crews are working on the line



Install, Configure, Use

- Basic configuration provides immediate benefits
- Priority settings enable predictable, repeatable results to ensure planning criteria are met

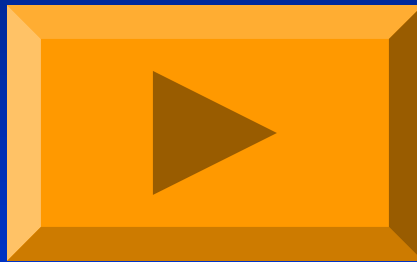


Here Now

- FPL – Florida
- Progress Energy – Florida
- Blue Ridge Electric Cooperative – North Carolina
- Enmax – Canada



Example



IntelliTEAM II Installations: Southeast utility in USA

- Reacting to a corporate directive, engineers set out to improve customer reliability
- The Goals:
 - To provide a higher level of service
 - To be distinguished as a premier supplier of electricity among all US utilities
- Expected Benefits:
 - Increased customer as well as regulatory support
 - Reduced costs from fewer service complaints/investigations
 - Eventual revenue expansion from customers attracted to high reliability service area



Project Background

- Utility limits permanent outages to under 1 minute, even though regulators are not so stringent
- Designed a “Ideal Feeder” to allow quick reconfiguration by dispatchers
- But reconfiguration still often exceeded the 1 minute limit during storms or other significant events
- The less than 1 minute goal mandates Feeder Automation for the majority of interruptions
- The complexity of the Ideal Feeder Topology presented problems for conventional automation schemes



Ideal Feeder Implications

- This logic is manageable by veteran dispatchers in typical outages, but becomes time-consuming in widely distributed outages
- This logic is not easily automated with traditional tools
- Ideal Feeder logic could also not be served with a 2-feeder open loop scheme
- IntelliTEAM II was deployed in Jan, 2003
- Over 300 overhead switches/controls now in operation



IntelliTEAM II Installations: CANADA

A multiple-year, Feeder Automation (FA) project is now underway

- Phase I (to complete in Nov, 03) involves 7 subs, 19 feeders and 46 switches (32 overhead & 14 underground)
- Completion will include over 200 switching points and automate over 80 feeders
- The primary requirement is automatic circuit reconfiguration in less than 60 seconds



Project Background

Key Project Requirements:

1. Reconfiguration in under 1 minute on fault or loss of voltage
2. Minimum availability for each FA feeder over 99.9%
3. FA System must detect Under-Voltage & Under-Frequency Load Shedding & disable auto-reconfiguration in affected area
4. Station breakers must also participate in reconfiguration, despite most having electro-mechanical relays and 1-shot to Lockout
5. Project to include a Communication Management System (CMS) to enable operators to monitor, interrogate & control the operation of all components in the FA System



