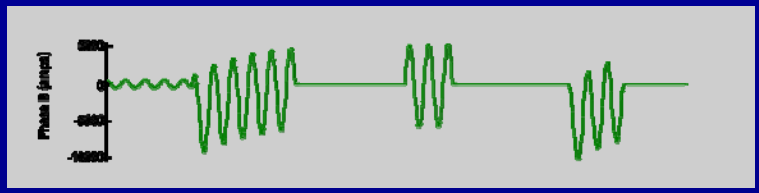
A Kinder and Gentler Way of Overhead Fault Testing

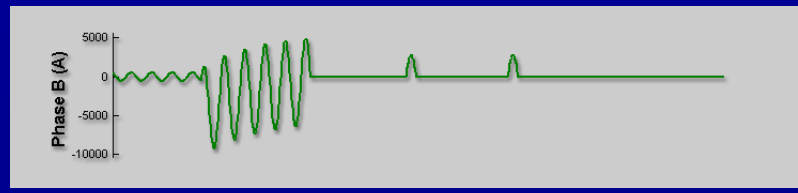
A Story of Engineering Innovation

IEEE/PES Chicago Chapter Meeting
3/14/2007

Engineering Innovation

Reclosing vs. PulseClosing





Conventional Reclosing

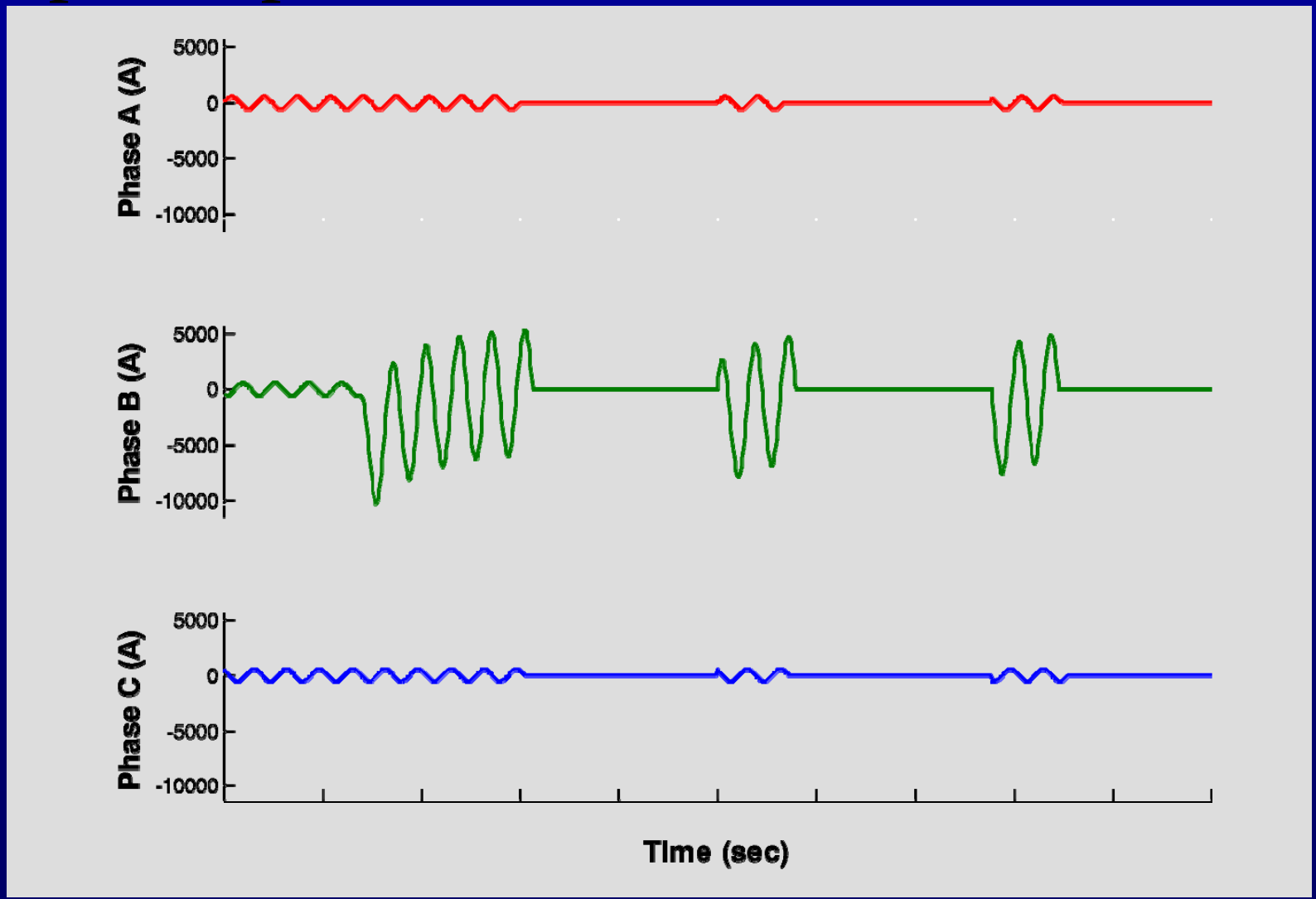
- Test by closing – causes another fault
- Significant system stress
- Through-fault on transformers
- Voltage sags
- Difficult to coordinate

PulseClosing

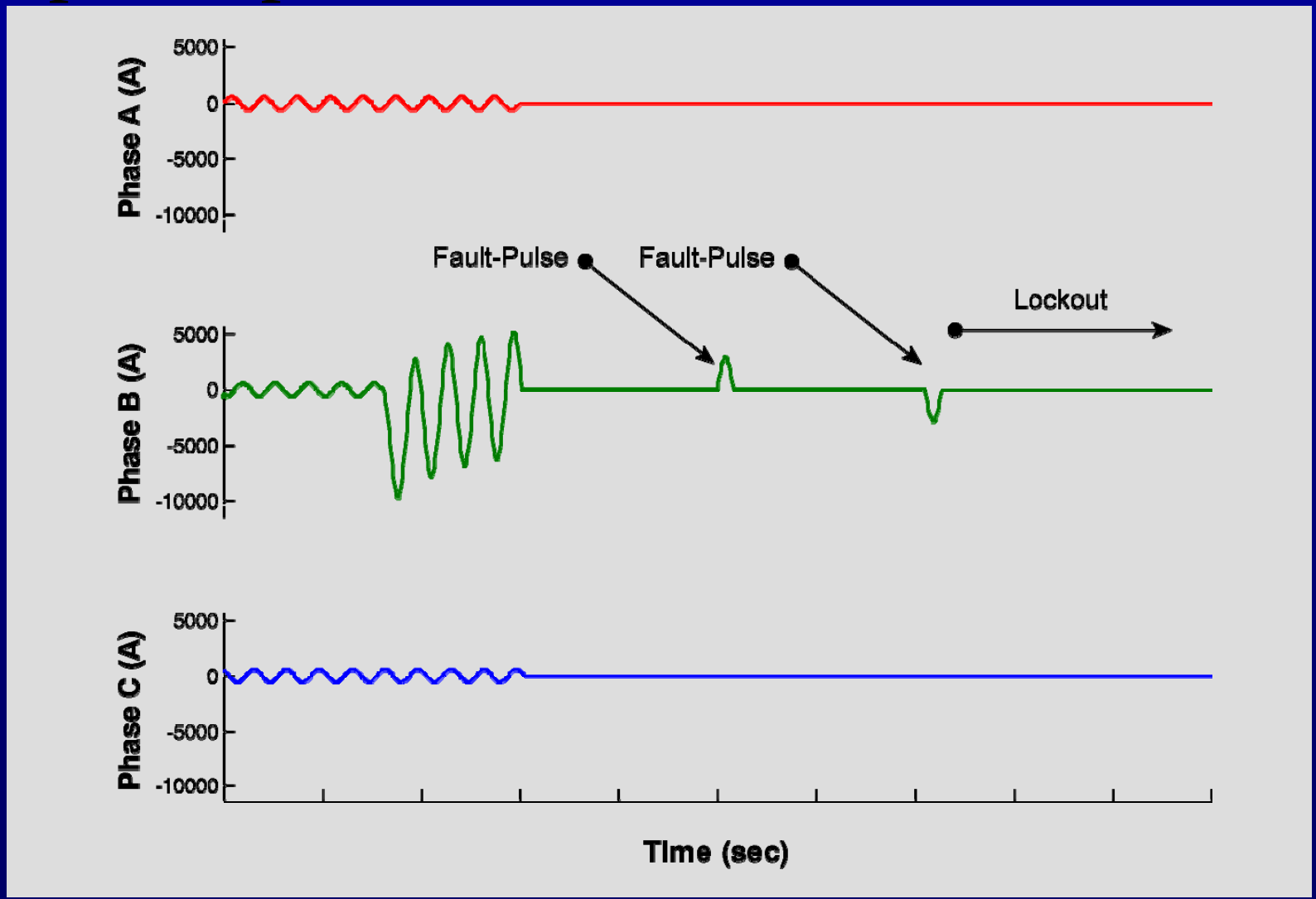
- Test by PulseClosing
- <2% of let-through energy
- No stress on system
- No transformer through-fault
- No voltage sags
- Solves coordination problems

