

# **ELECTRIC UTILITY SYSTEMS 101 & SMART GRID**

**The road between here and there**

**SCIENCE, TECHNOLOGY AND  
TELECOMMUNICATIONS COMMITTEE**

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Room 307, State Capitol

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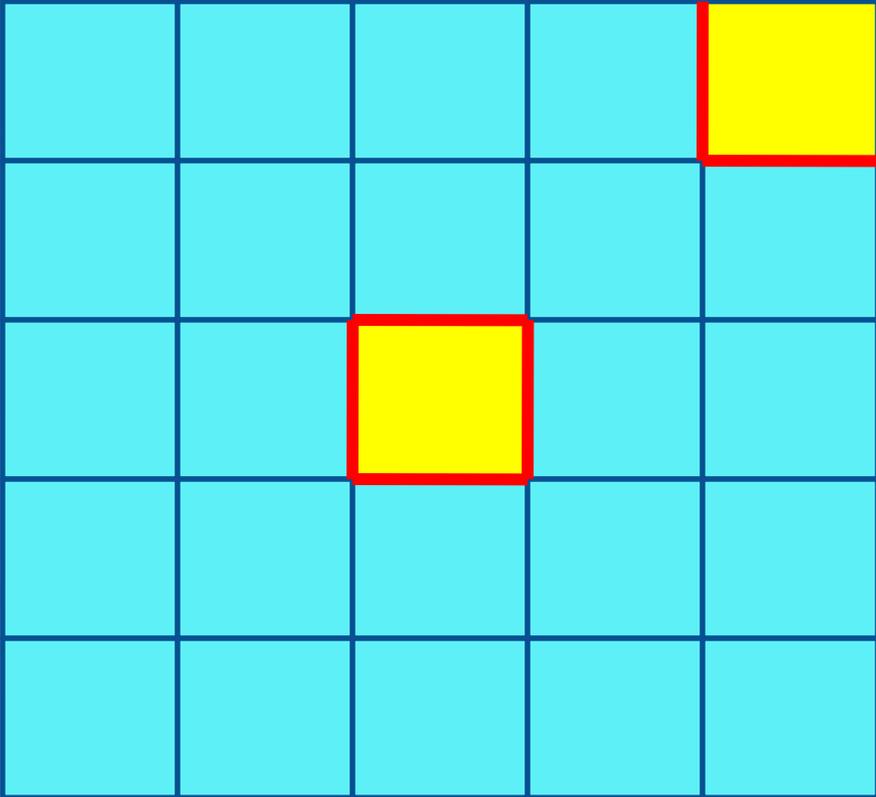


The DOE has identified the following properties for the 21<sup>st</sup> Century “Modern” or “Smart” Grid.

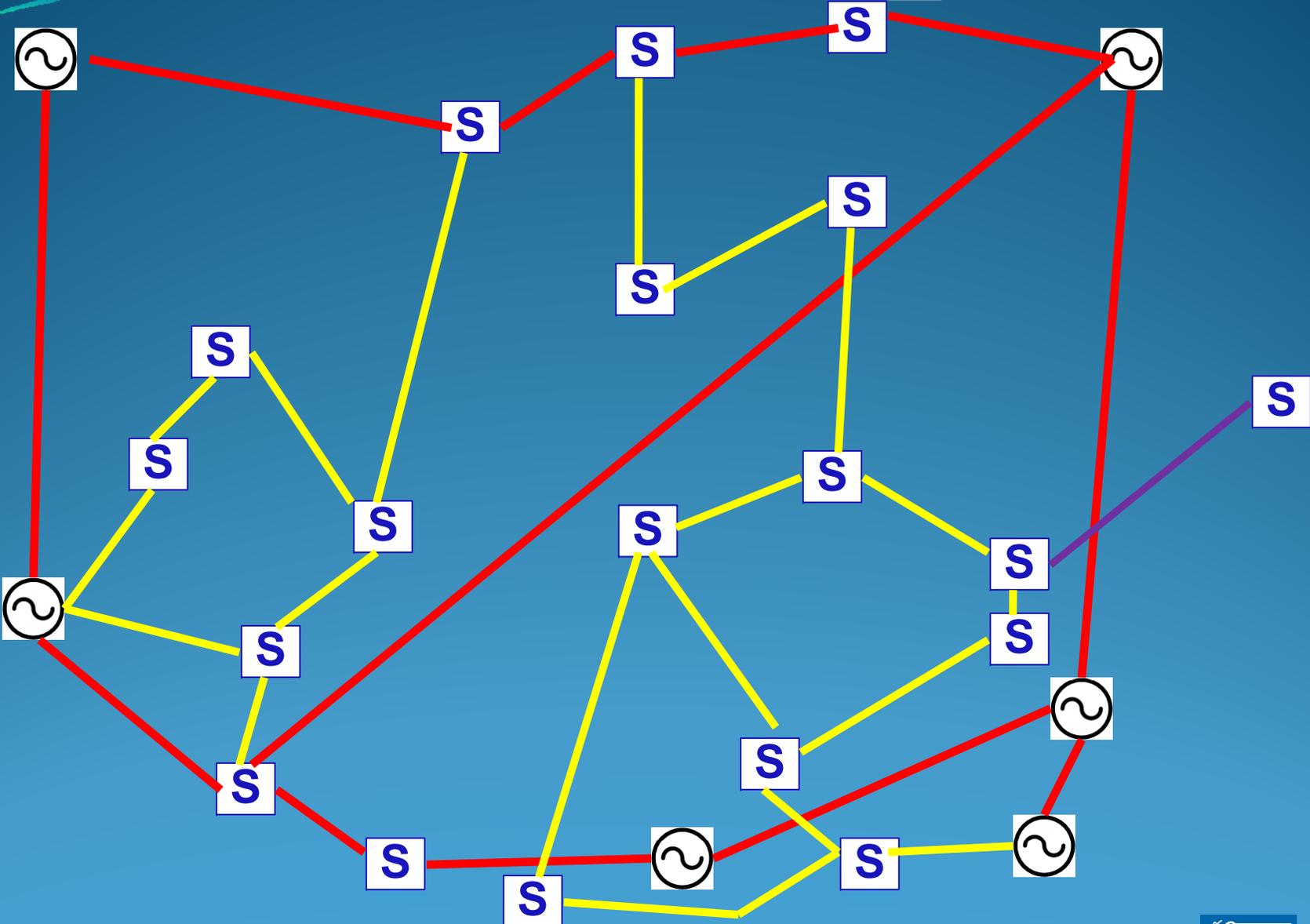
## The Smart Grid will:

