SCADA Master Plan Project Update

Chad Beck – Operations Superintendent

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Agenda

- SCADA System Background
- 15-year Vision
- Gap Analysis
- Future System Design
- Implementation Roadmap

What is SCADA?

Supervisory **C**ontrol **a**nd **D**ata **A**cquisition

- Remotely operate geographically dispersed equipment
  - 31 Water sites
  - 48 Wastewater sites
  - 11 Storm/Surface Water sites
- Gather and store data for system feedback and analysis

Aging Communications Network

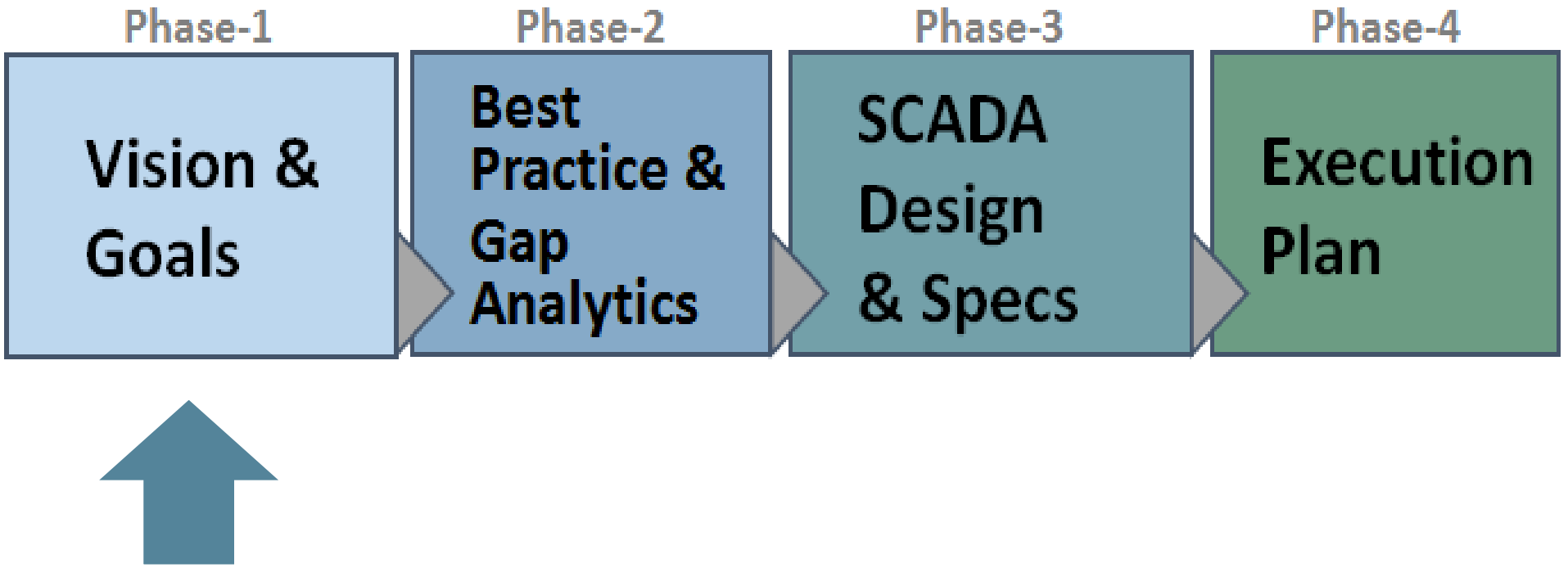
- Connected via copper telephone lines
- Increasing frequency of failures
  - 559 outages in 2018-2019
  - Avg duration: 6.4 hours
  - Total: **150 Days!**
- Decreasing Telecom Support
  - Dying business model for Frontier & Century Link
  - Only 2 vendor technicians
  - Likely in the last decade of support

SCADA Master Plan

- Goals:
  1. Identify and prioritize required infrastructure hardware & software upgrades
  2. Leverage emerging technology to improve system performance
  3. Ensure compliance with industry best practices

SCADA Master Plan

Phase 1: Visioning & Goals



Phase 1: Visioning & Goals

Four major themes emerged from cross-departmental visioning workshops:

1. Increase critical infrastructure resiliency & redundancy
2. Ensure critical infrastructure cybersecurity
3. Improve quality of Utility services
4. Advance Bellevue's 'Smart City' vision within the Utilities Department