INTELLITEAM II: PRINCIPLES OF OPERATION



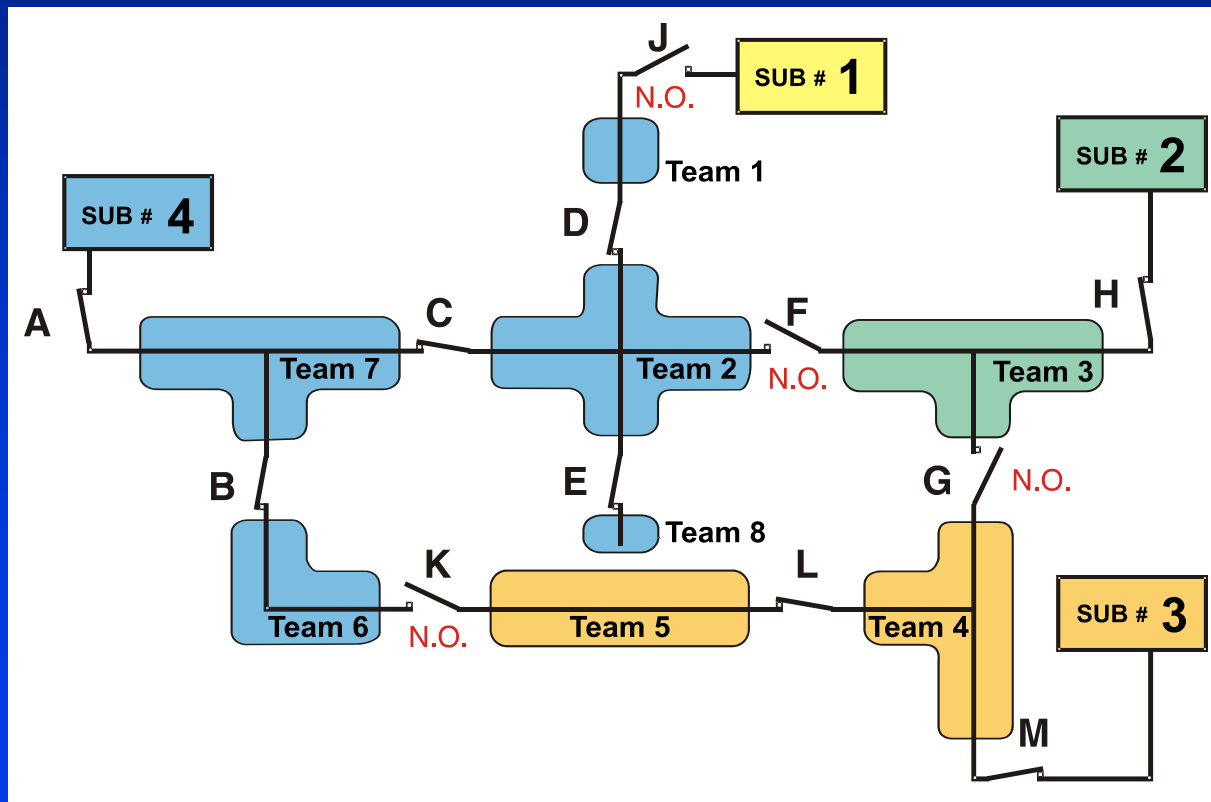
IntelliTEAM II — Teams

- Teams are the switches bounding the line segments
- A team may have one to eight switches
- A switch can belong to one or two teams
- Each switch is defined as a specific switch type for each team that it is in



