

Case Study: Using Distribution Automation to Build the Next Generation Utility in the City of Wadsworth

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Overview

- Implementing automatic FDIR
- Installing volt / VAR control scheme
- Designing high-speed trip blocking scheme with IEC 61850 GOOSE

City of Wadsworth, Ohio

- Approximate population is 20,000
- Less than 1 hour from Akron and Cleveland
- City-run Internet service provider

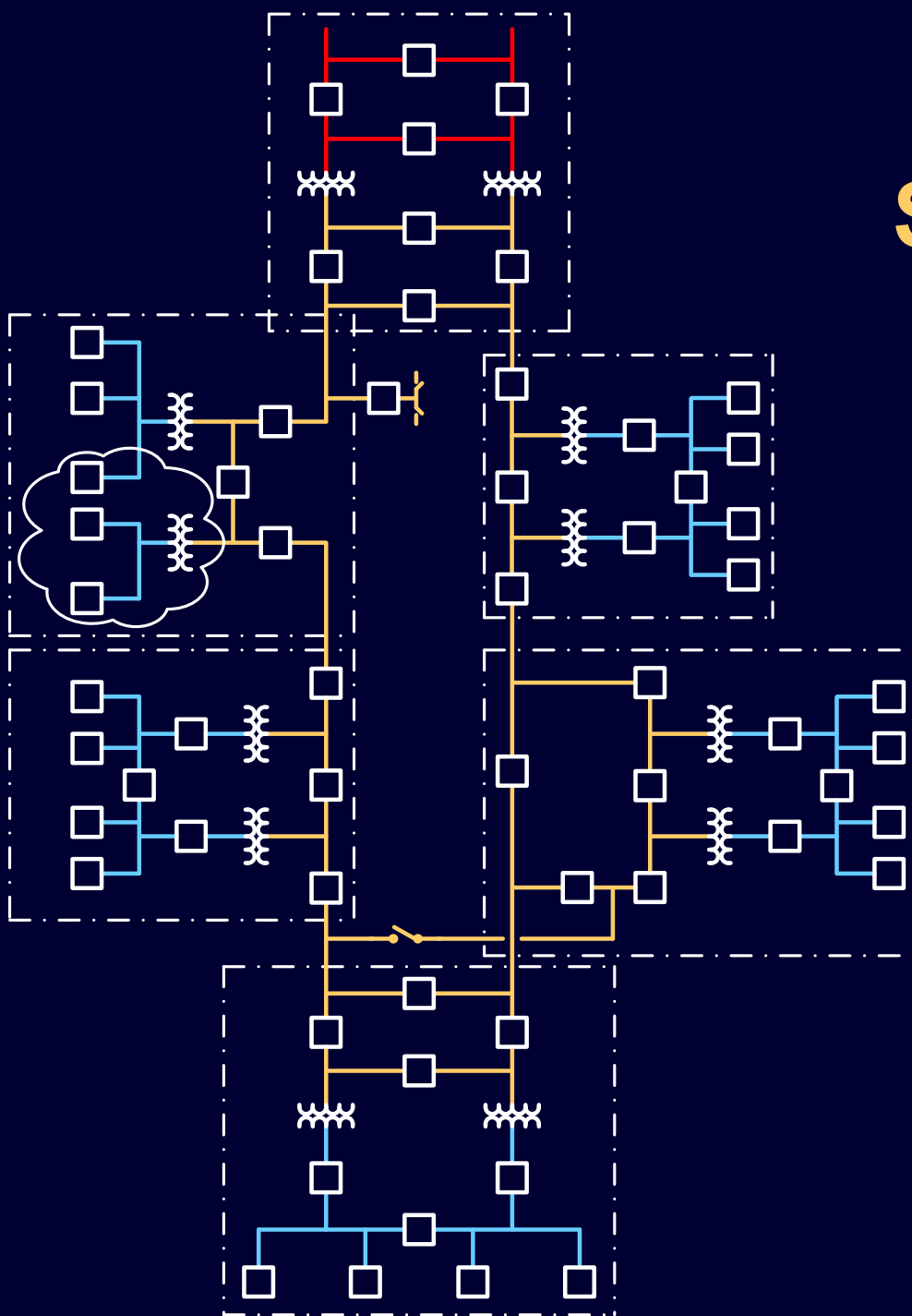
City Details

Existing Asset

City-Wide Fiber-Optic Network

- Gigabit ring around city
- Additional point-to-point fiber runs between substations

One-Line Subtransmission



Equipment Upgrades

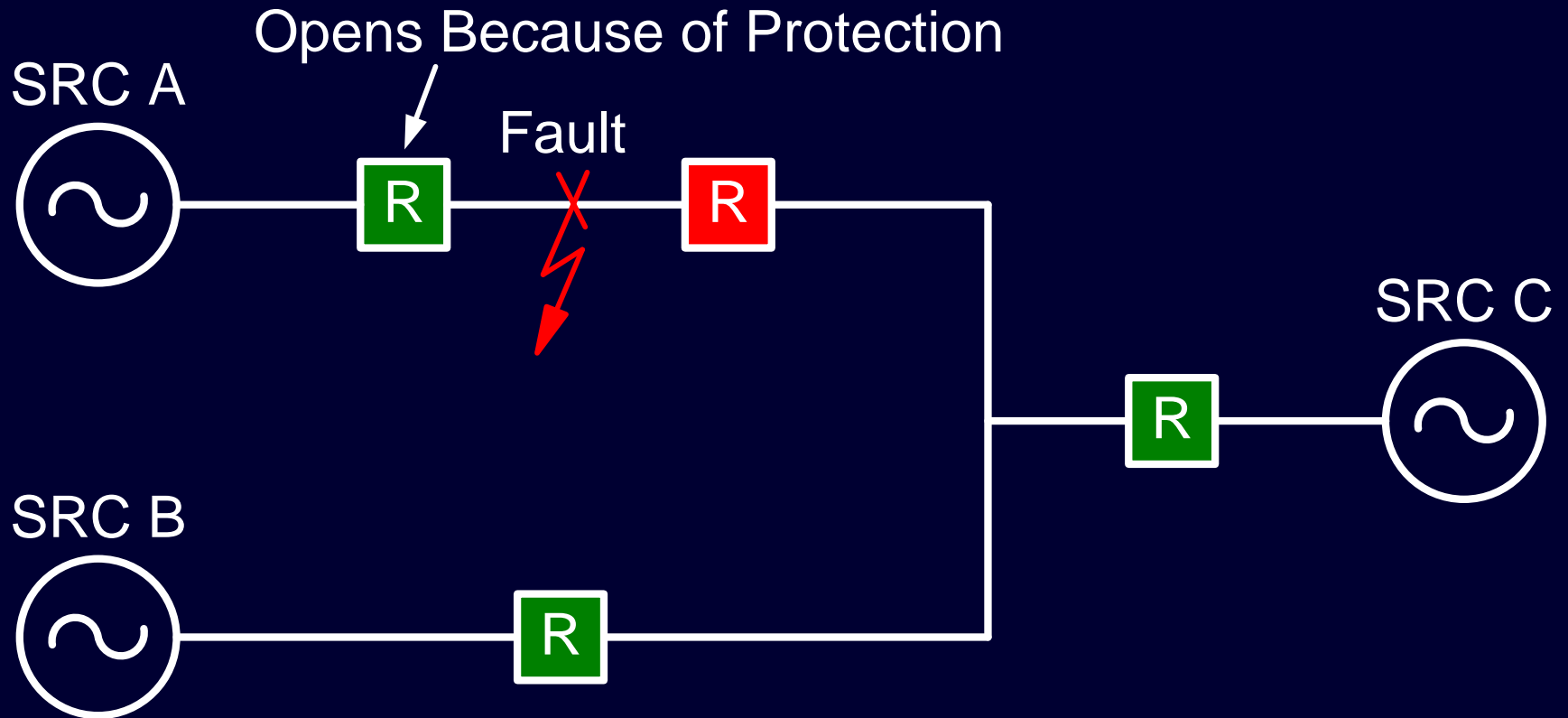
- Main breaker relays
- Bus-tie relays
- Feeder breaker relays
- Existing voltage regulator controls
- Existing capacitor bank controls