DEMONSTRATION

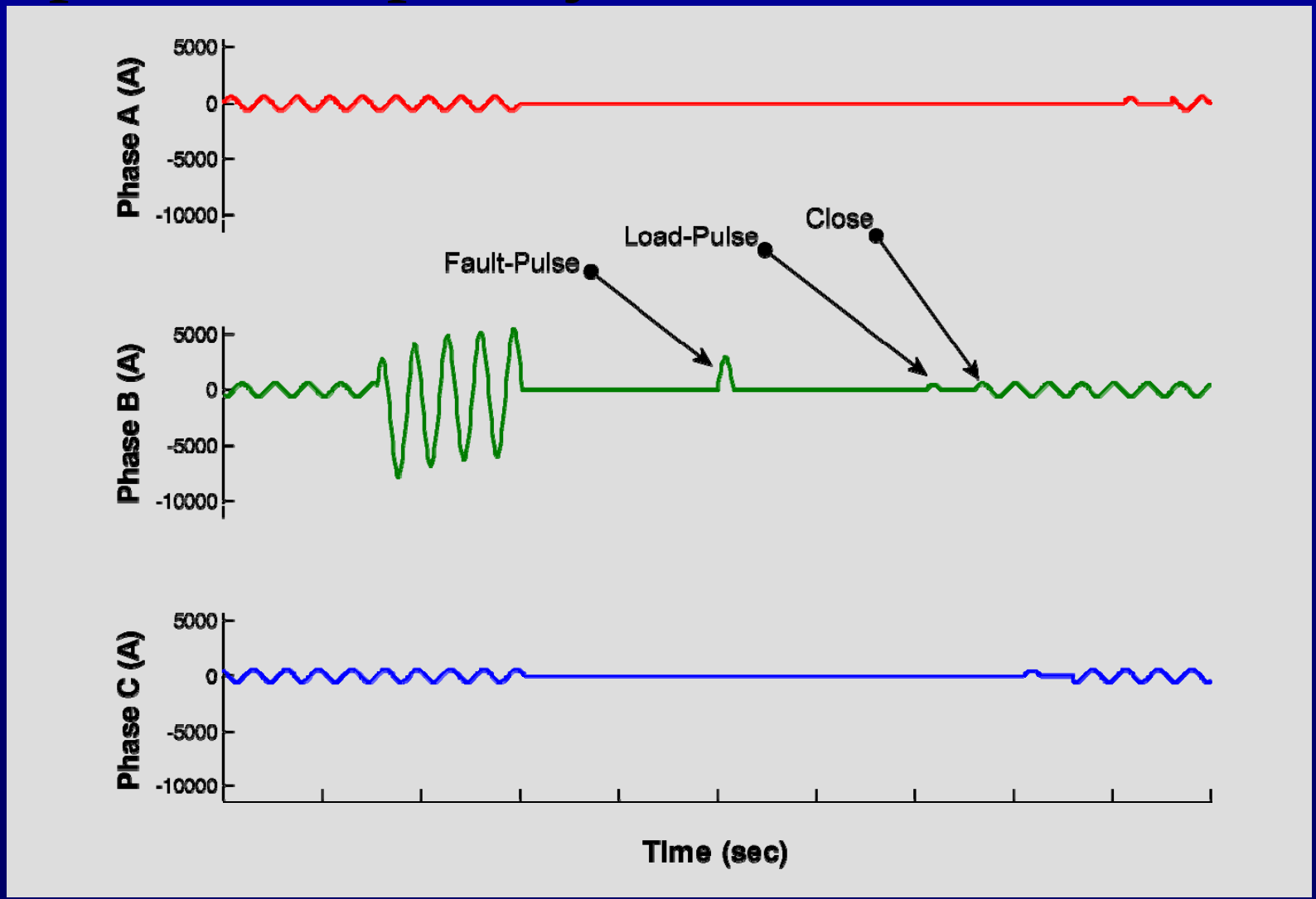
Conventional Reclosing
B phase permanent fault



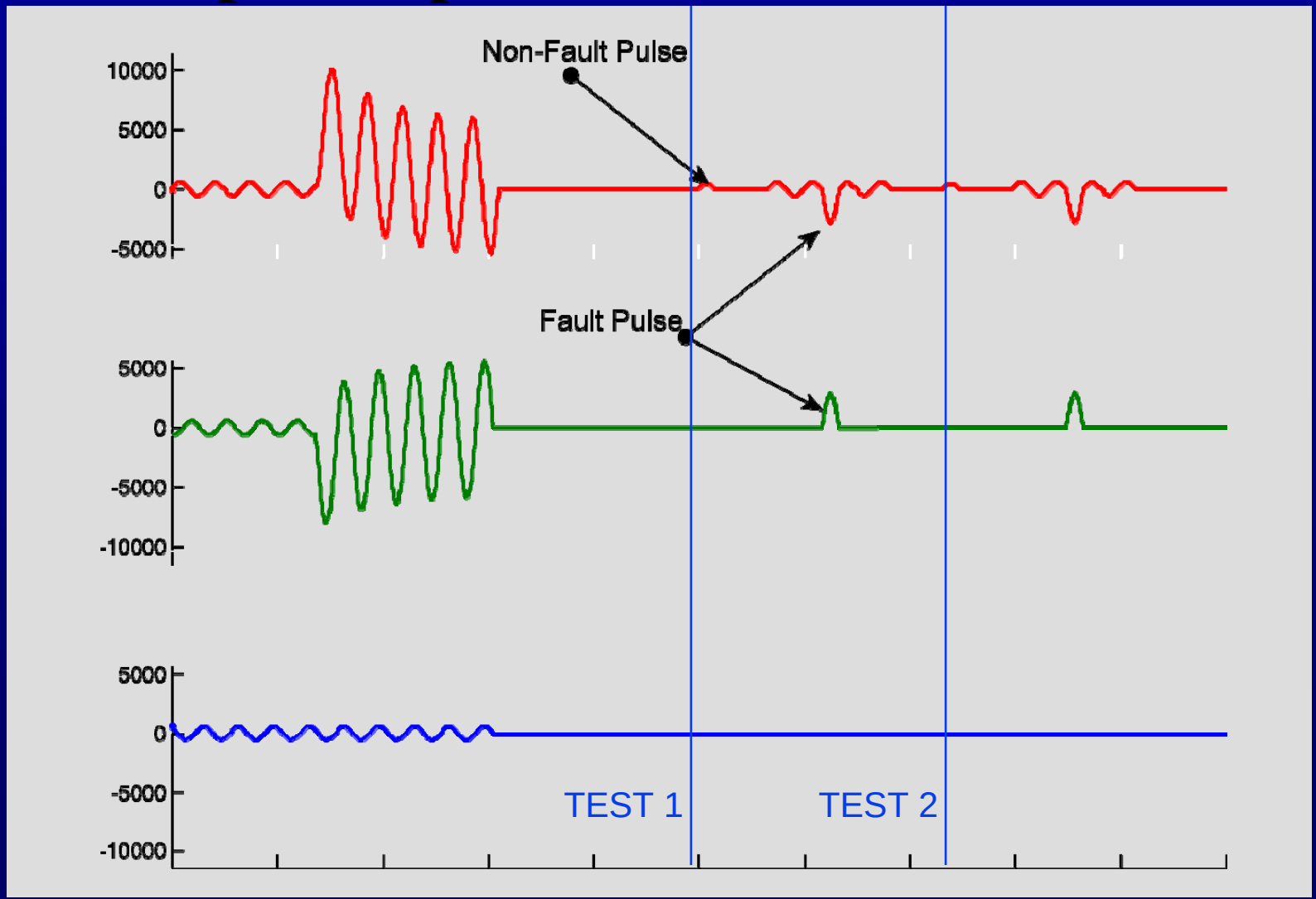
PulseClosing
B phase permanent fault



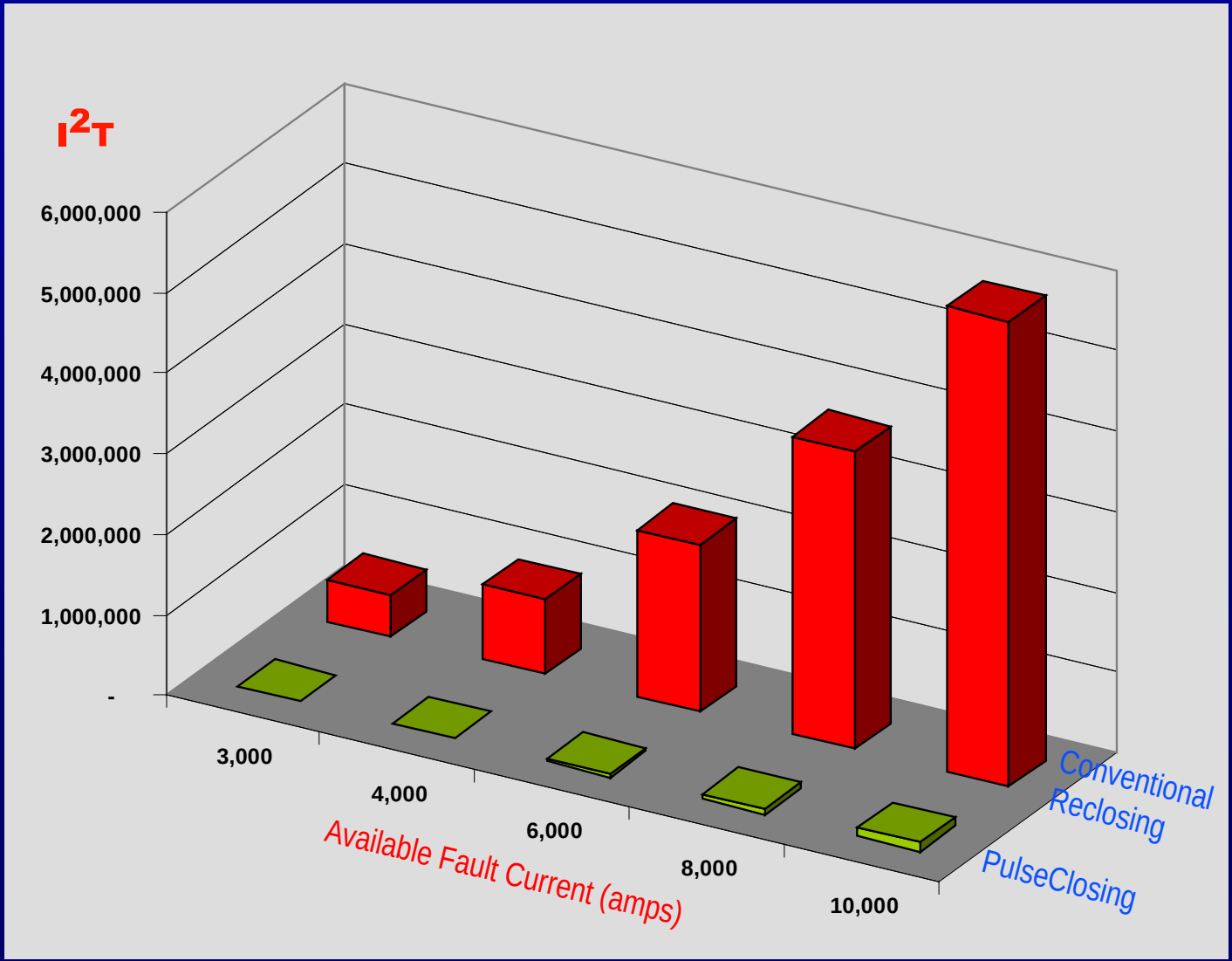
PulseClosing
B phase temporary fault



PulseClosing
A to B phase permanent fault



Fault Let-Through

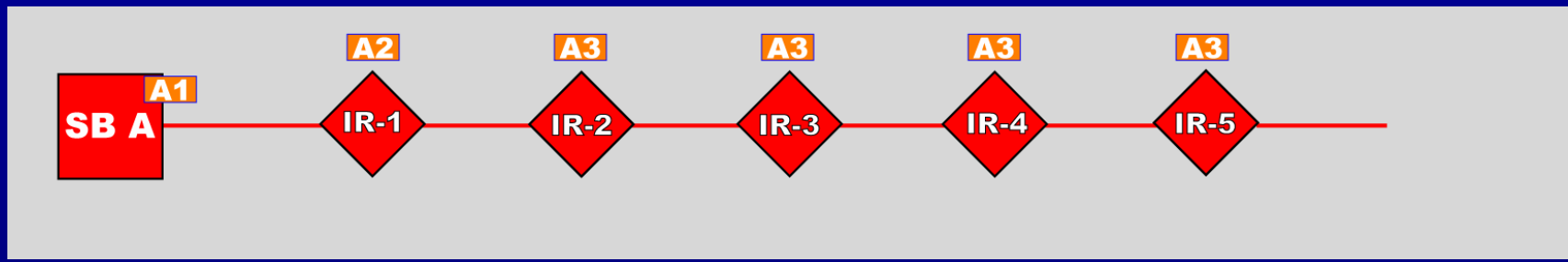


New systems – New Technologies – Advanced Capabilities

- PulseClosing
  - Improves asset life
  - Improves power quality & customer service
  - Improves ability to greater segment lines where needed