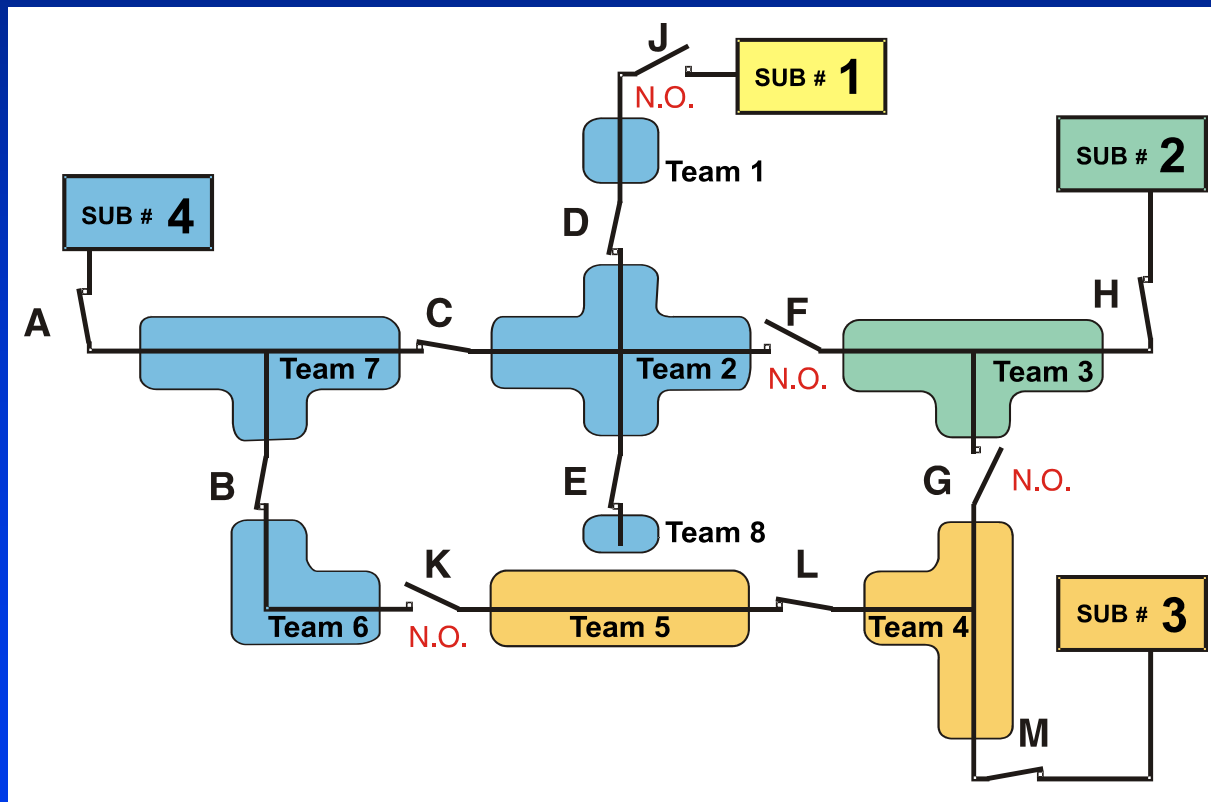
IntelliTEAM II — Systems

- Build up system of line segments
- Share team members at connection points
- Set automatic operation values (no programming)
- Set optional source priorities and strategies



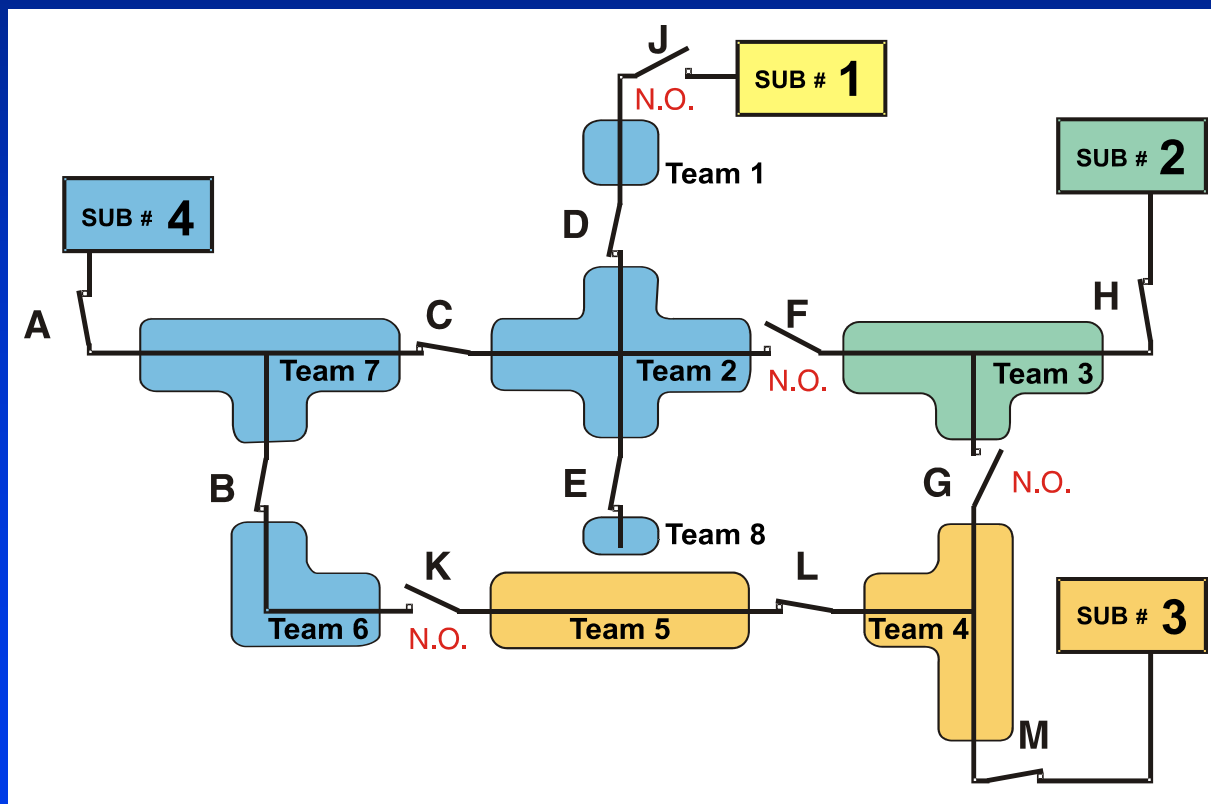
IntelliTEAM II — Systems

- Coordinate with breaker settings, number of shots
- Can order ties in priority
- Can limit number of segments picked up
- Can set loading limits