New Equipment

- Reclosers with two-sided voltage sensing
- Substation HMI
- Network firewall with remote engineering access
- Transformer monitors
- Additional capacitor bank controls

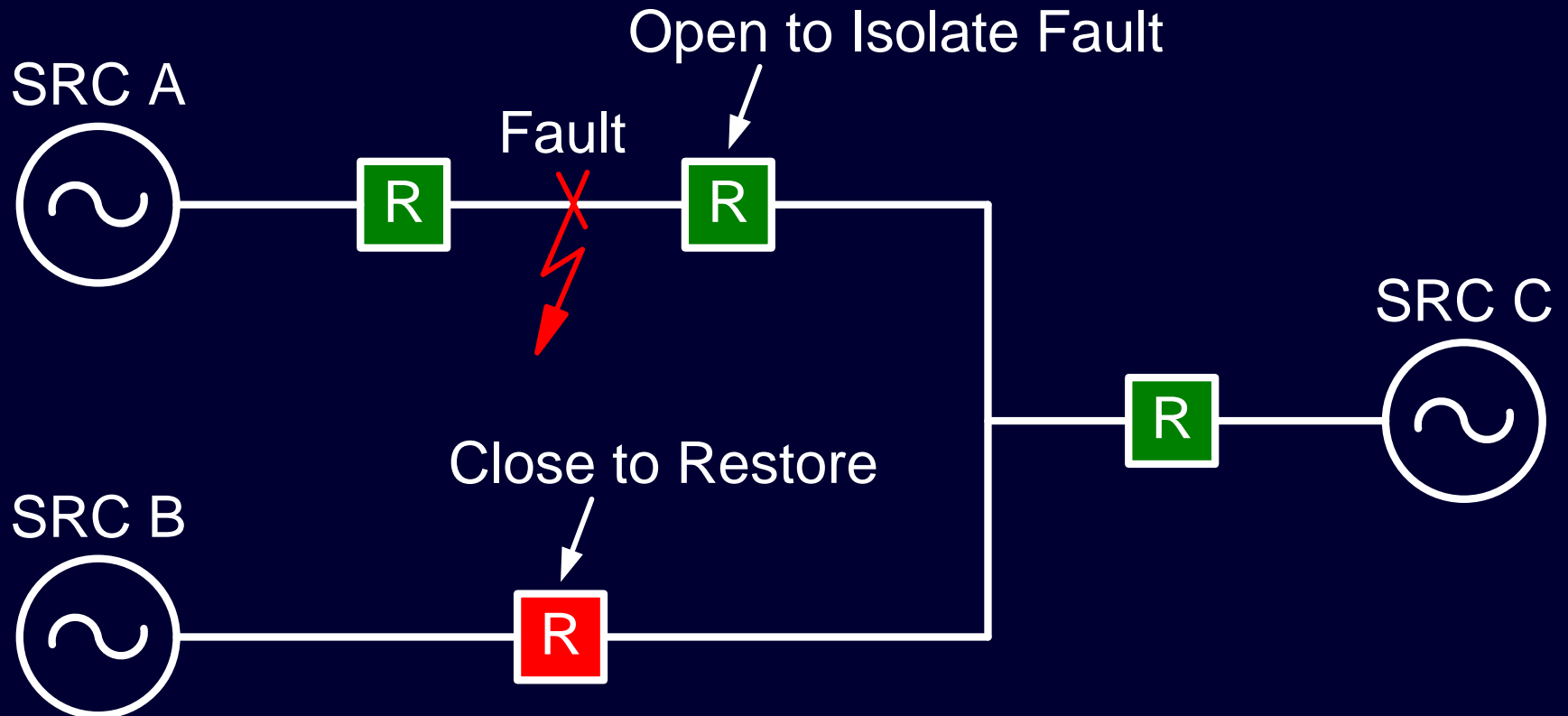
New Equipment, New Possibilities

FDIR



New Equipment, New Possibilities

FDIR

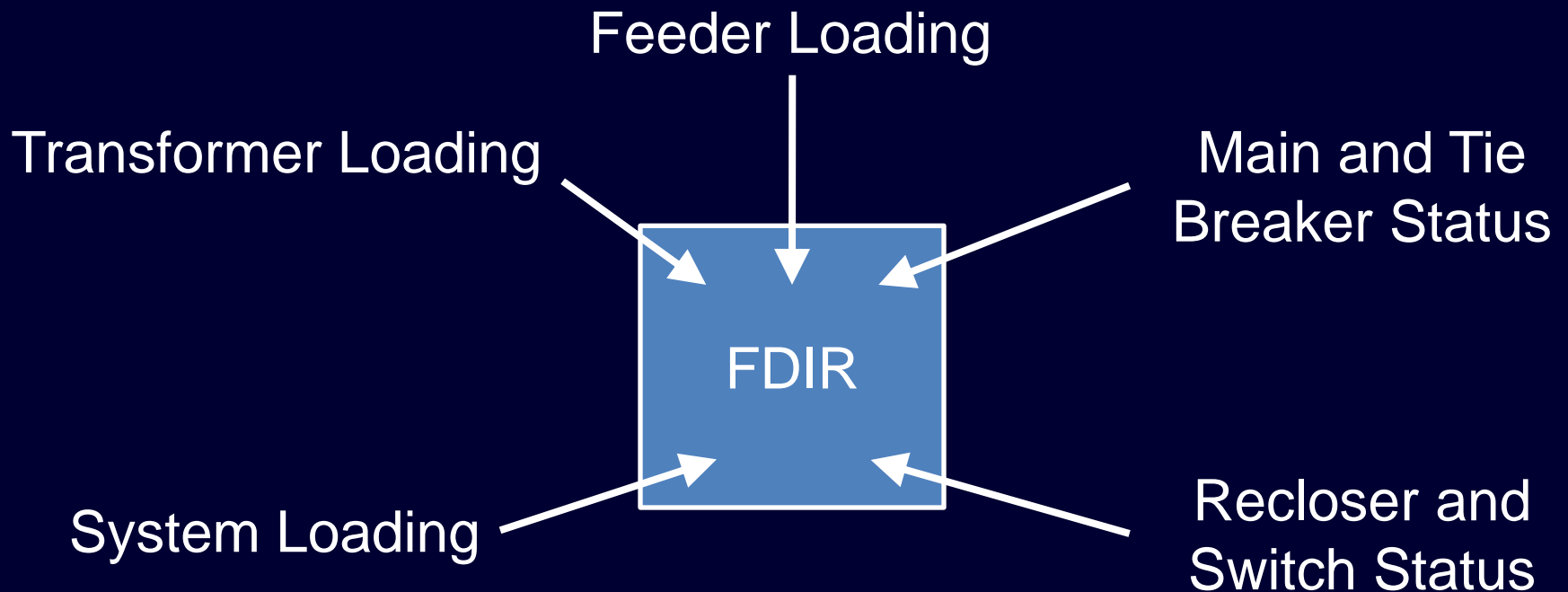


FDIR Design

Centralized System

Why?

System-wide data become actionable



Centralized FDIR Creates New Possibilities

- Integrated volt / VAR control
- Adaptable high-speed blocking scheme

Data Collected

Transformer Monitors

Current
Capacity

Temperature

Cooling
Status