- be self healing
- resist attacks (cyber & real)
- deliver power quality desired by 21<sup>st</sup> century users
- accommodate all generation and storage options
- enable markets to flourish
- optimize its assets and operate more efficiently

# Electric Utility Systems 101



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## The Generation/Transmission “Grid”

- Highly Trained & Skilled System Controllers
- State & schedule of all generation
- Generation reserve capacity
- State of every transmission line
- Supervisory control of switches
- Schedule of all purchases and or sales
- Fault, frequency, thermal, load alarms
- Crew schedules & availability
- Load, capacity, & state of every substation

## The Generation/ Transmission Grid:

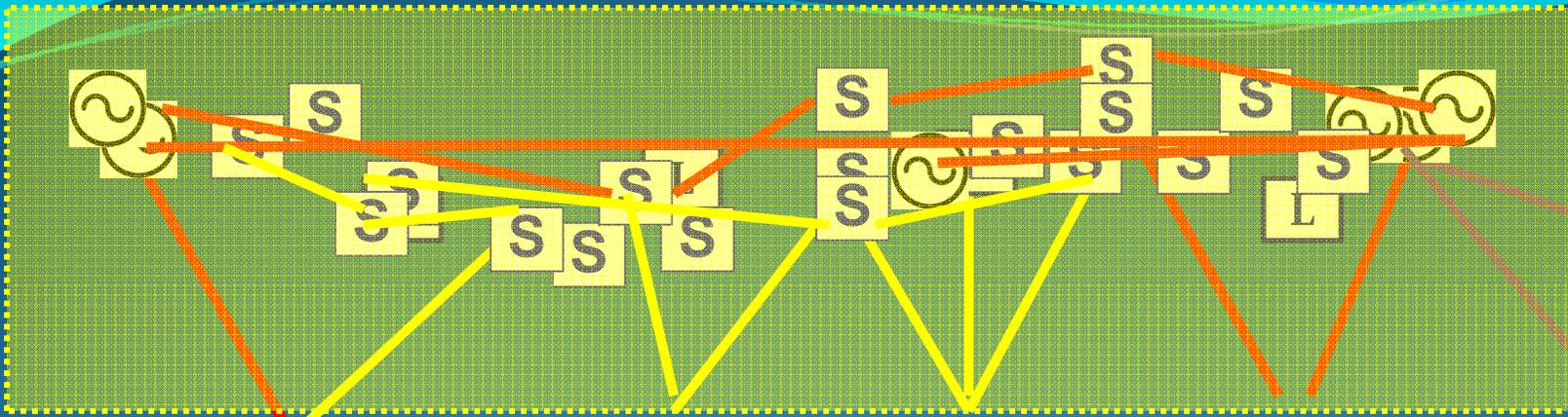
- ✓ Self healing
- ✓ Resist attacks (cyber & real)
- ✓ Deliver power quality desired by 21<sup>st</sup> century users
- ✓ Accommodate all generation and storage options
- ✓ Enable markets to flourish
- ✓ Optimize its assets and operate more efficiently