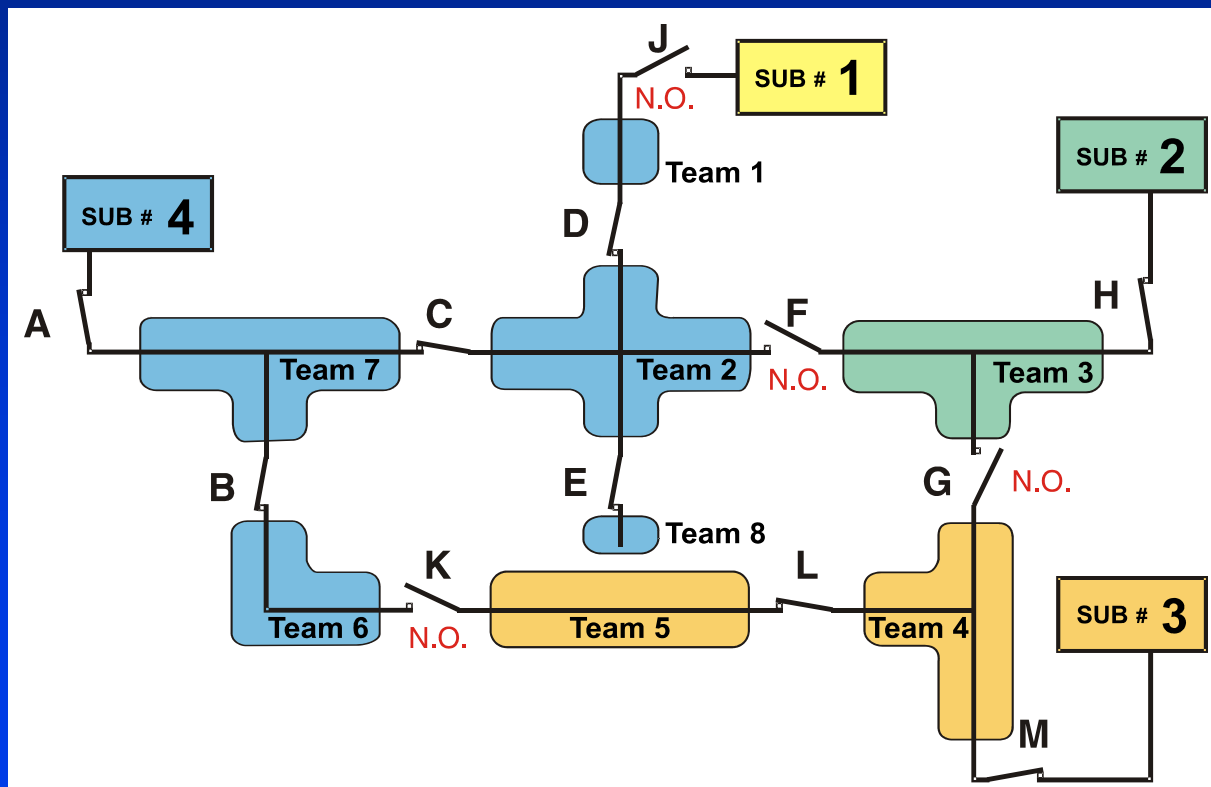
IntelliTEAM II — Coaches

- Software agents called “coaches” circulate among the teams and “call the plays” to keep customers in service
- The coach brings system data to team members and dynamically prioritizes the team restoration strategy