1. Infrastructure Resiliency & Redundancy

- Data transmission is reliable, secure and affordable
- Data storage is redundant, actionable and available to those with appropriate access
- Servers and processing equipment are virtually, physically and geographically redundant
- Network architecture ensures critical infrastructure continues to operate without human intervention

2. Infrastructure Security

Security compliance with

- **Dept of Homeland Security requirements**
- **Industry Best Practices**

Role-based access & user rights

- **System control permissions**
- **Tailored data availability**
  - **Operators**
  - **Engineers**
  - **Analysts**
  - **Customers**
  - **Regional Partners**

3. Improve Quality of Services

Dramatically increase field sensors that monitor system performance

Leverage data analytics to provide insight & enhance decision making

- **System Operation**
- **Emergency Response**
- **Engineering Planning**
- **Financial Planning**
- **Asset Management**
- **Strategic Policy**

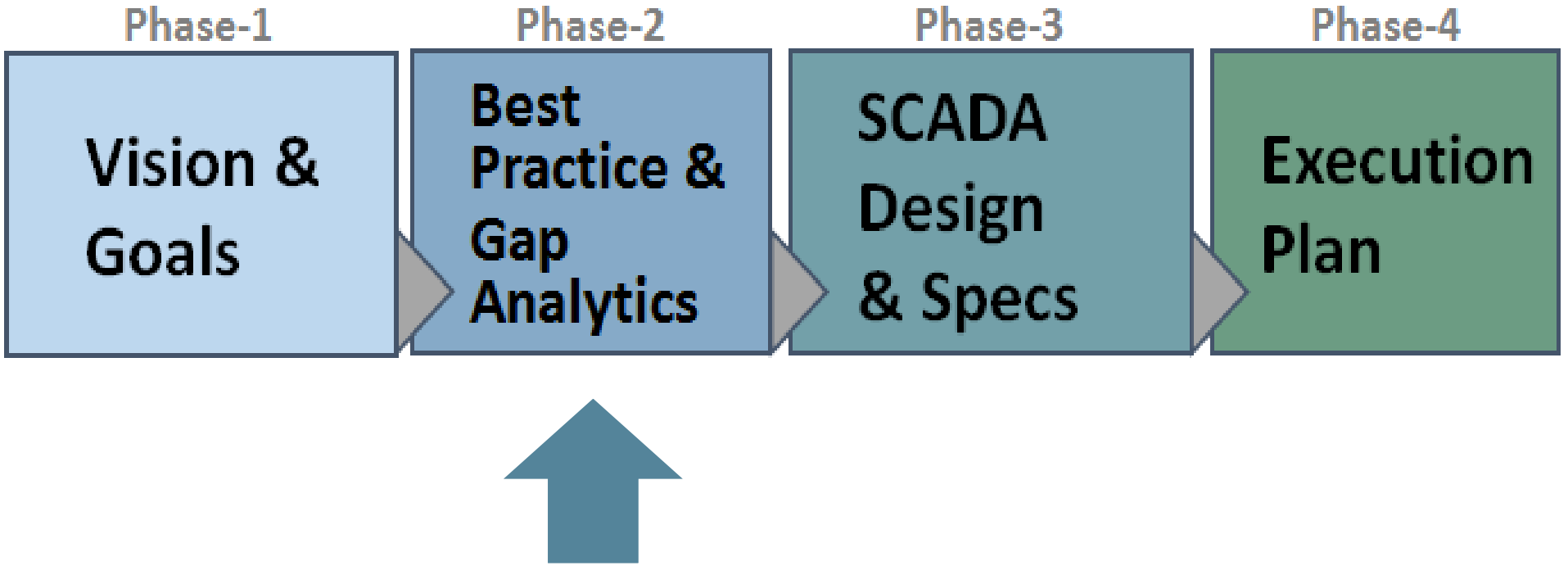
4. Advance ‘Smart City’ Vision

Posture the SCADA system for future integration of advanced technology

- **Machine Learning & Artificial Intelligence**
- **Predictive Simulation**
- **Self-healing Systems**
- **Just-in-Time Asset Replacement**

SCADA Master Plan

Phase 2: Gap Analysis



Phase 2: Gap Analysis

Communication Network

Analog Communications

- Aging Infrastructure
- Declining vendor support
- Limited agility
- Restricted use w/ new technology