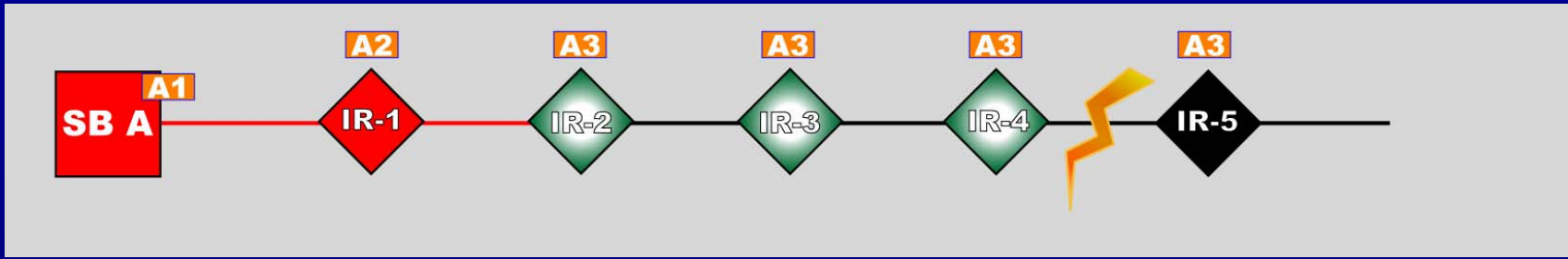
PulseFinder – a new way to “coordinate”

PulseFinder



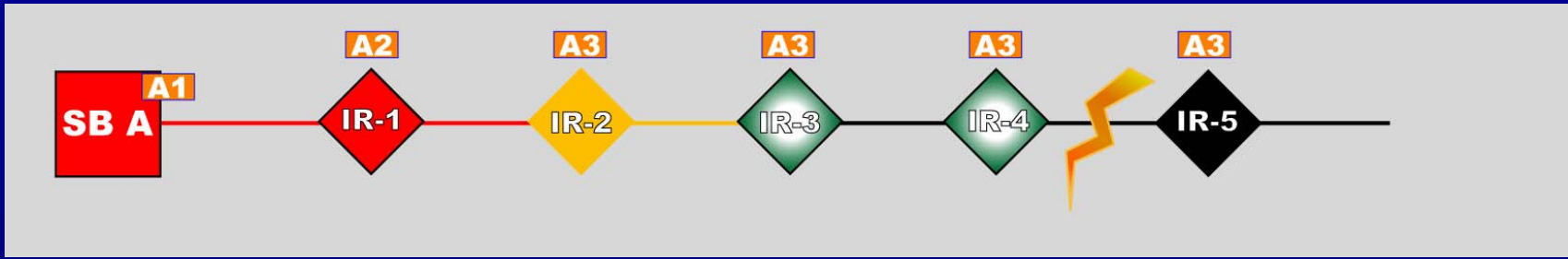
- Non-communicating automatic sectionalizing & restoration
- Coordination as much as possible
- Shared curves for remaining devices

PulseFinder



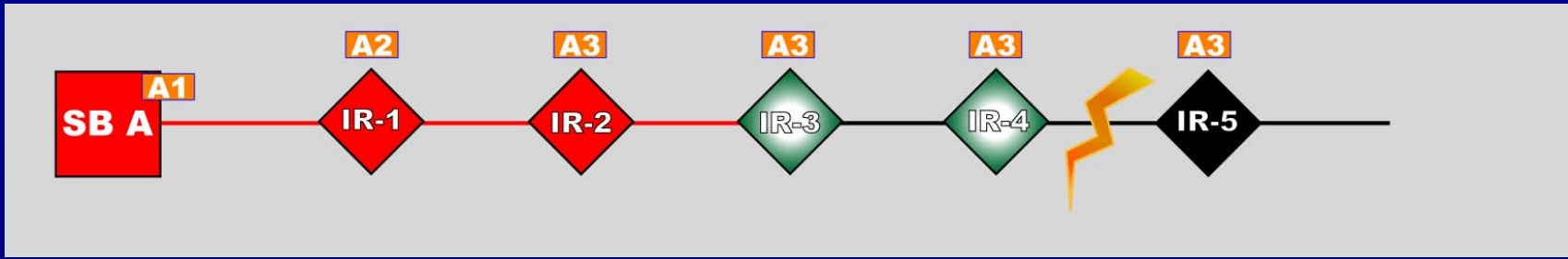
- T=0
- Fault in segment 5
- All PulseClosers with A3 curve trip