Main and Bus-Tie Breakers

Current
Loading

Bus Voltage

Breaker
Status

Feeder Breakers and Reclosers

Currents

Voltages

Breaker Status

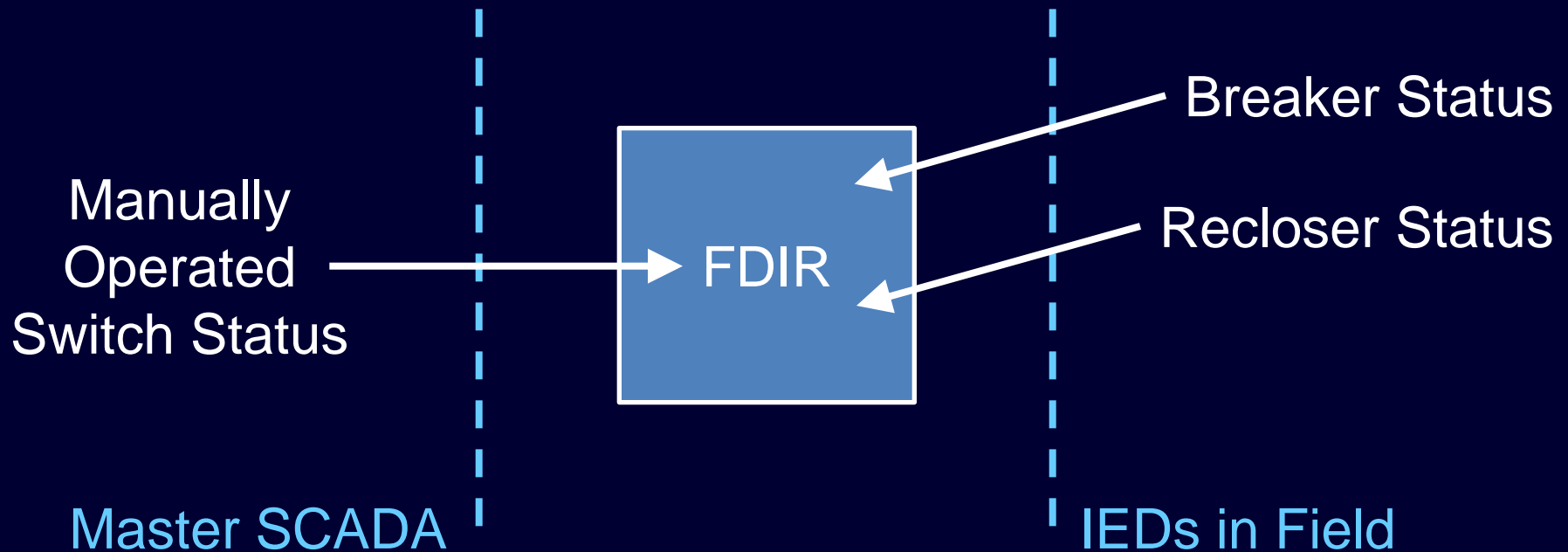
Recloser Status

Fault
Indications

Work Tags

FDIR Complication

Approximately 100 Manually
Operated Switches



Volt / VAR Control

Equipment Installed

- Transformers with load tap changers
- Voltage regulators
- Switched capacitor banks

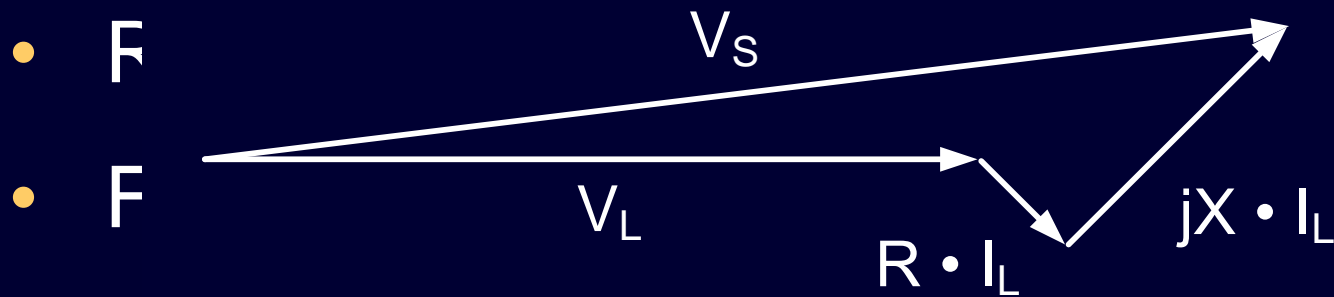
Volt / VAR Control

Most Often Implemented at Feeder Level

- Greater control sensitivity
- Unable to use for system-wide purposes
- Must be disabled when FDIR reconfigures system