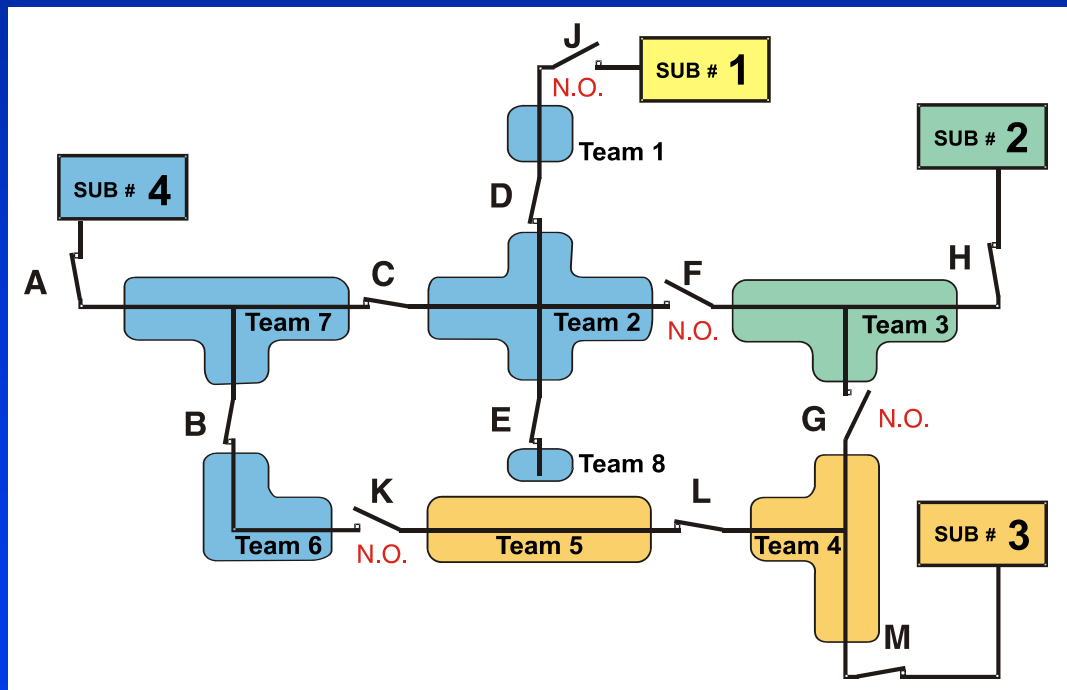
IntelliTEAM II — Coaches

- A team's coach works to keep the team energized by negotiating with adjacent coaches – and can close switches that teams share when both coaches agree
- When an outage or line fault occurs, the coach of each affected team reads the situation and develops a restoration strategy