PulseFinder



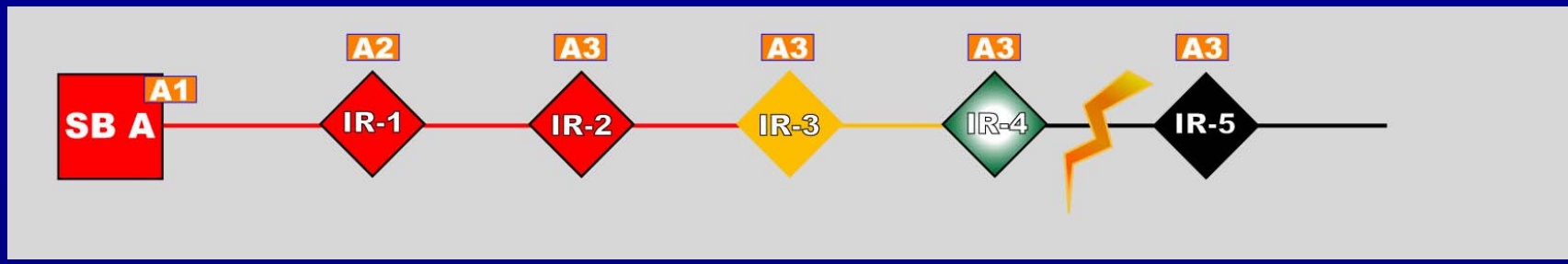
- T=1 sec
- IR-2 pulses

PulseFinder



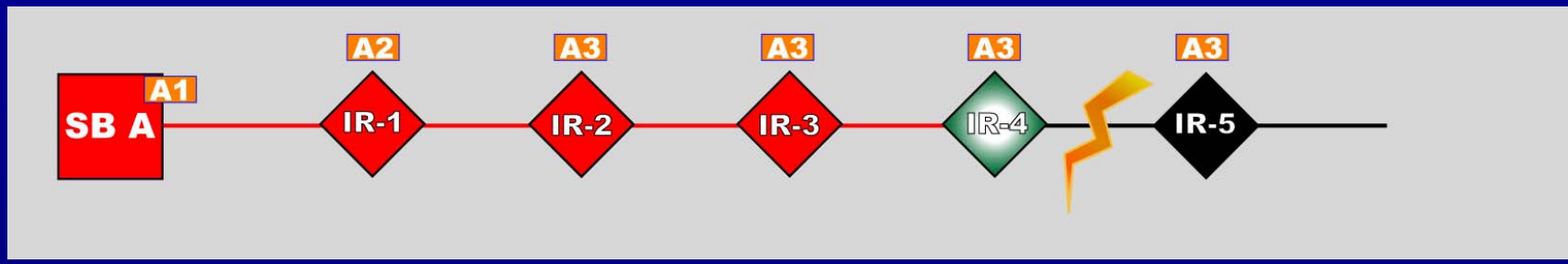
- T=1 sec
- IR-2 pulses and closes

PulseFinder



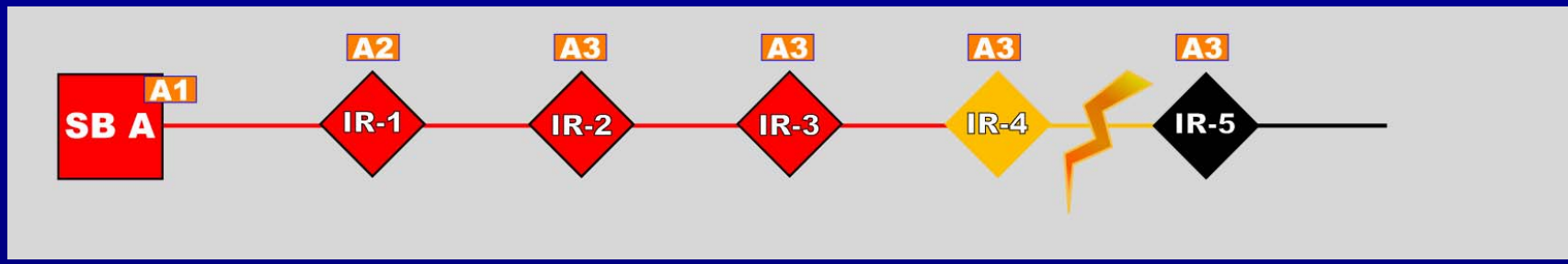
- T=1.5 sec
- IR-3 pulses

PulseFinder



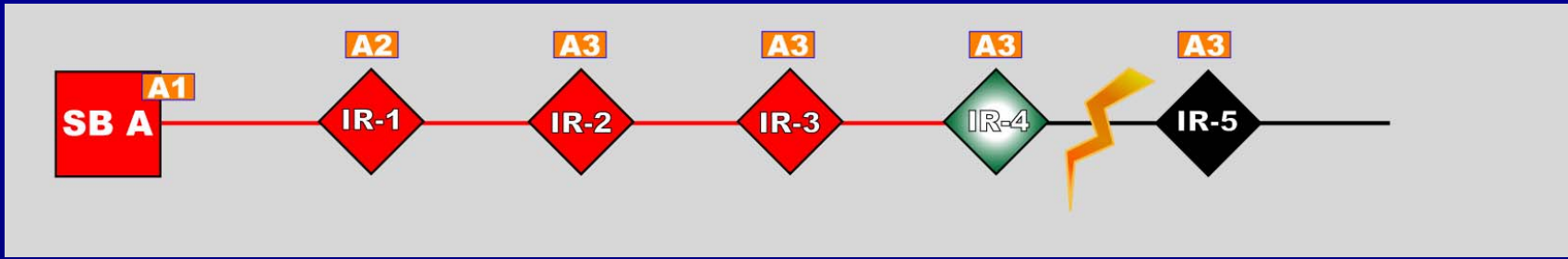
- T=1.5 sec
- IR-3 pulses and closes

PulseFinder



- T=2 sec
- IR-4 pulses

PulseFinder



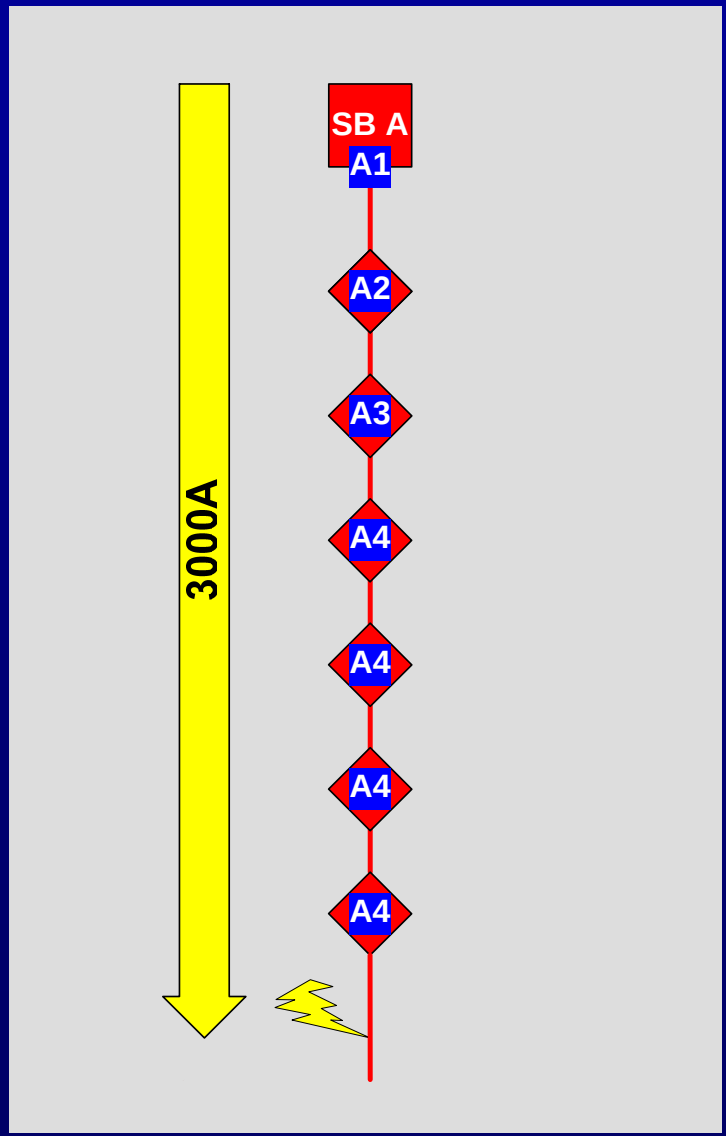
- T=2 sec
- IR-4 pulses and continues PulseClosing test sequence

PulseFinder

- Communication not required
- Use in lieu of overcurrent protection
- Use to add segmentation to overhead loop restoration systems
  - Requires reserved capacity