Purpose of Volt / VAR Control

- Voltage profile optimization with CVR
- Power factor correction



- Changing system topology adaptation

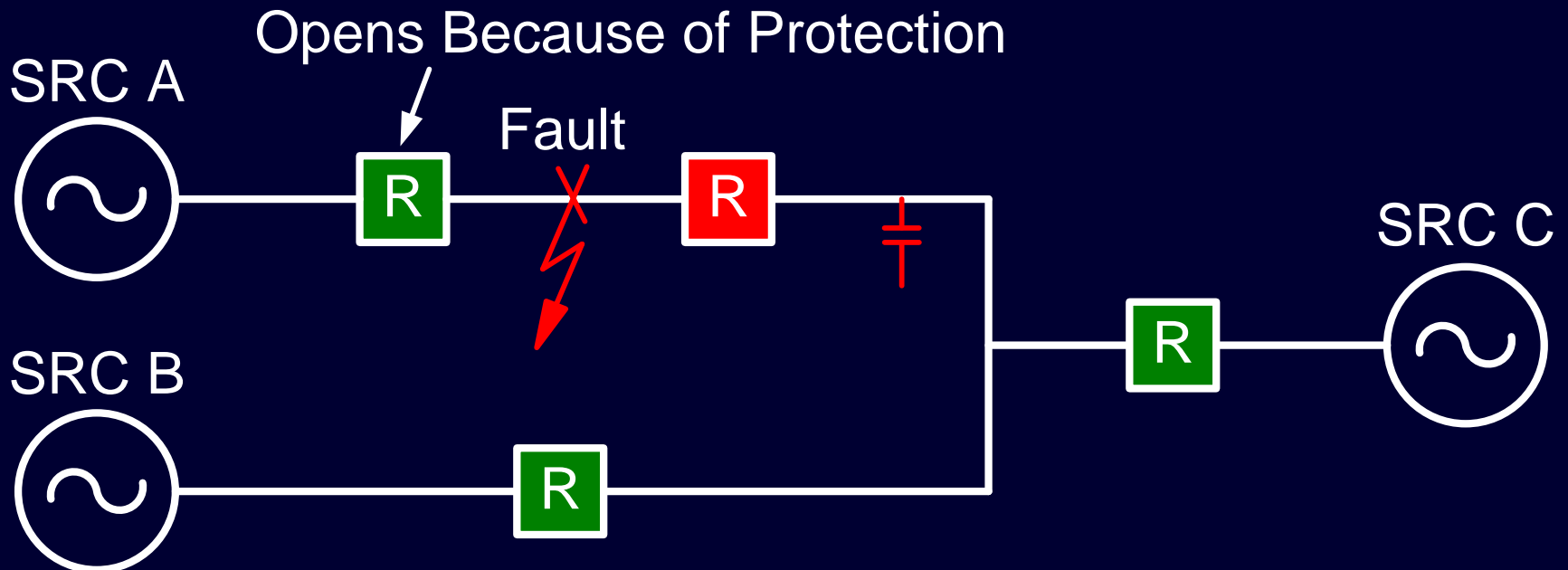
Volt / VAR Control Implementation

Equipment Used

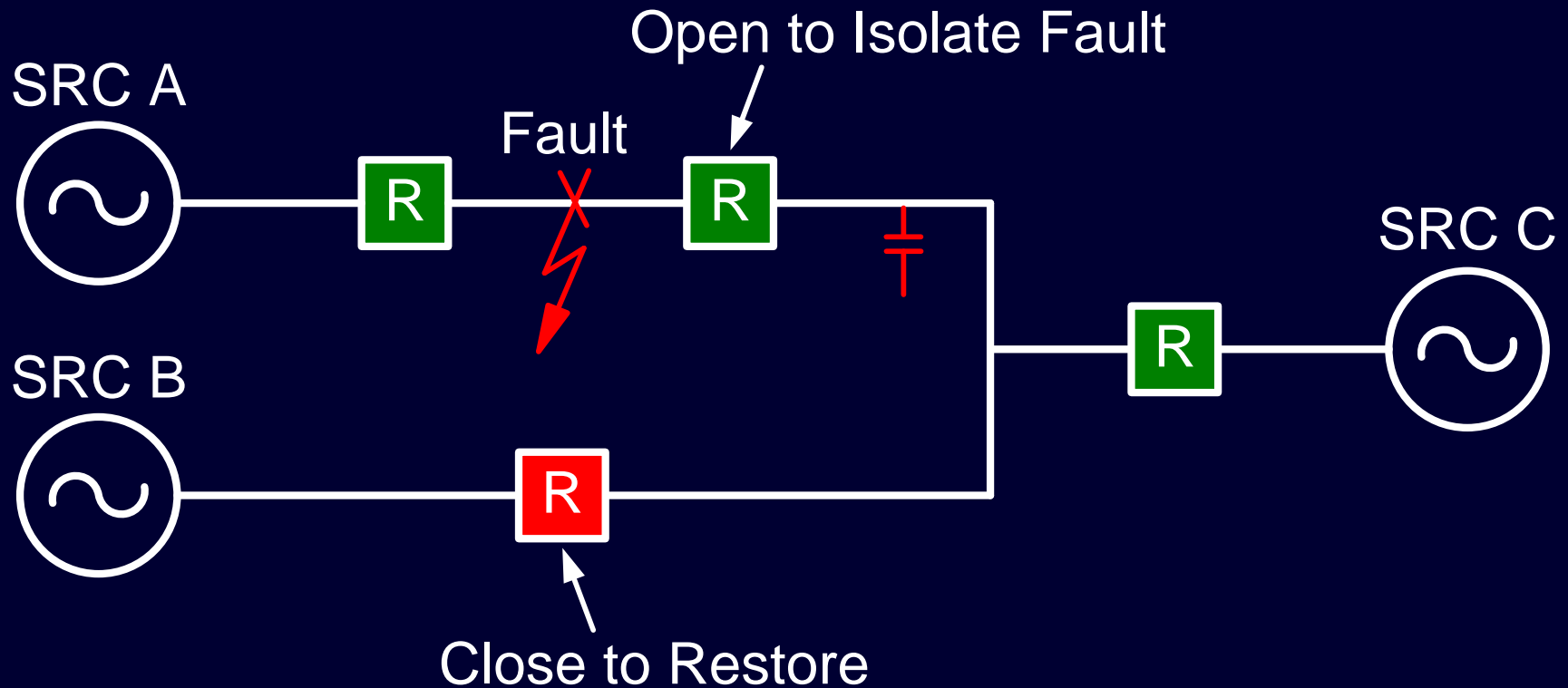
- Main breaker (P, Q, PF)
- Voltage regulators in substation yard (transformers do not have load tap changers)
- Switched capacitor banks outside substation fence
- Switched capacitor banks distributed