Digital Communications

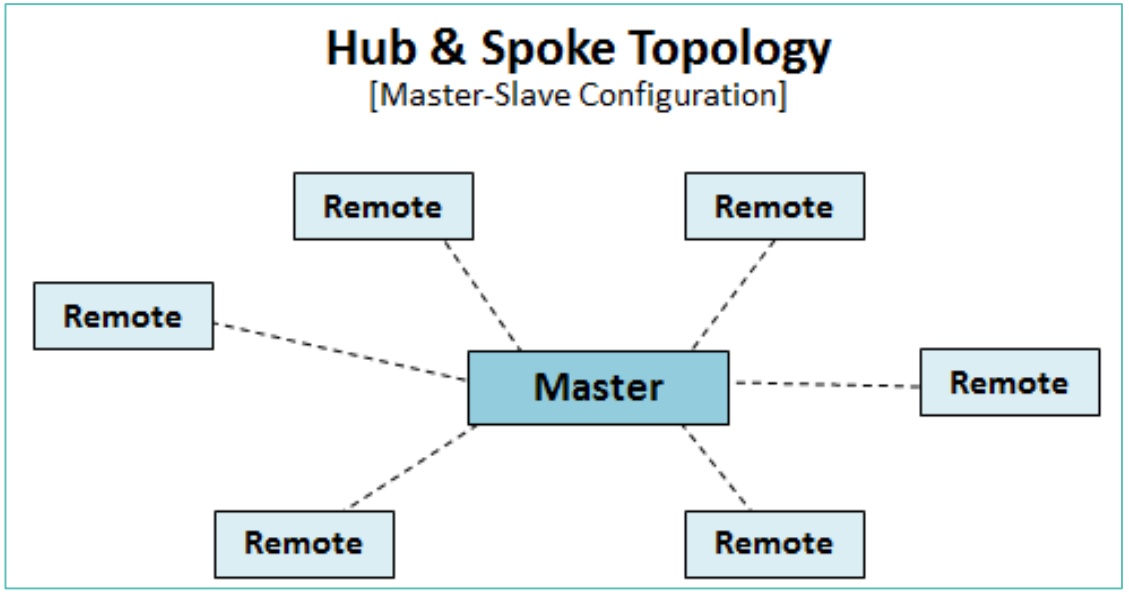
- Highly reliable & resilient
- Fast, high bandwidth
- Compatible w/ new technology
- Large commercial growth