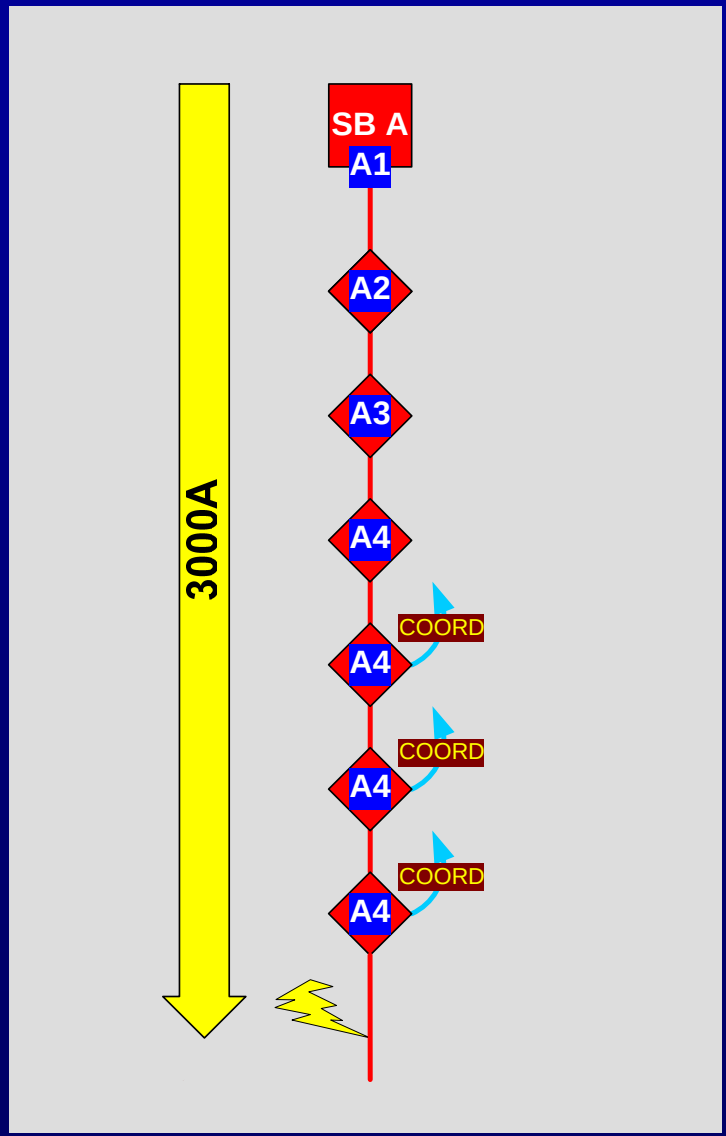
Communication Enhanced Coordination

- T=6ms
- Fault Occurs
- Exceeds pickup level of A4



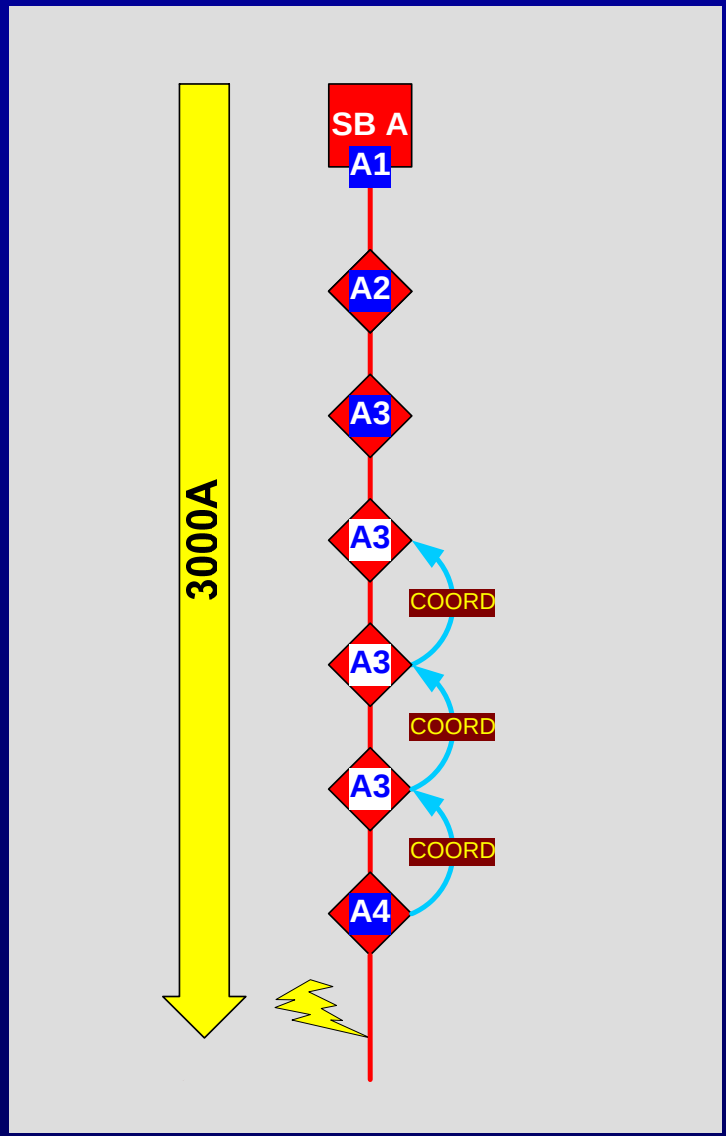
Communication Enhanced Coordination

- T=8ms
- Simultaneous Coordination signal sent

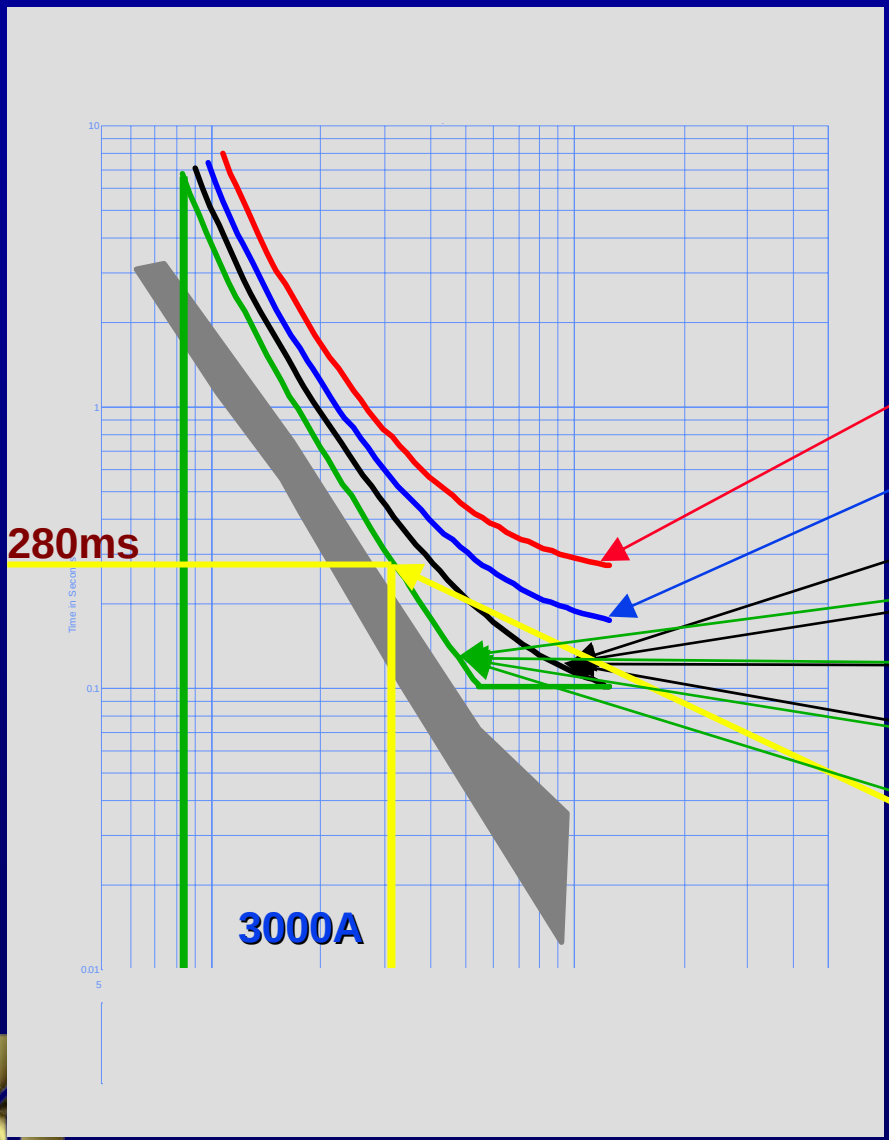


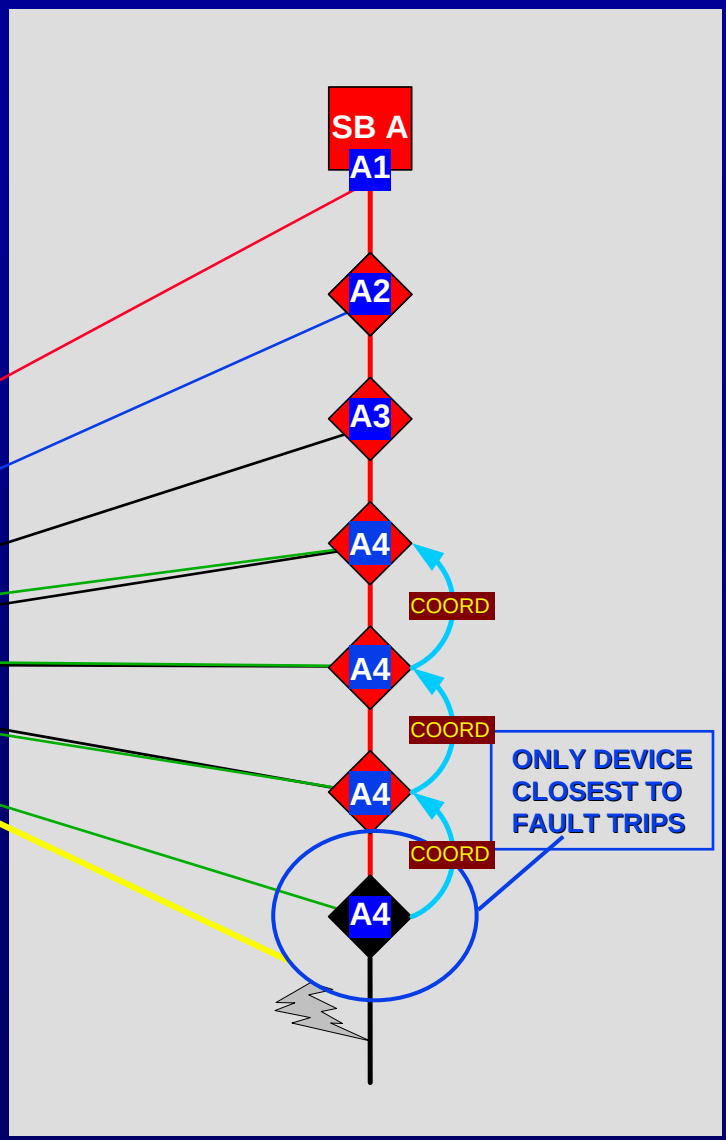
Communication Enhanced Coordination

- T=100ms max
- Coordination signal received
- All upstream IntelliRupters sharing TCC shift curve – enabling total coordination.