# Quick Overview & Review

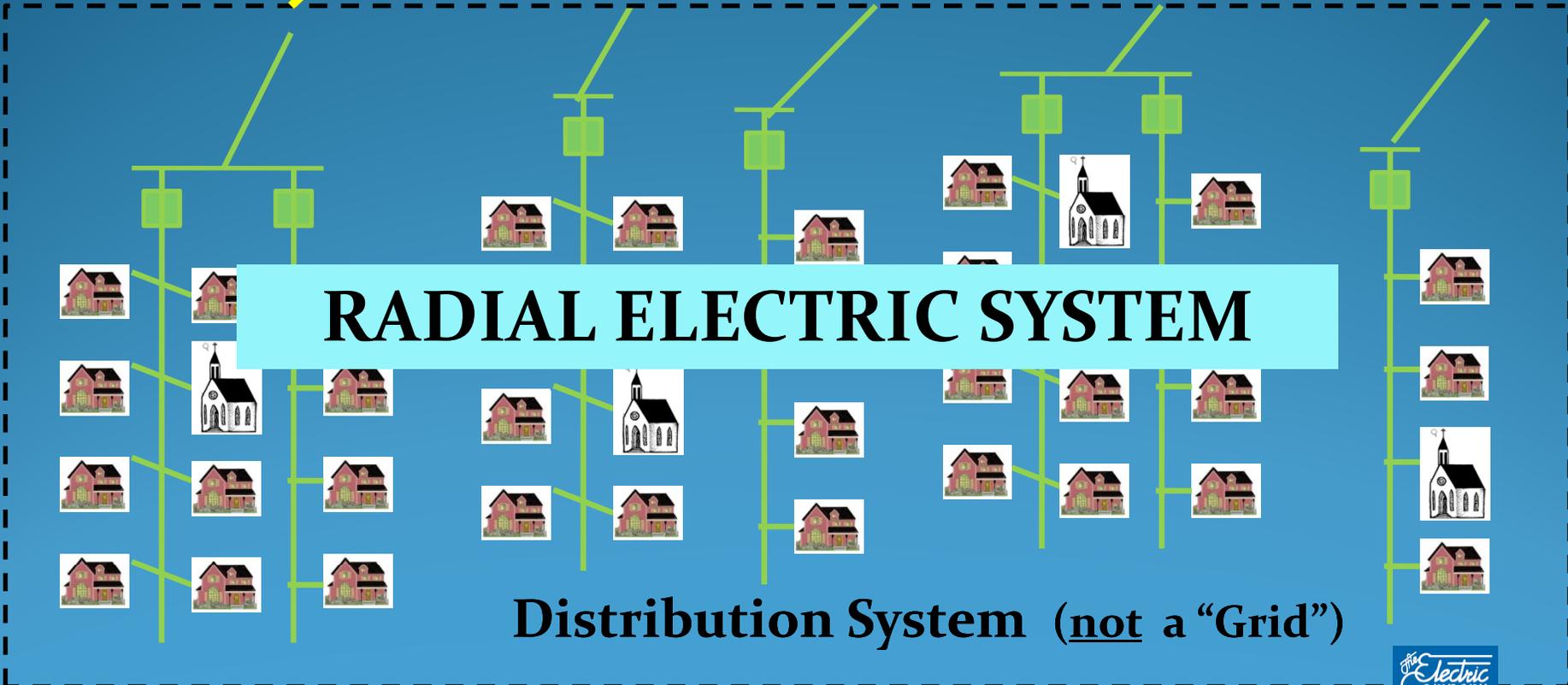
## Generation/Transmission Systems

- Most Generation is connected at the Transmission Level
- Transmission lines are high voltage (38 kV to 500 kV)
- Generation/Transmission System is “Networked” (a “Grid”)
- System Controllers are highly trained in Grid operation
- Operation of Gen/Tran “Grid” regulated by FERC & Others
- Gen/Tran “Grid” highly evolved control and monitoring cap.
- Gen/Tran “Grid” meets all DOE “Smart” Grid requirements
- Customers are not connected to the Gen/Tran “Grid”

# Generation/Transmission "Grid"



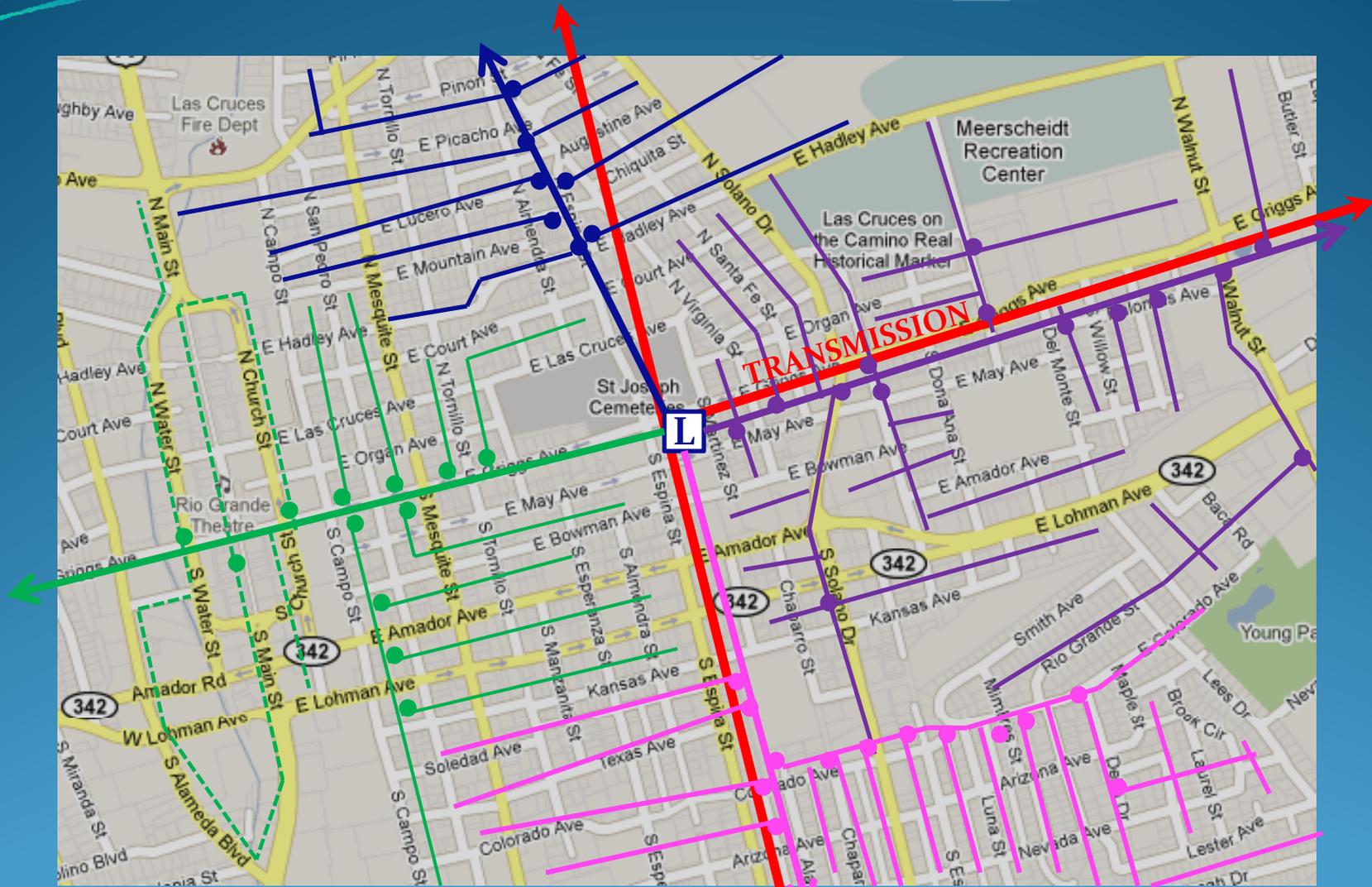
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## RADIAL ELECTRIC SYSTEM