FDIR Complicates Volt / VAR Control

- Feeder length can change
- Volt / VAR devices can belong to more than one feeder



Volt / VAR Algorithms Integrated Into FDIR



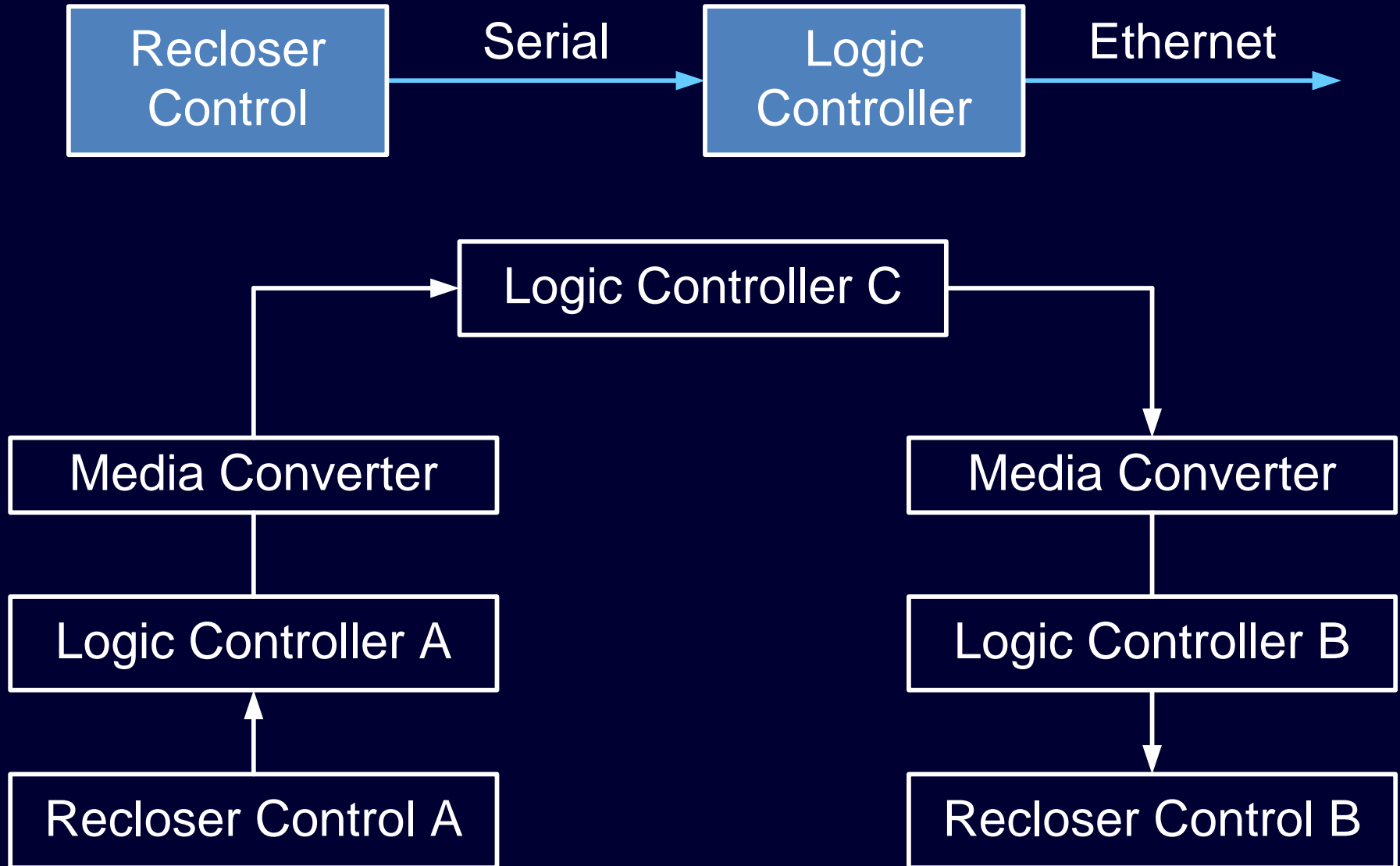
Volt / VAR Control Design Challenge

- Small municipal utility, no detailed system model
- Solution
 - ◆ Use observe-and-adapt control method to monitor changes in P and Q after control
 - ◆ Employ detailed substation transformer impedance models
 - ◆ Identify specific loads where possible