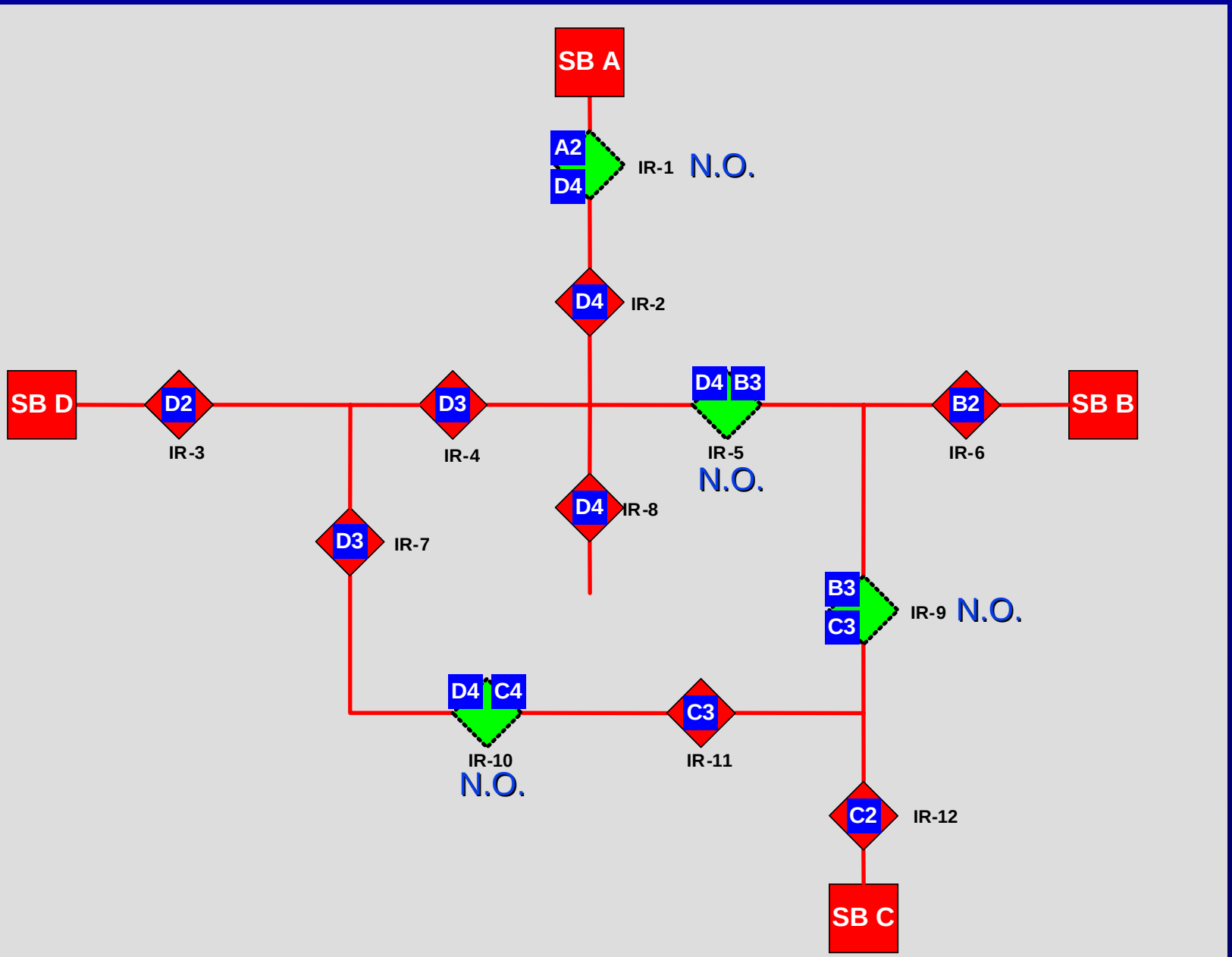
Communication Enhanced Coordination





Advanced Adaptive Protection

- Automatically reconfigure protection settings after circuit reconfiguration
  - To re-establish coordination
  - For any network of circuits
- Benefit
  - Enables complex circuit configurations
  - Enhances circuit planners ability to meet their customer's needs.
  - Enables better use of existing assets
  - No need to re-do protection when the system changes!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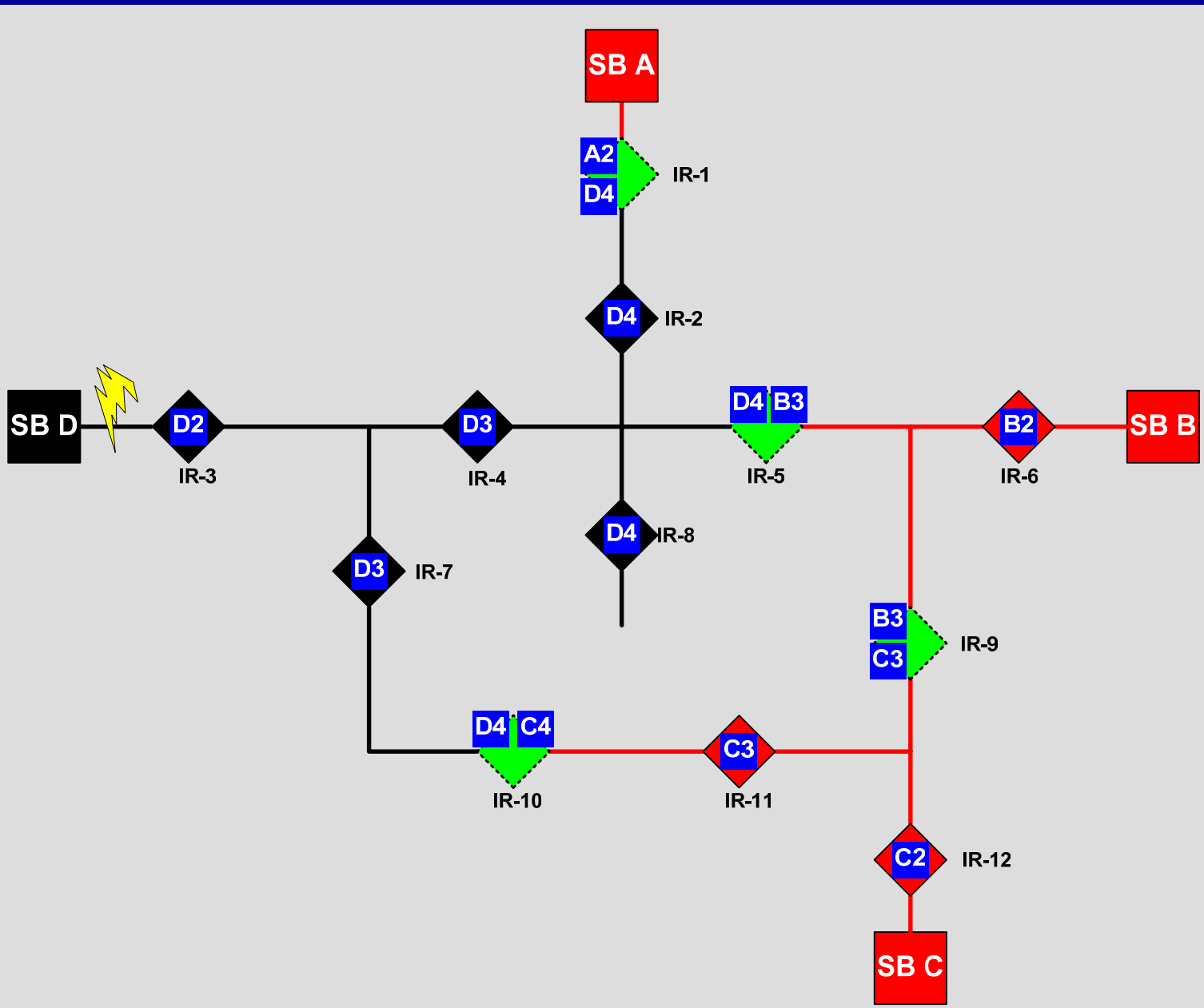
D4
IR-1
N.O.
D4
IR-2
SB D
D2
IR-3
D3
IR-4
D4
B3
IR-5
N.O.
B2
IR-6
SB B
D4
IR-8
D3
IR-7
B3
C3
IR-9
N.O.
D4
C4
IR-10
N.O.
C3
IR-11
C2
IR-12
SB C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D4
IR-1
D4
IR-2
SB D
D2
IR-3
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IR-4
D4
B3
IR-5
B2
IR-6
SB B
D4
IR-8
D3
IR-7