Phase 2: Gap Analysis

Current Network Architecture

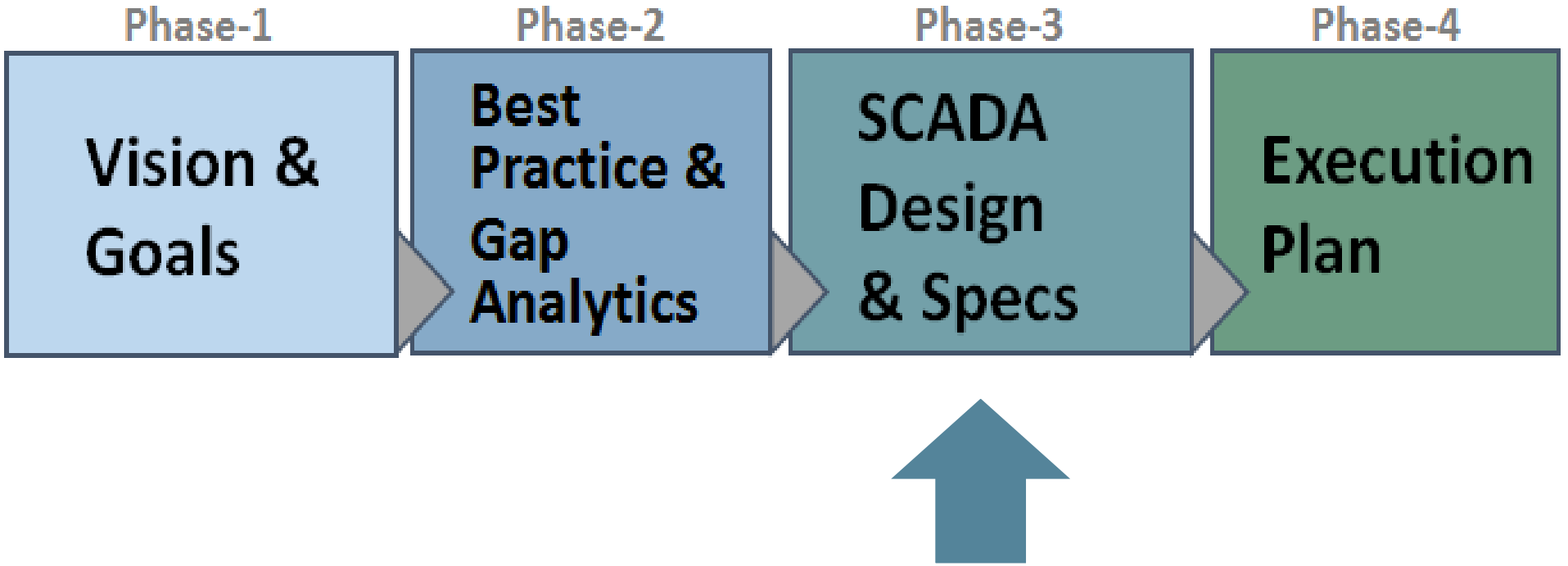
Hub & Spoke Topology

- Data flows from all sites into the master
- Operational commands and setpoints are transmitted out from master.
- Least Resilient
- No cooperation amongst ‘spokes’



SCADA Master Plan

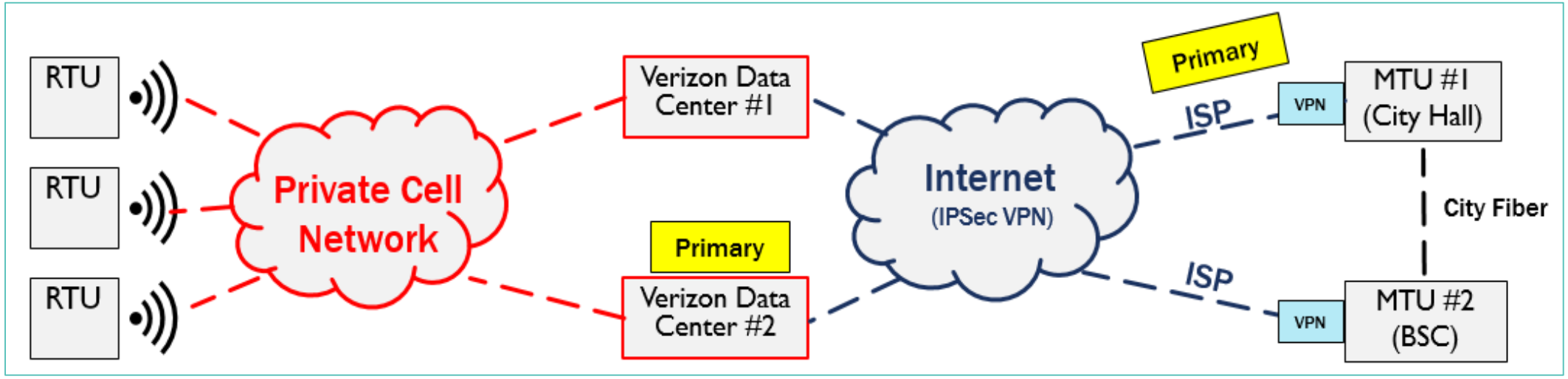
Phase 3: SCADA System Design



Phase 3: SCADA System Design

Cellular Network Configuration

Data at a pump station is sent via private cellular network to City of Bellevue SCADA servers via secure VPN “tunnel”. Each site must have a Vendor provided SIM card.