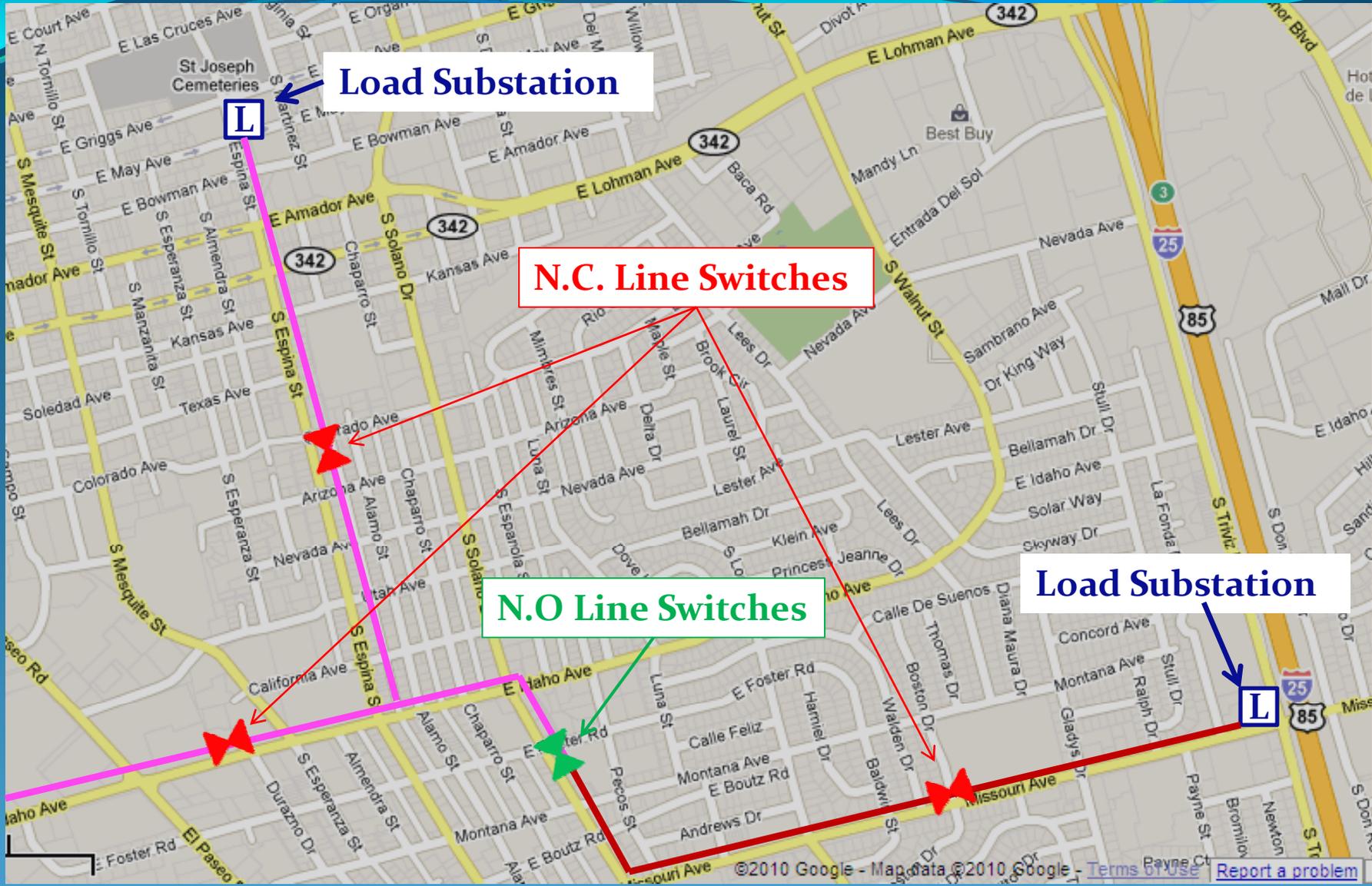
Distribution System (not a "Grid")