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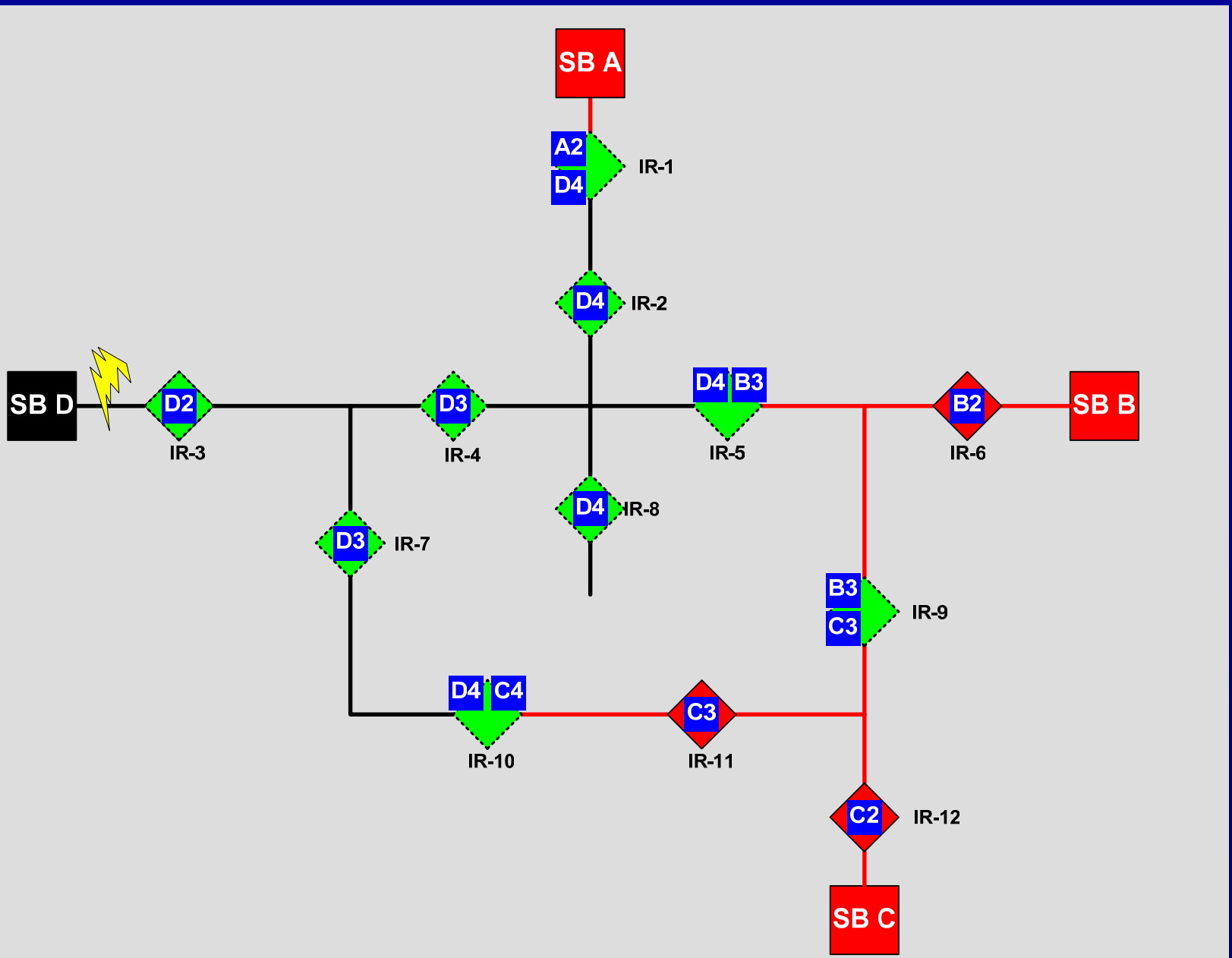
C3
IR-9
D4
C4
IR-10
C3
IR-11
C2
IR-12
SB C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SB D
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B2
IR-6
SB B
D4
IR-8
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IR-10
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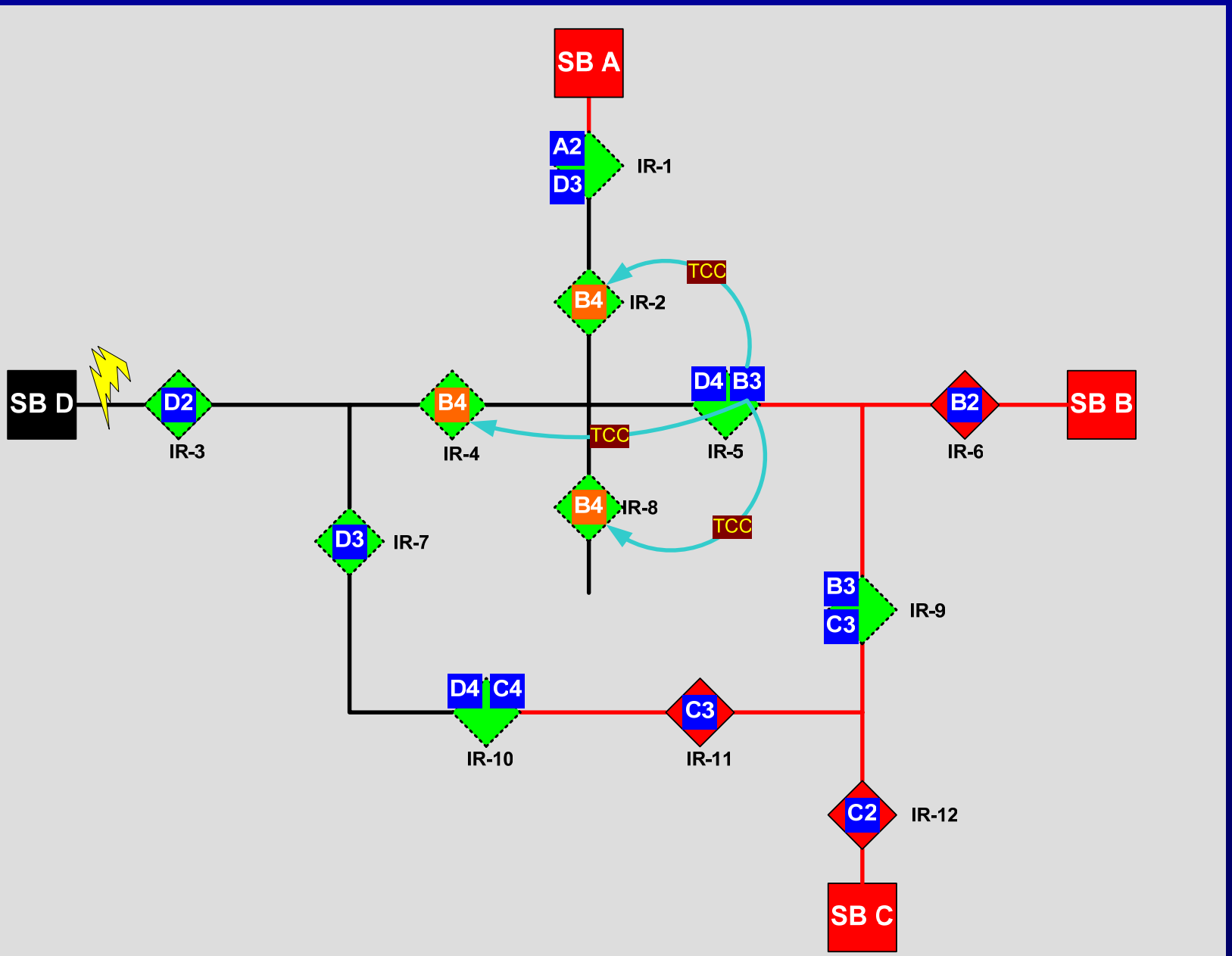
IR-11
C2
IR-12
SB C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IR-5
B2
IR-6
SB B
B4
IR-8
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C3
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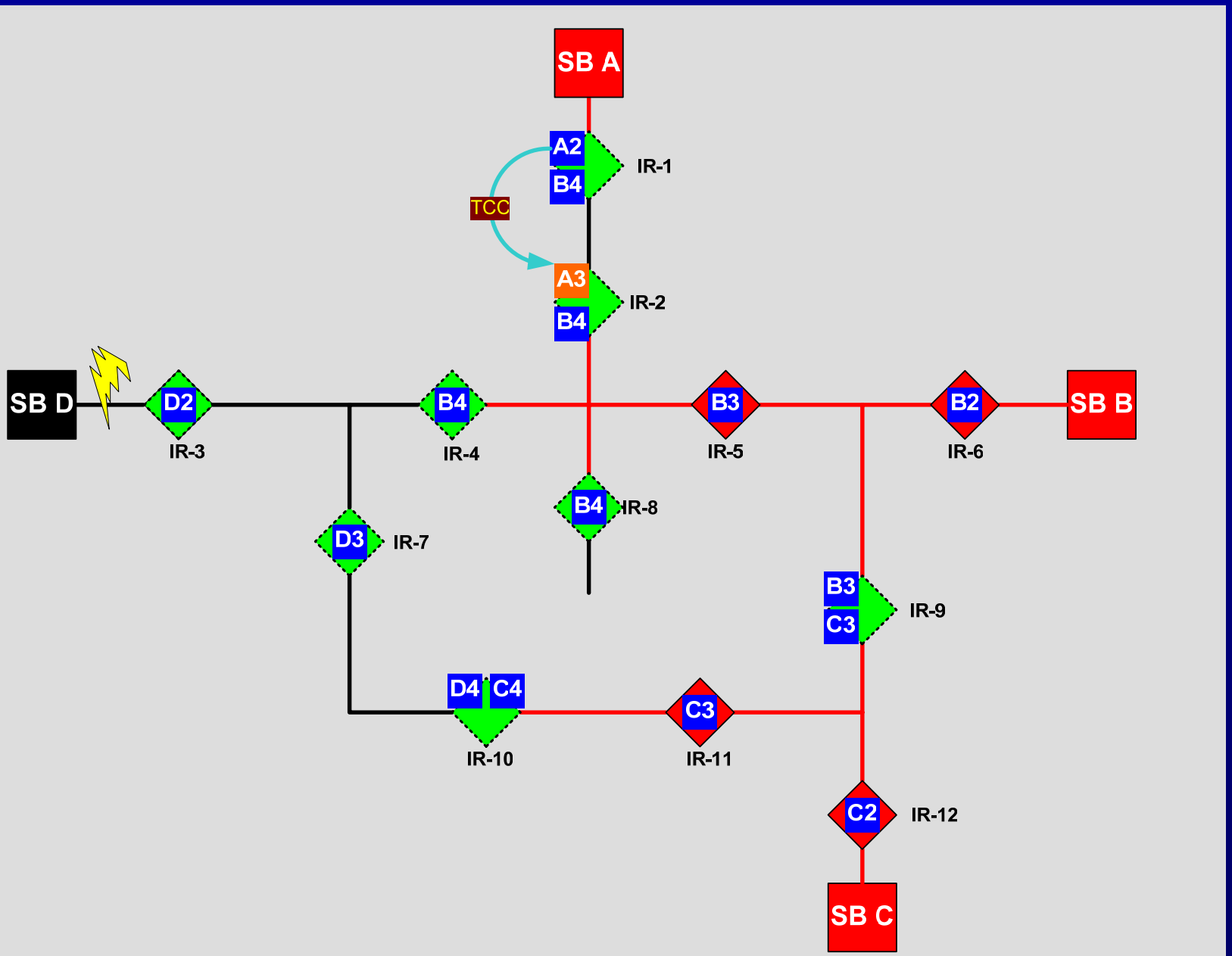
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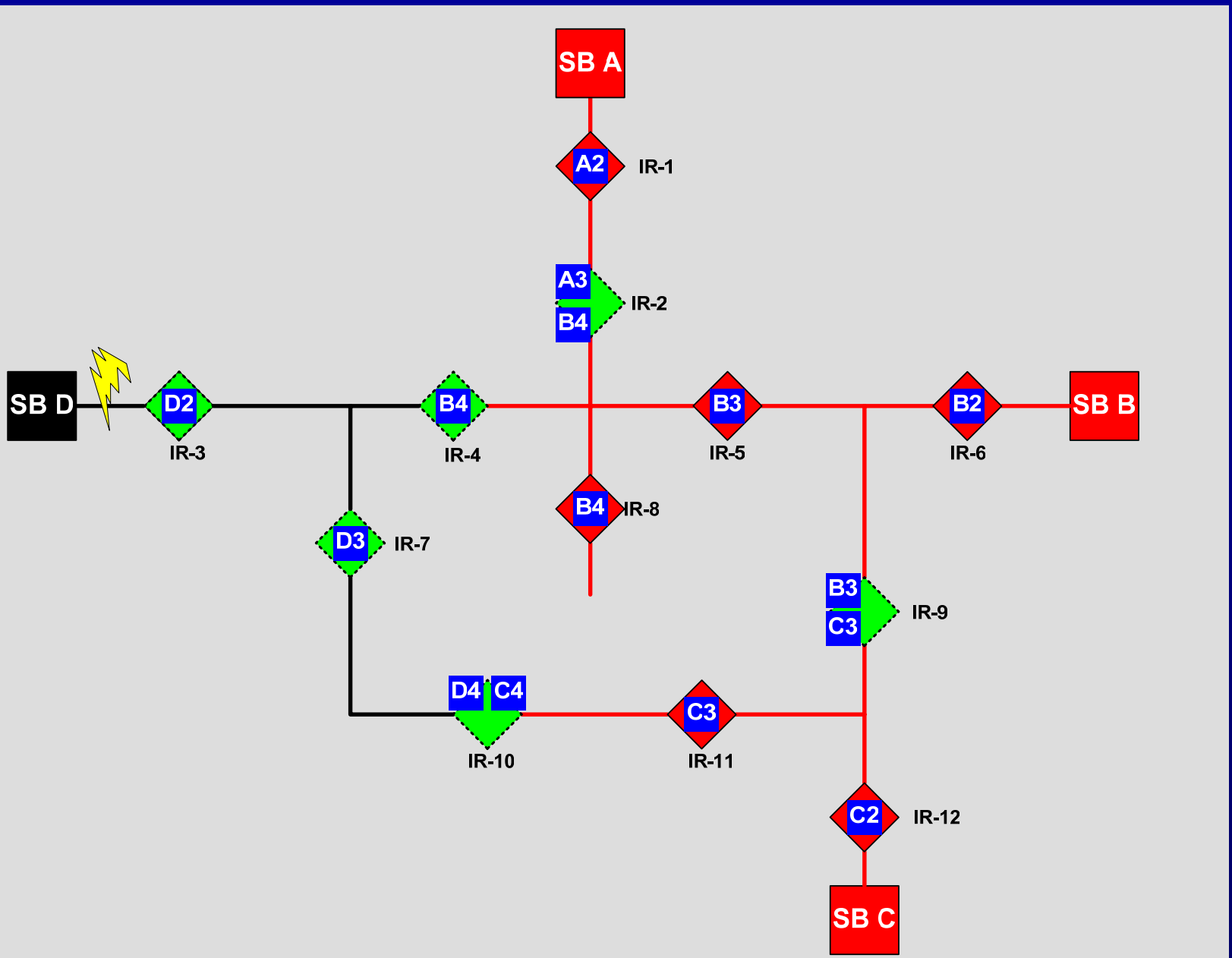
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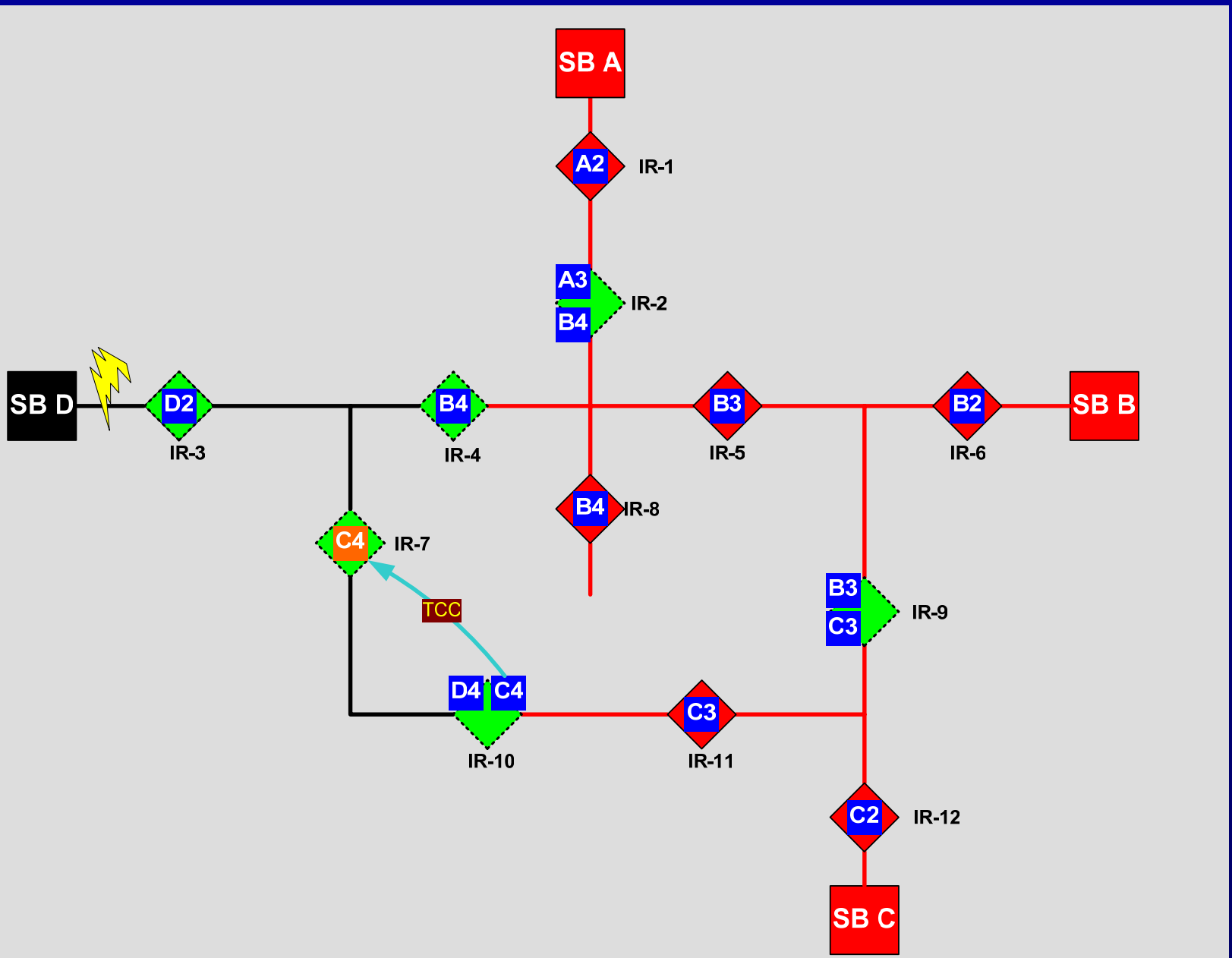
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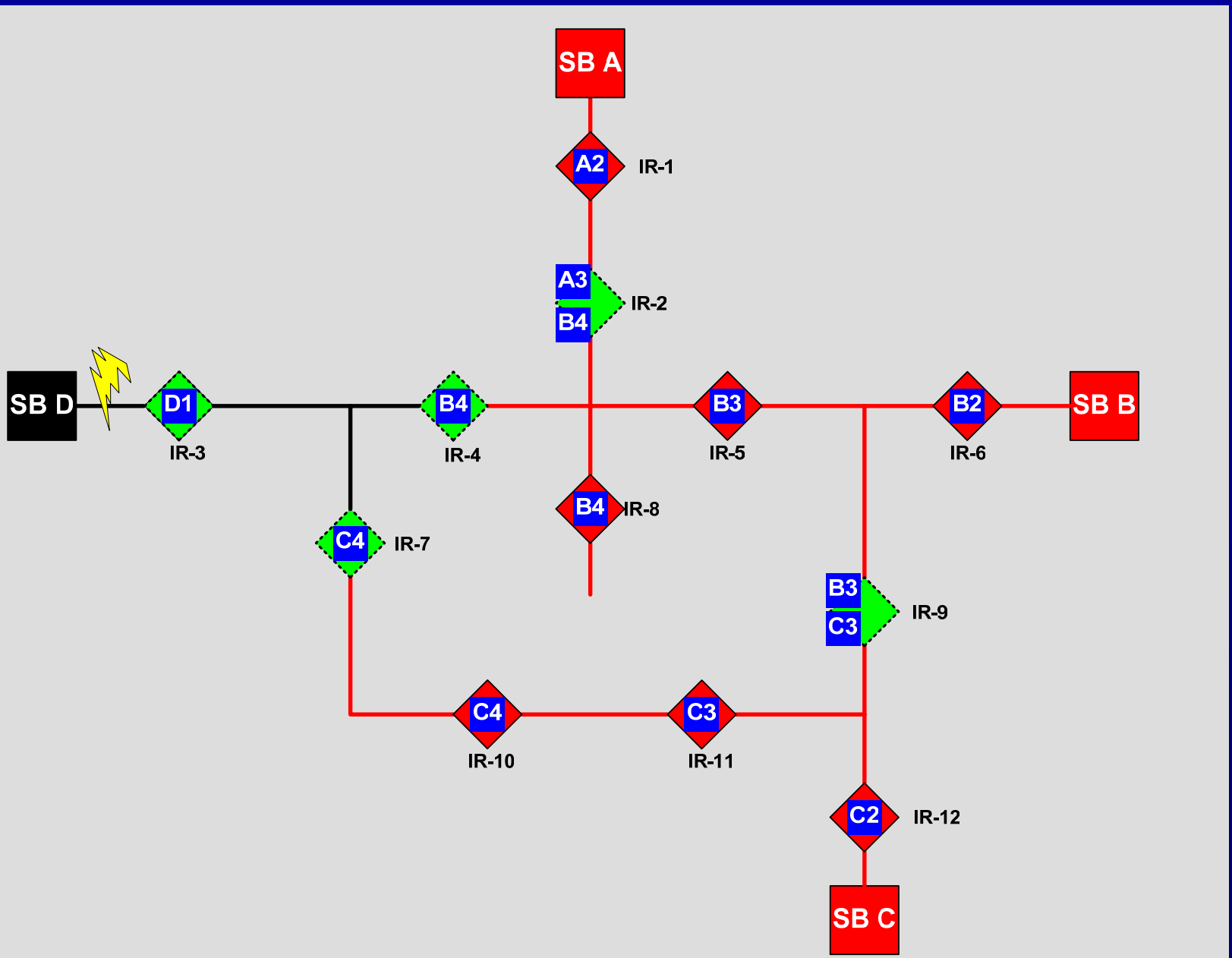