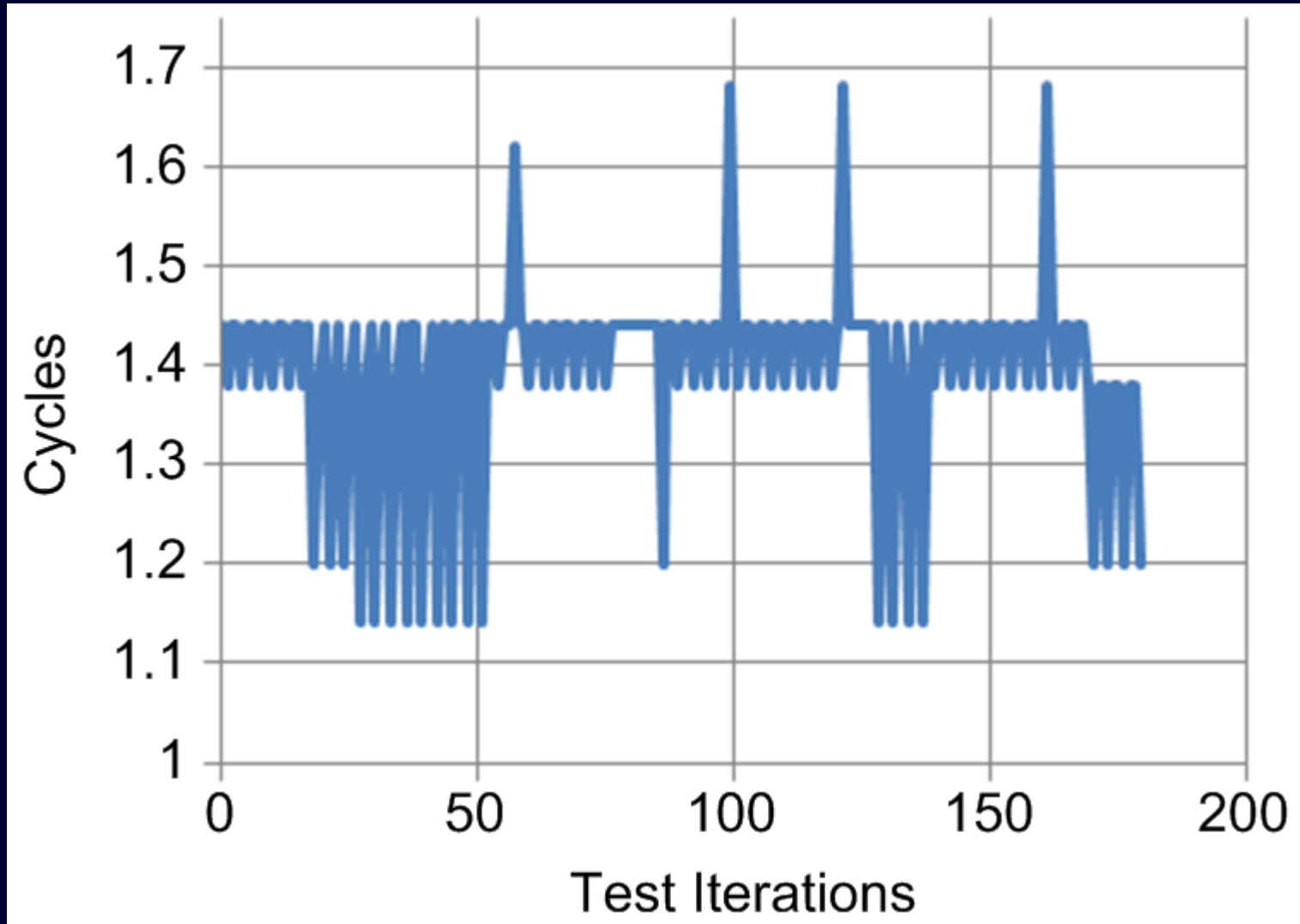
Dynamic Trip Blocking

- Why?
 - ◆ City uses very short maximum trip delay; timed coordination impossible
 - ◆ City fiber-optic network leveraged
- How?
 - ◆ IEC 61850 GOOSE
 - ◆ Logic processors