# Electric Utility Systems 101



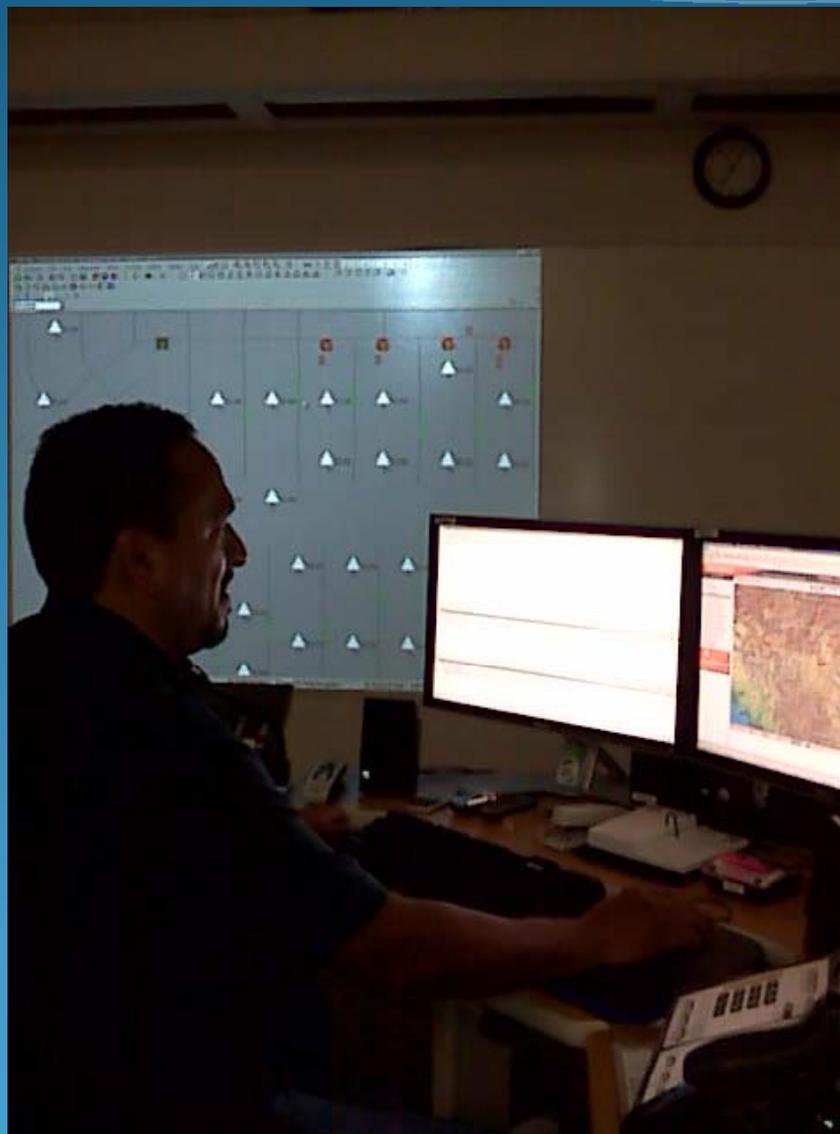
**Distribution System (not a "Grid")**

# Electric Utility Systems 101

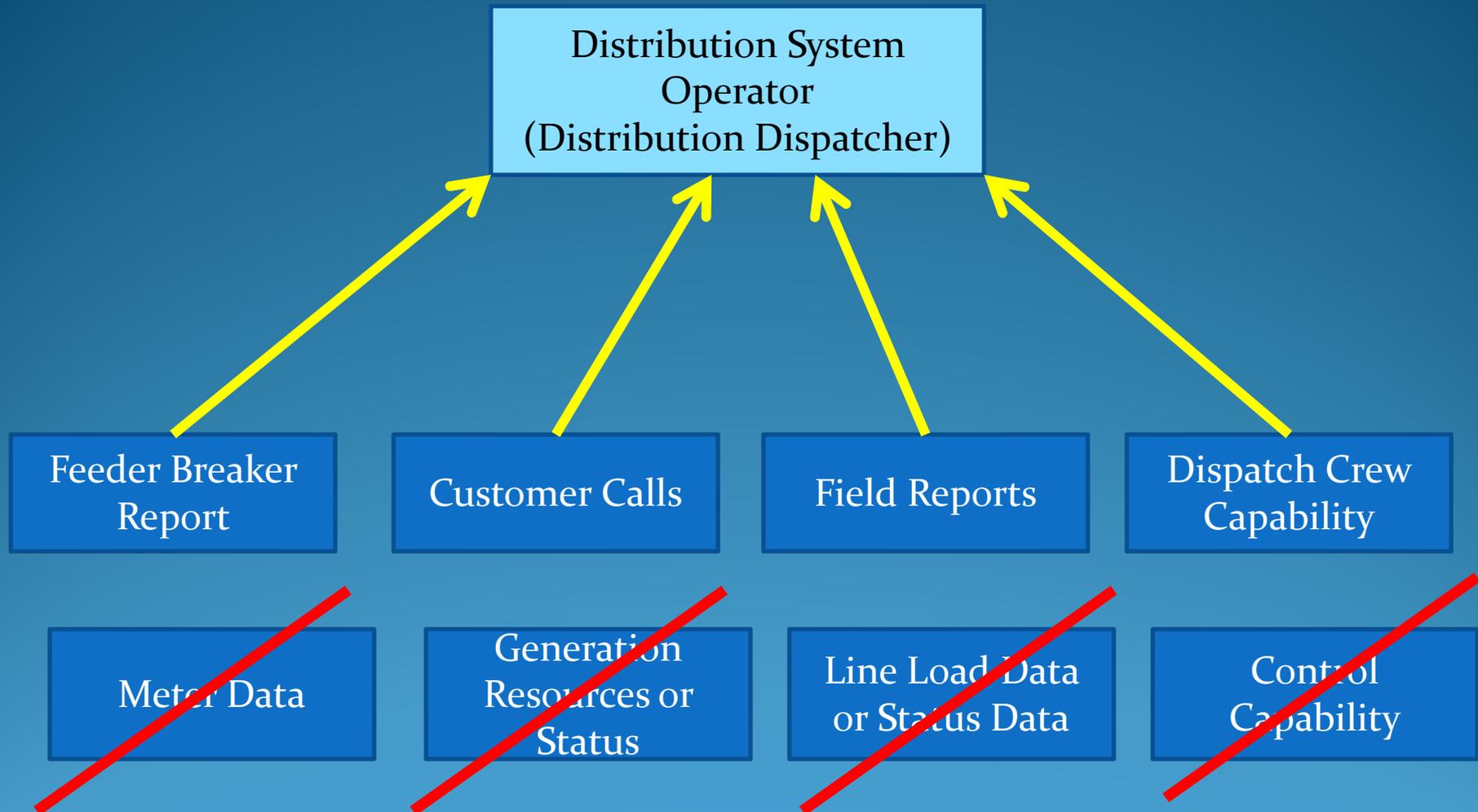


**Distribution System (not a “Grid”)**

## Electric Utility Systems 101



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# Quick Overview & Review Distribution Systems

- Nearly all customers are connected at the Distribution level
- Distribution System is RADIAL System (not a network or grid)
  - Generally, only 1 path of service to your home or business
- Most Distribution System have limited remote control capability
- Distribution System Controllers are mostly Outage Mgrs.
- Outage management: Identify, Isolate, repair
- Do not have DOE “Smart” Grid requirements
- Gen/Tran “Grid” highly evolved control and monitoring cap.

# The “Smart” Grid

Part 1 – Smart or Advanced Metering

Part 2 – System Control & Monitoring

Part 3 – Distributed Generation

Part 4 – The Challenges

The DOE has identified the following properties for the 21<sup>st</sup> Century “Modern” or “Smart” Grid.

### **The Smart Grid will:**

- **be self healing**
- **resist attacks (cyber & real)**
- **deliver power quality desired by 21<sup>st</sup> century users**
- **accommodate all generation and storage options**
- **enable markets to flourish**
- **optimize its assets and operate more efficiently**

## Part 1 - Smart or Advanced Metering

### Texas PUC Requirements

- Automated or remote meter reading
- Two way communication
- Remote disconnect and reconnect capability
- Time stamped and portable meter data capability
- Provide real-time customer access to meter data
- Price signaling capability
- 15 minute interval recording capability
- On board meter data storage
- Open standards for future compatibility
- Load side communication capability

## Part 1 - Smart or Advanced Metering

### Immediate Benefits:

- Better outage management
- Less field crew time for disconnects /reconnects
- Theft & meter tampering reduction
- Better load modeling

### Future Benefits:

- Potential beyond the meter load control
- Real time data & pricing
- Better resource allocation
- More robust rate options