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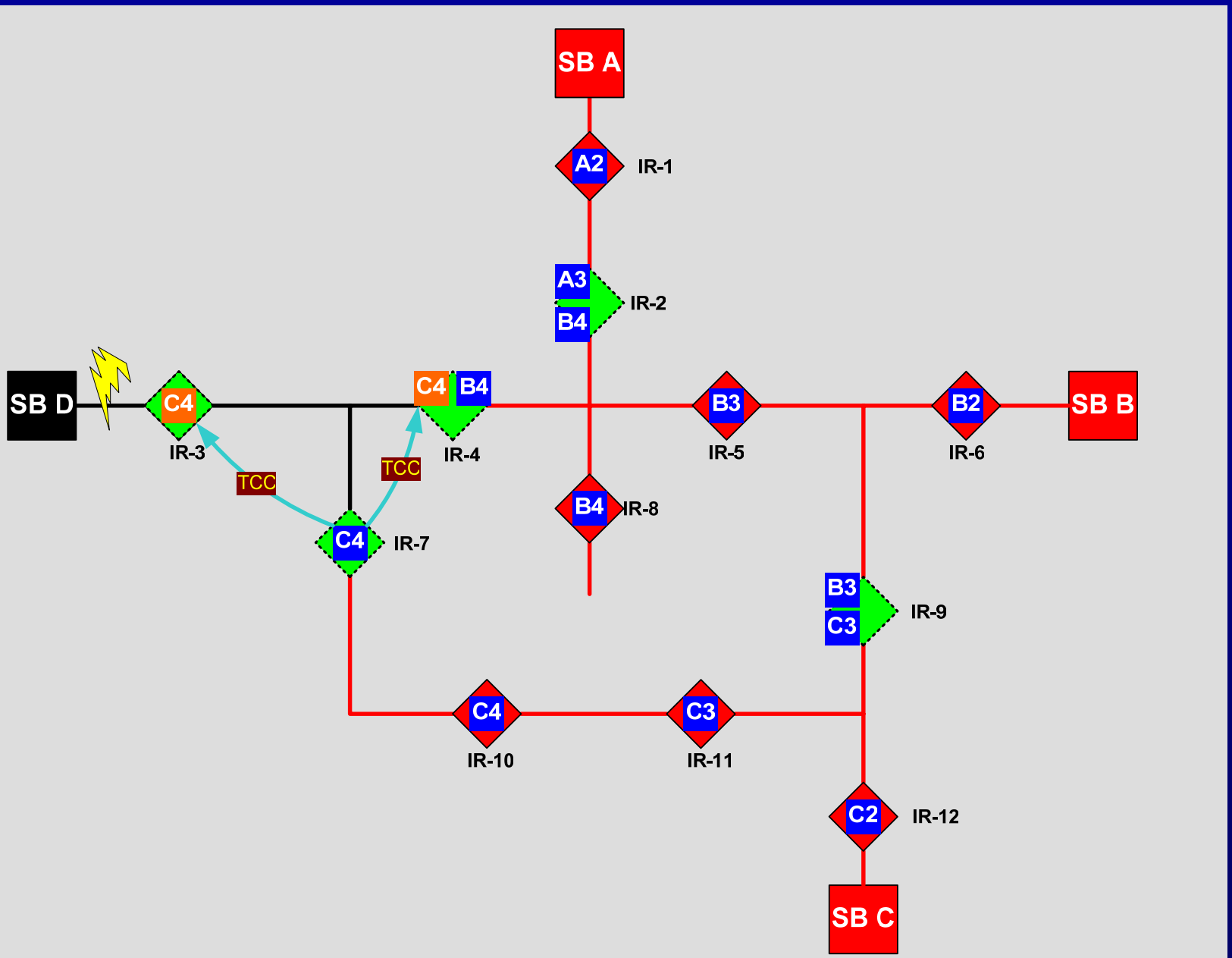
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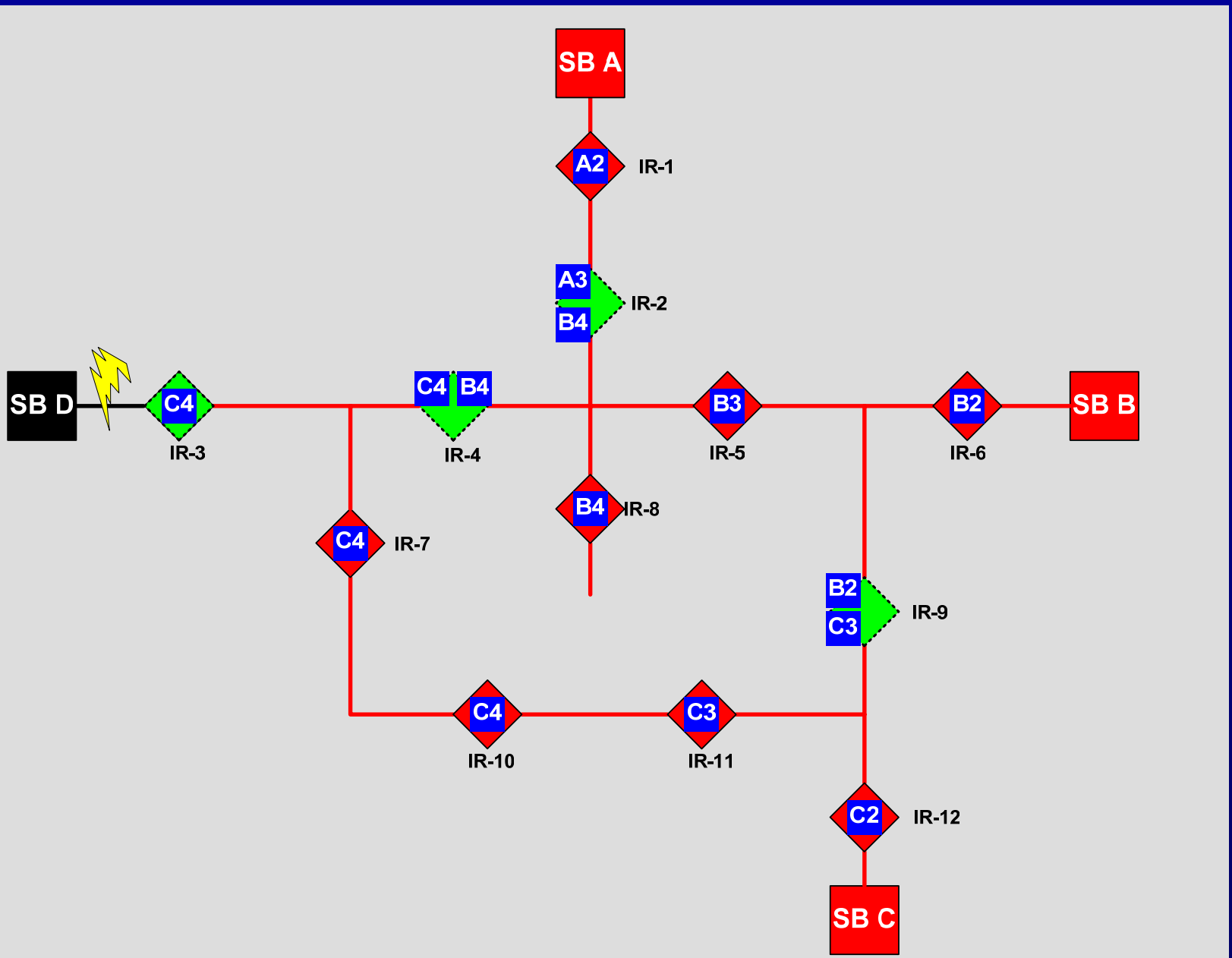
SB A
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B4
IR-8
C4
IR-7
B2
C3
IR-9
C4
IR-10
C3
IR-11
C2
IR-12
SB C

New systems – New Technologies – Advanced Capabilities

- High-speed controls
  - Machine-coordination development
  - Advanced restoration algorithms – faster, better
  - Intelligent fuse saving algorithms – save only when feasible
- High-Speed Radio + Distributed Intelligence =
  - Automatic setup of series devices
  - Coordination of any number of series devices
  - Adaptive protection ensures system stays coordinated

Design for the Future, not for the Past

- New tools give utility engineers and planners the ability to design 21st century systems to serve 21st century loads

End