Trip Blocking Scheme Design

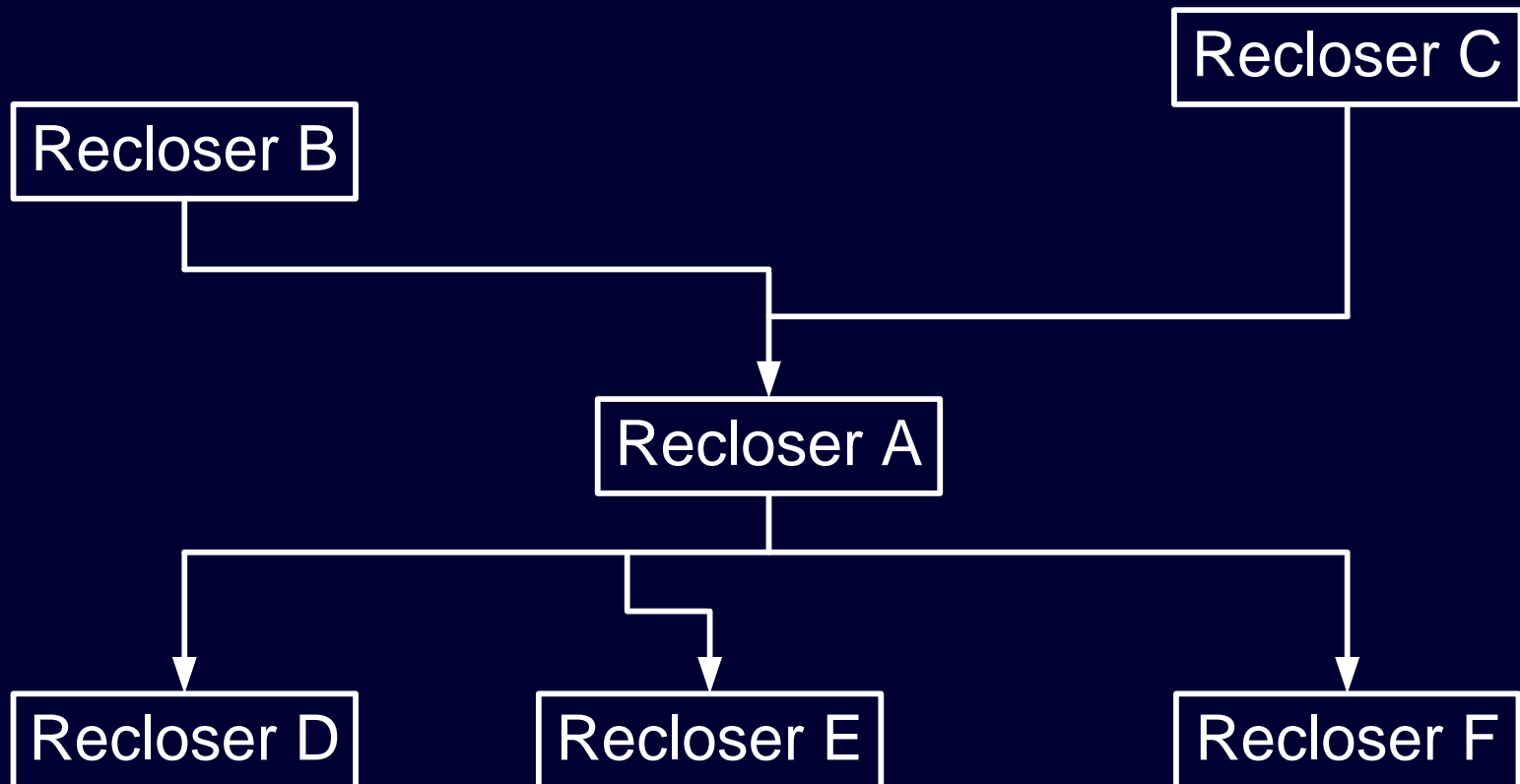


GOOSE Message Timing Results



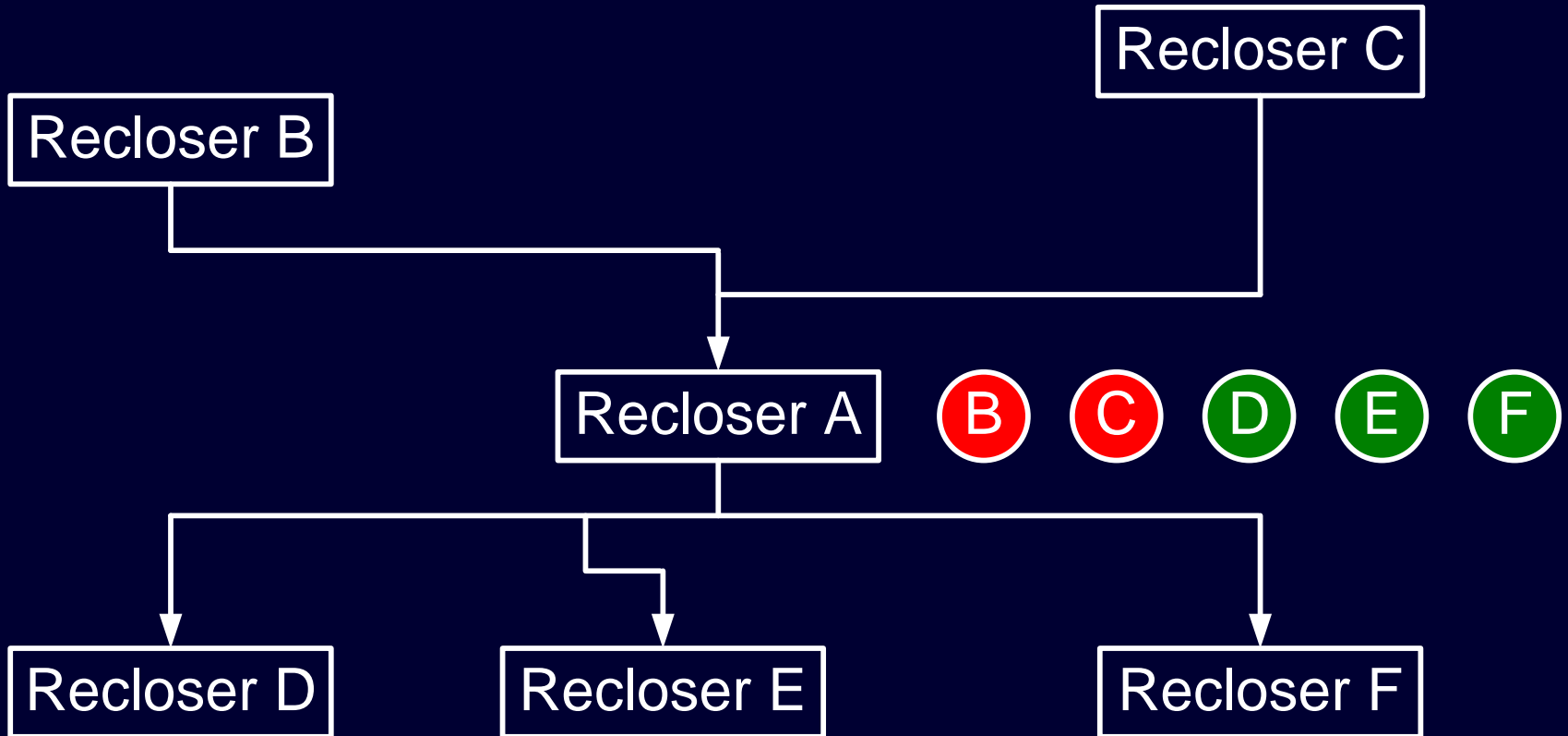
FDIR Complicates Blocking Scheme

Reclosers can belong to different feeders at different times

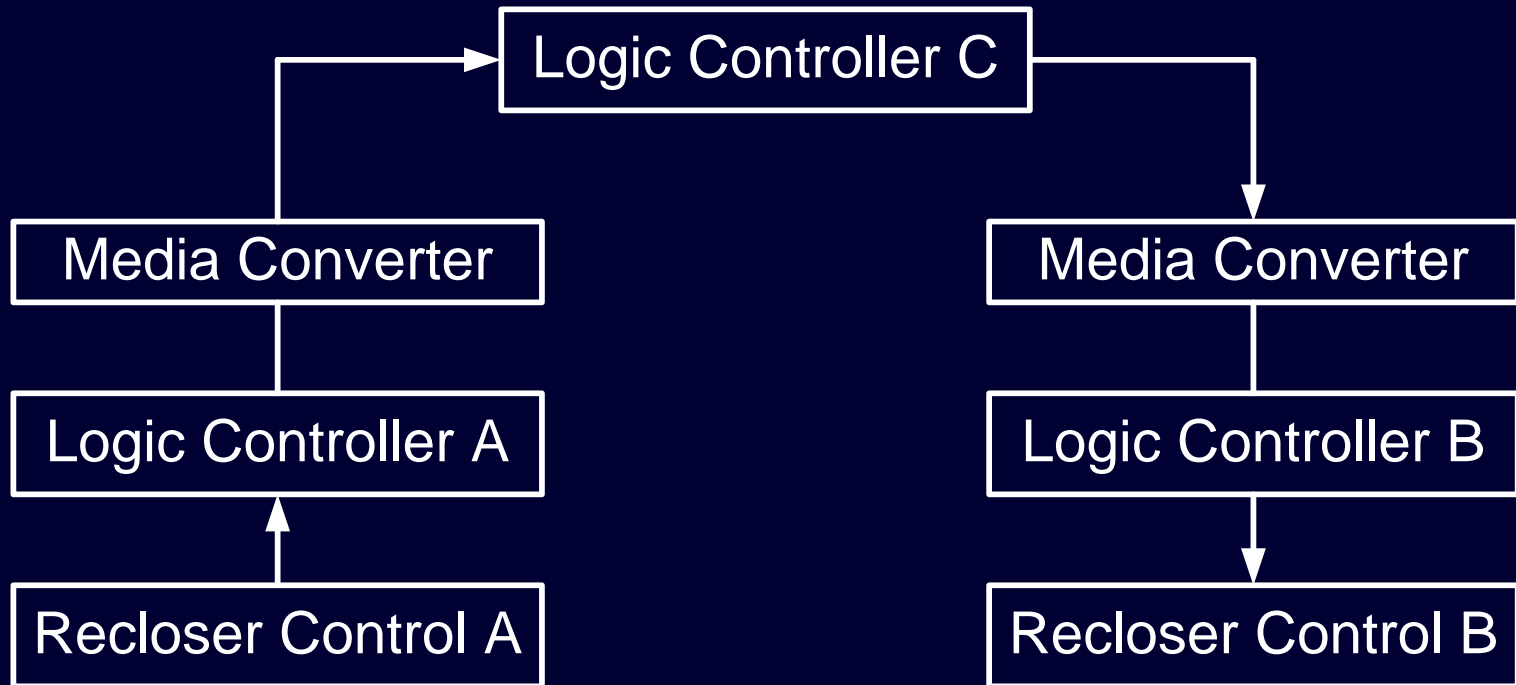


Solution

Filter Block Signals

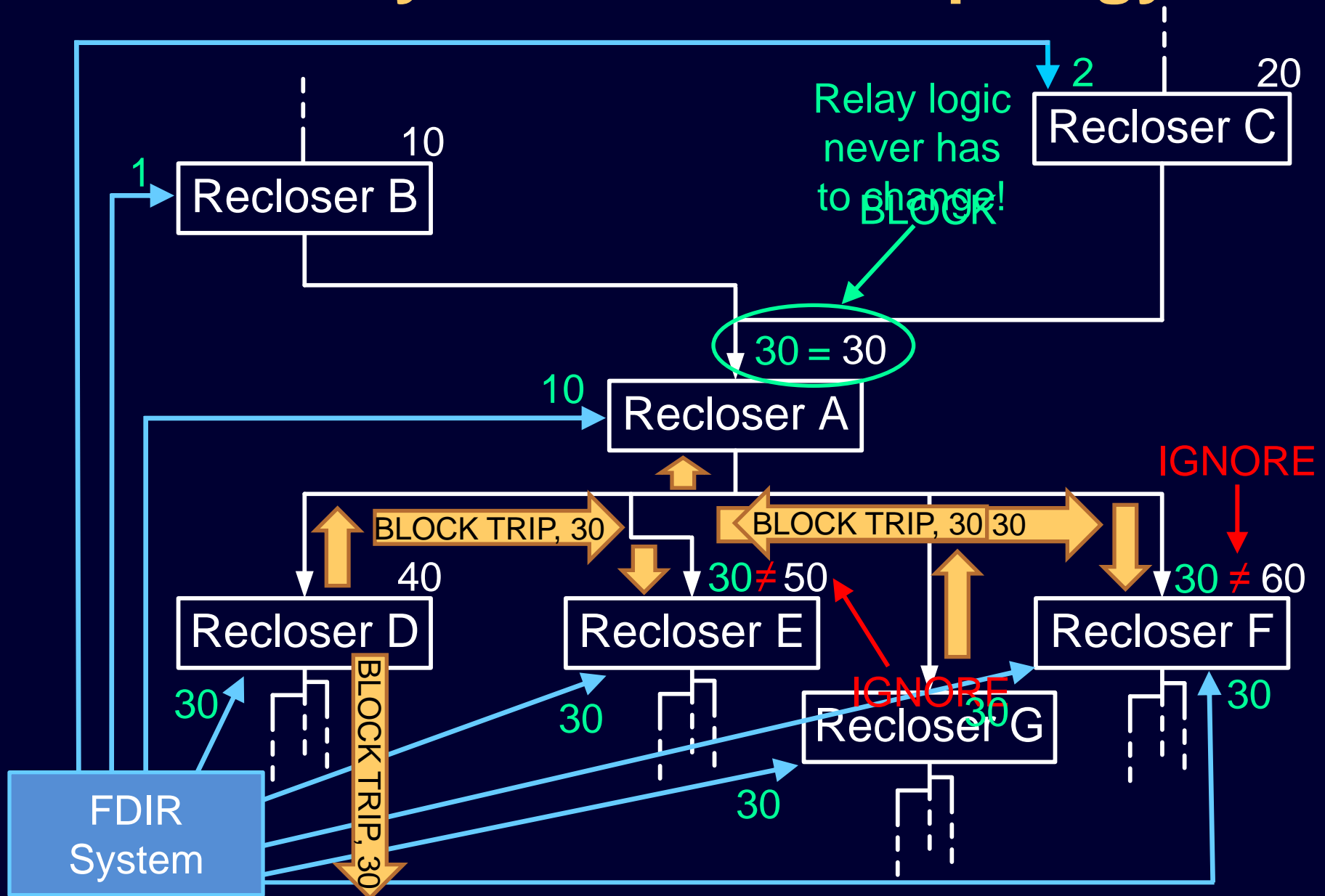


Filter Block Signals



- Each logic controller assigned unique ID
- Each GOOSE message has upstream ID analog

FDIR System Shares Topology



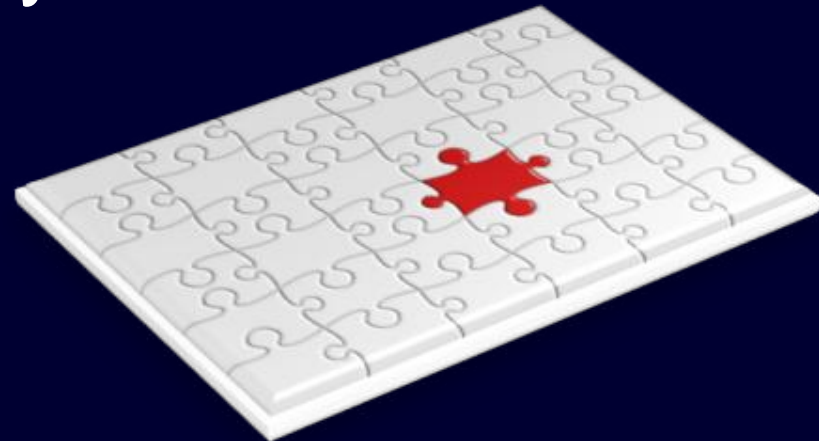
Using FDIR to Filter Block Signals

Advantages

- Uses logic already tracking system topology
- Allows high-speed blocking to exist on changing system
- Properly accounts for both automatic and manual switching with periodic evaluation design

Summary

- City of Wadsworth project has provided opportunity to implement new DA solutions
- FDIR system is both problem and solution for high-speed trip blocking scheme coordination
- Volt / VAR control and system-wide high-speed blocking schemes can coexist with FDIR



Questions?



Thank You!