# Part 1 - Smart or Advanced Metering

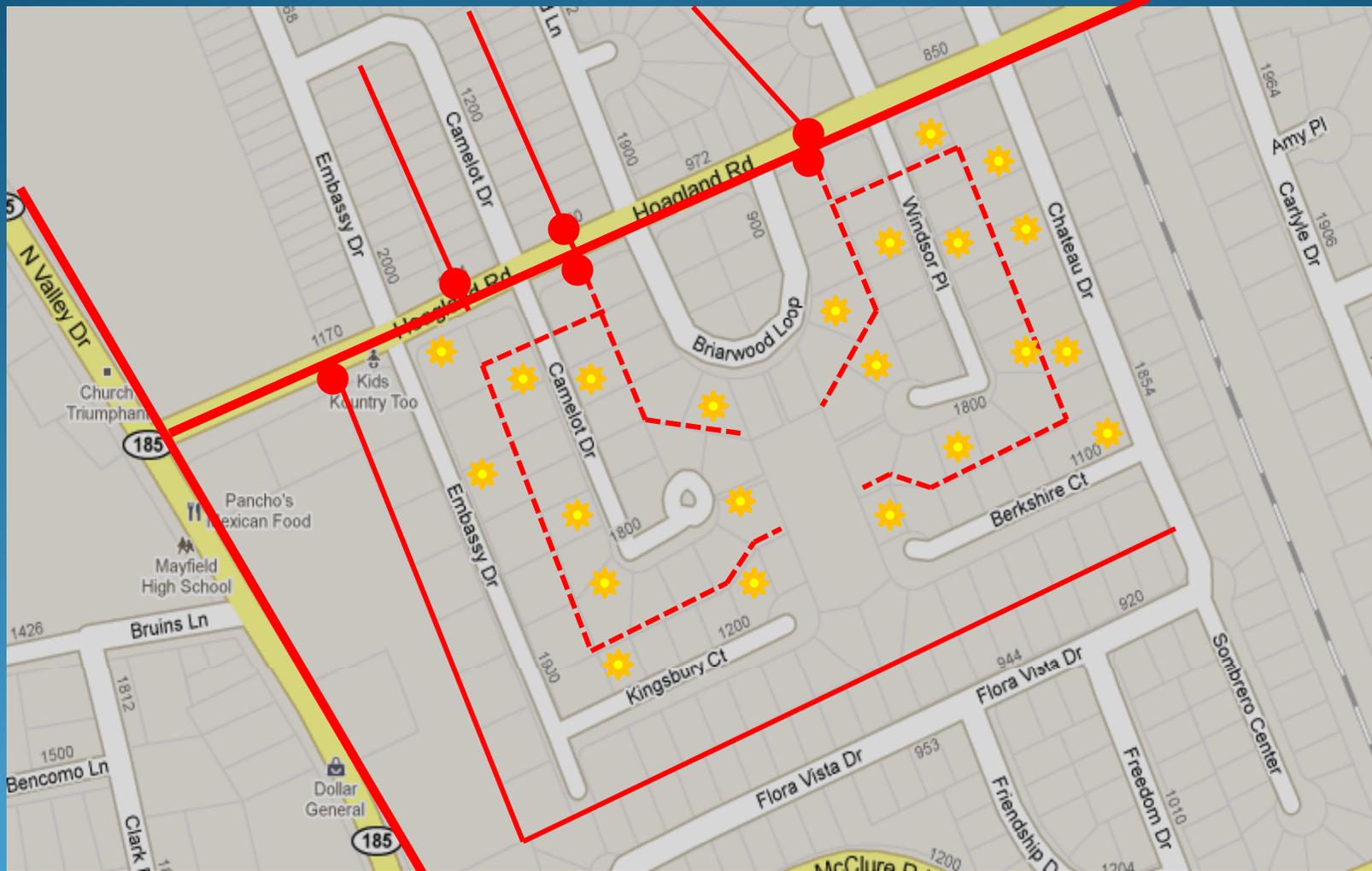
## Hurdles

- Data, data, and more data
- Implementation Cost (\$150 - \$400 per meter)