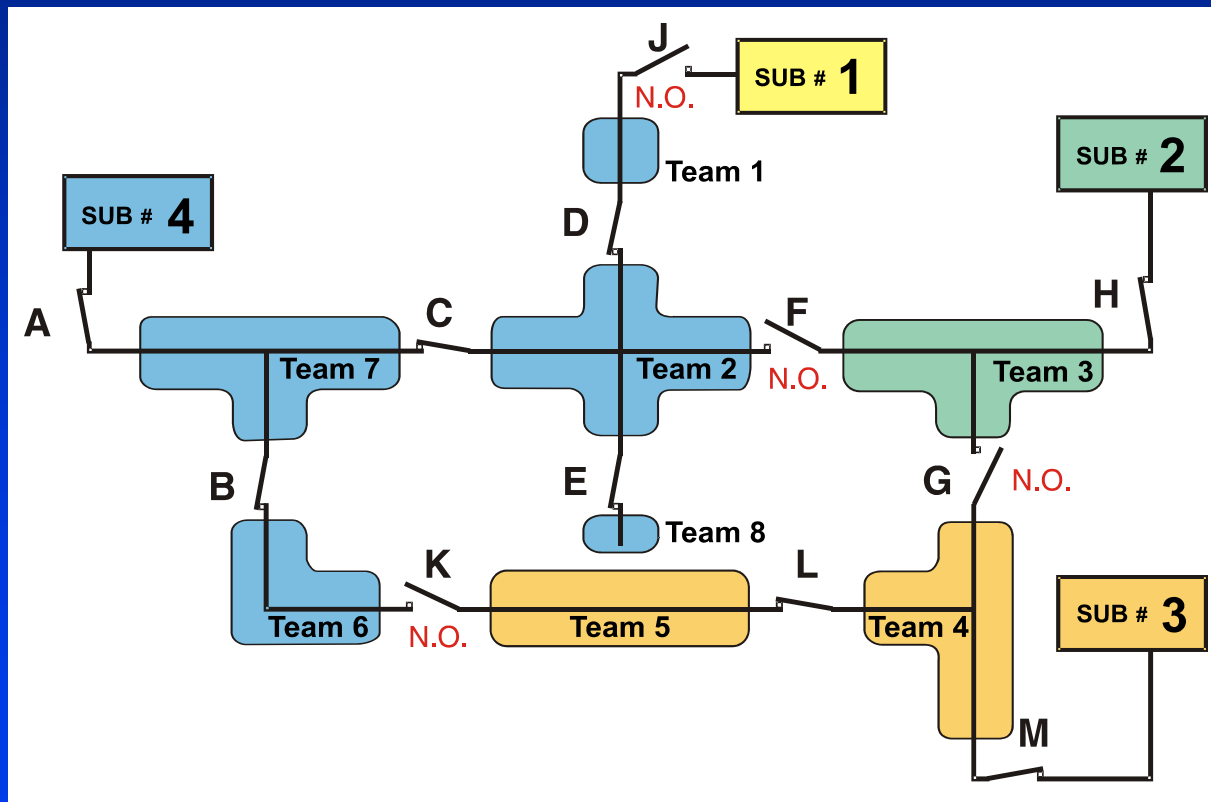
How IntelliTEAM II Works — Details

- Coach must check on each team member within a predetermined time interval
- If a team member does not hear from the coach in this period of time, error condition is flagged
- Team members notify the coach and other team members when events occur that will affect the line segment



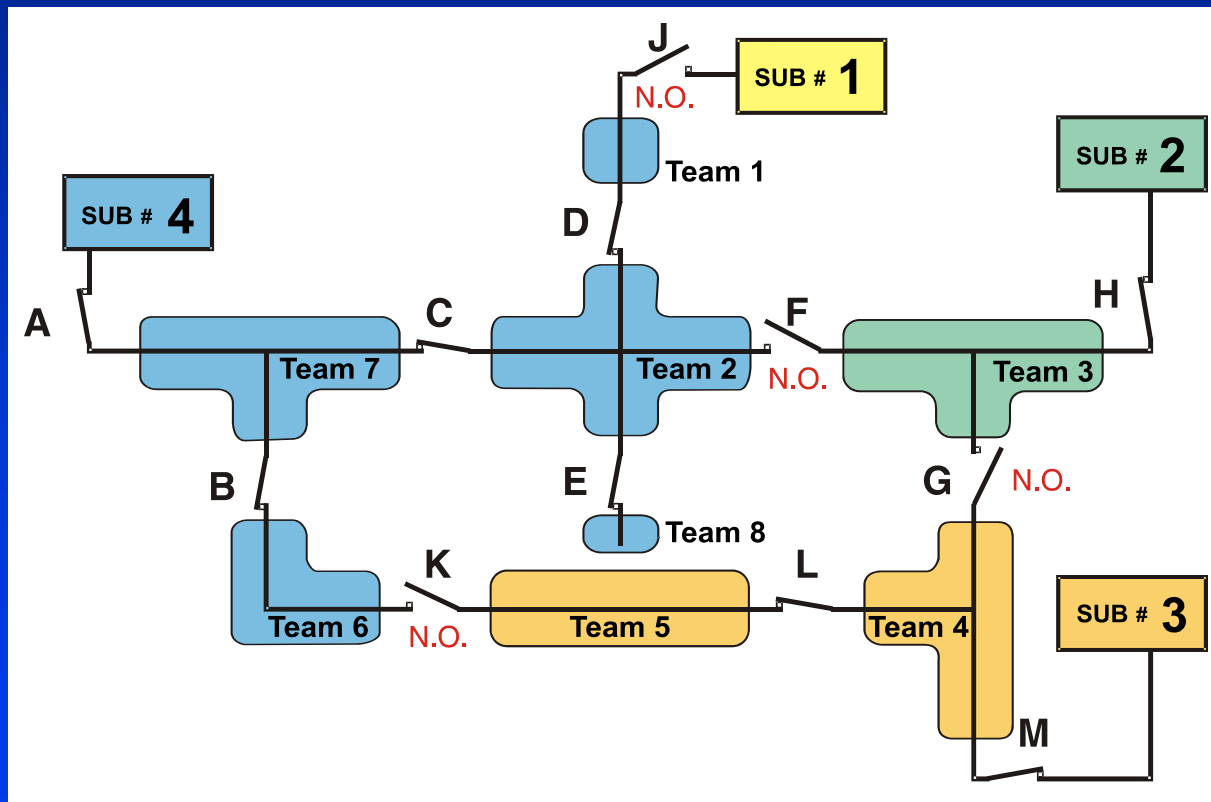
IntelliTEAM II — Return to Normal

- When normal power has been restored or the fault has been corrected, the system will return to its normal configuration, either manually, automatically, or via SCADA command.



IntelliTEAM II — Contracts

- Contracts are optional and are used with segment limits to “look” ahead and prevent circuit overload in case of multiple faults



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For More Information

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For Demo of IntelliTEAM II

www.sandc.com/products/Energyline/IntelliTEAM/it2_demo.asp