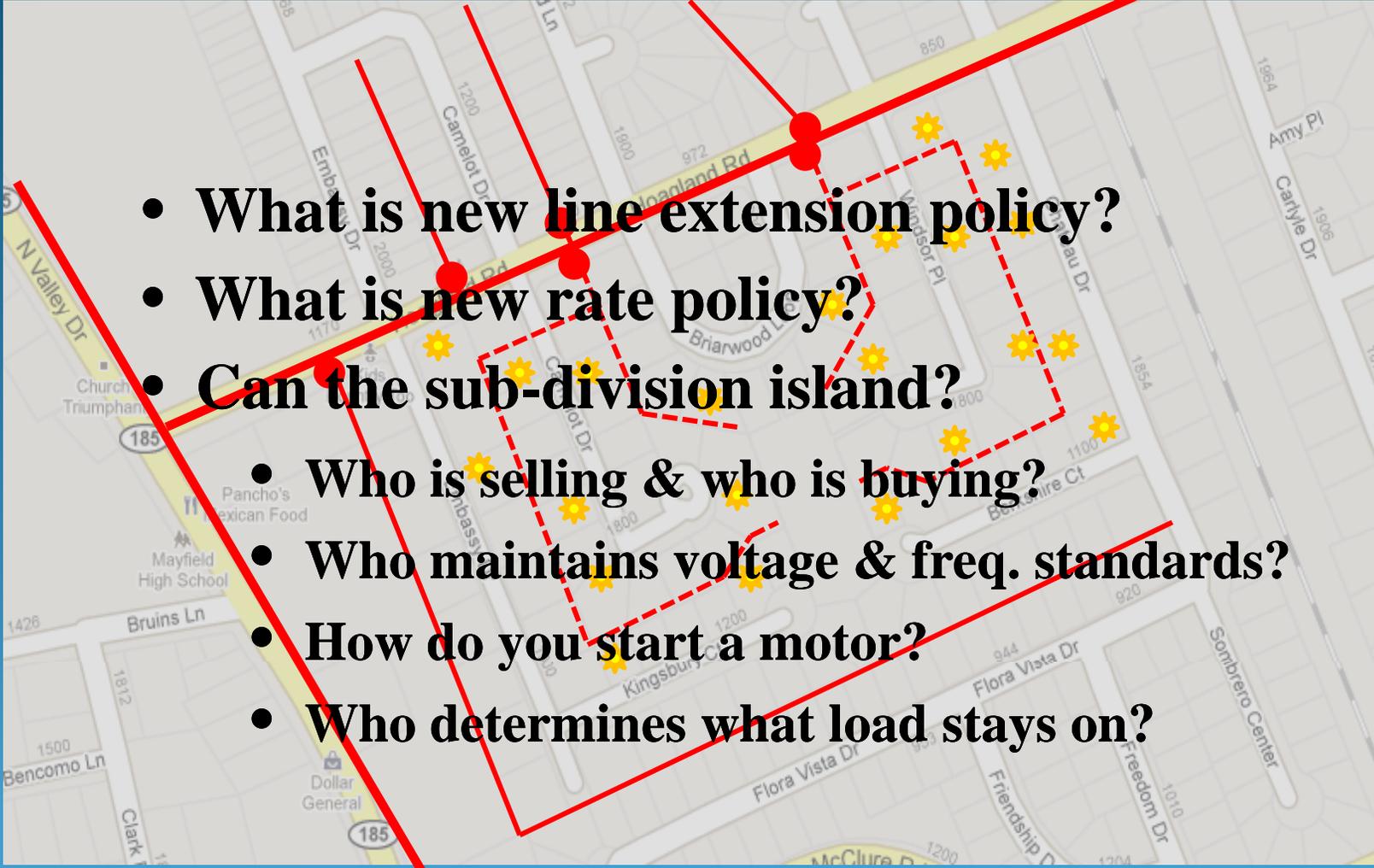
System Control & Monitoring



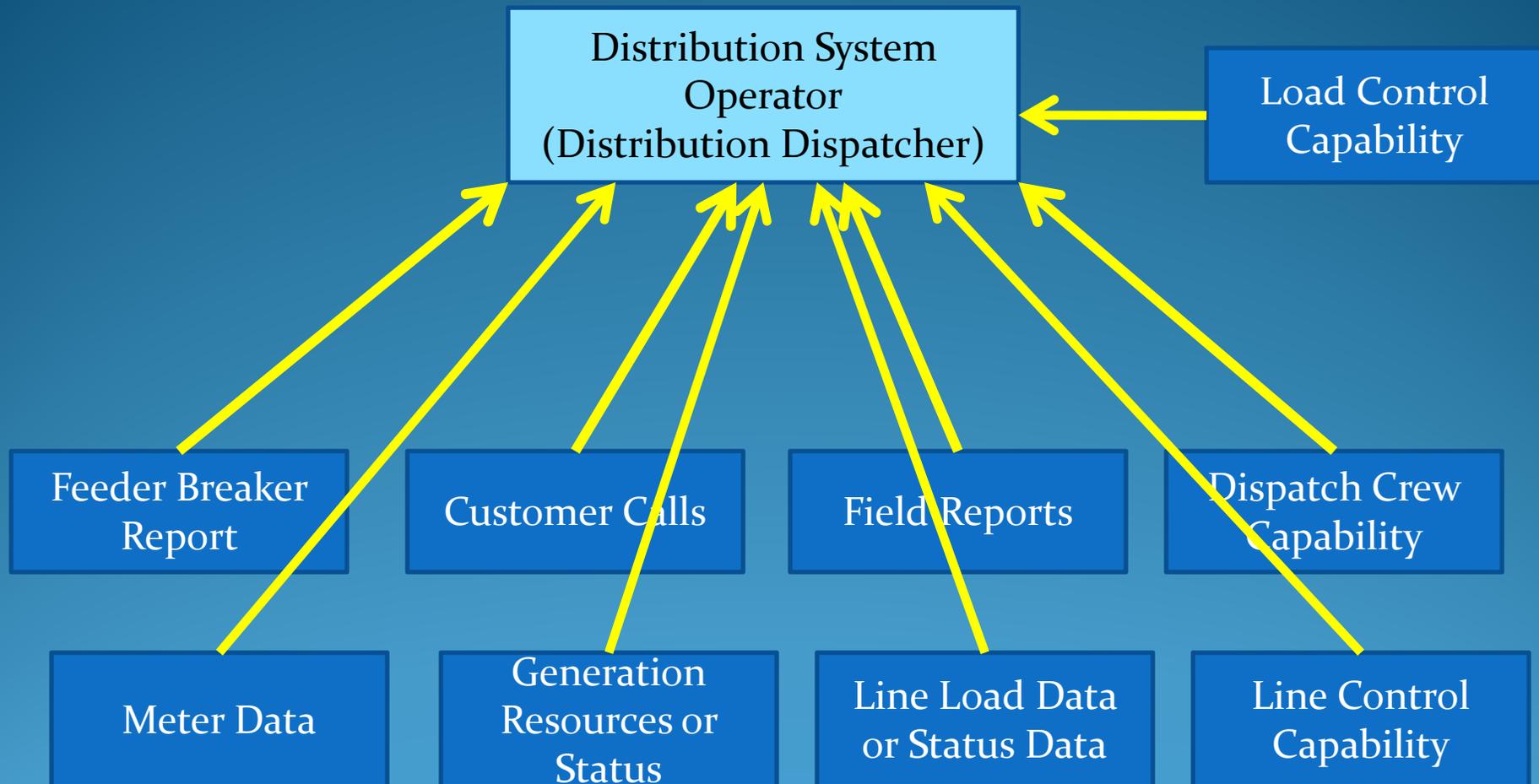
# Part 3 - Distributed Generation



## Part 3 - Distributed Generation

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- **What is new line extension policy?**
  - **What is new rate policy?**
  - **Can the sub-division island?**
    - **Who is selling & who is buying?**
    - **Who maintains voltage & freq. standards?**
    - **How do you start a motor?**
    - **Who determines what load stays on?**

# Part 4 - The Challenges



# Summary

- Utility is responsible for standards (reliability, voltage, etc.)
- Gen/Tran System is a “Grid” arguably a “Smart” Grid
- Distribution System is Not a “Grid” it is a Radial system
- Almost all customers connected to Distribution system
- Smart Meters & Dist. Generation don’t make Smart Grid
- Smart Meters & Distribution System control expensive
- Dist. Generation not presently capable of islanding
- Will require new regulatory models (policy & rates)
- **No trained personnel or system on which to train**
- Will require much research, modeling, experience