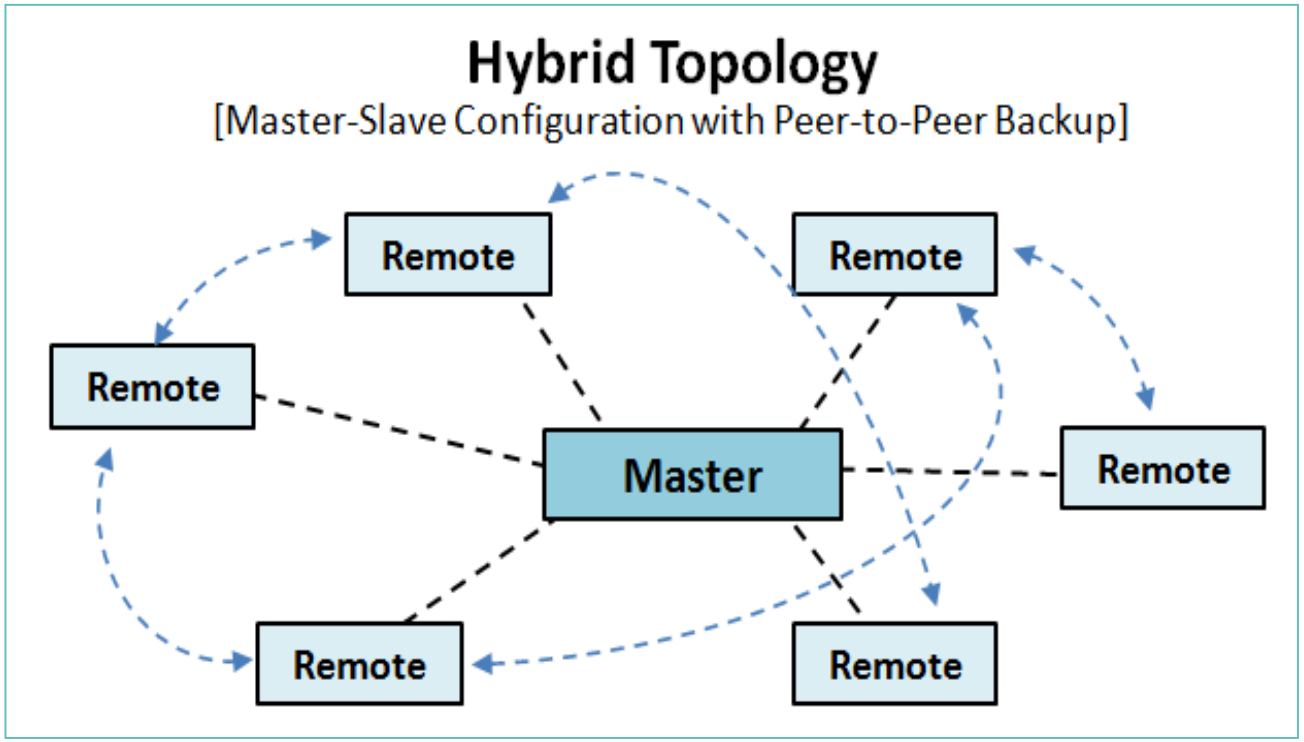


Phase 3: SCADA System Design

System Architecture

Hybrid Topology

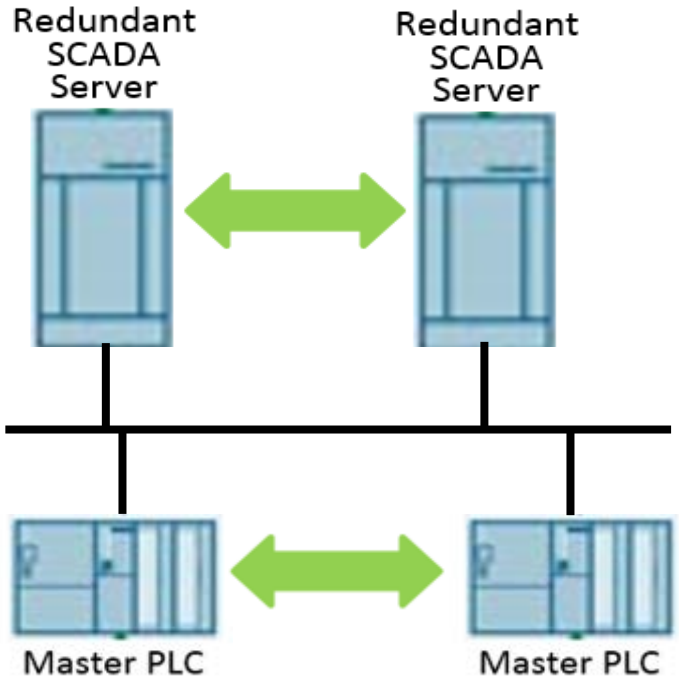
- Data from all sites flows into the master unit
- Remote sites coordinate where necessary or advantageous
- Improved Resilience



Phase 3: SCADA System Design

SCADA PLC & Server Redundancy

- Two complete sets of PLCs and Servers at City Hall and Bellevue Service Center
- Identically configured to support the SCADA system and record all data simultaneously
- Either PLC can be seamlessly transferred between either server.



Advantages

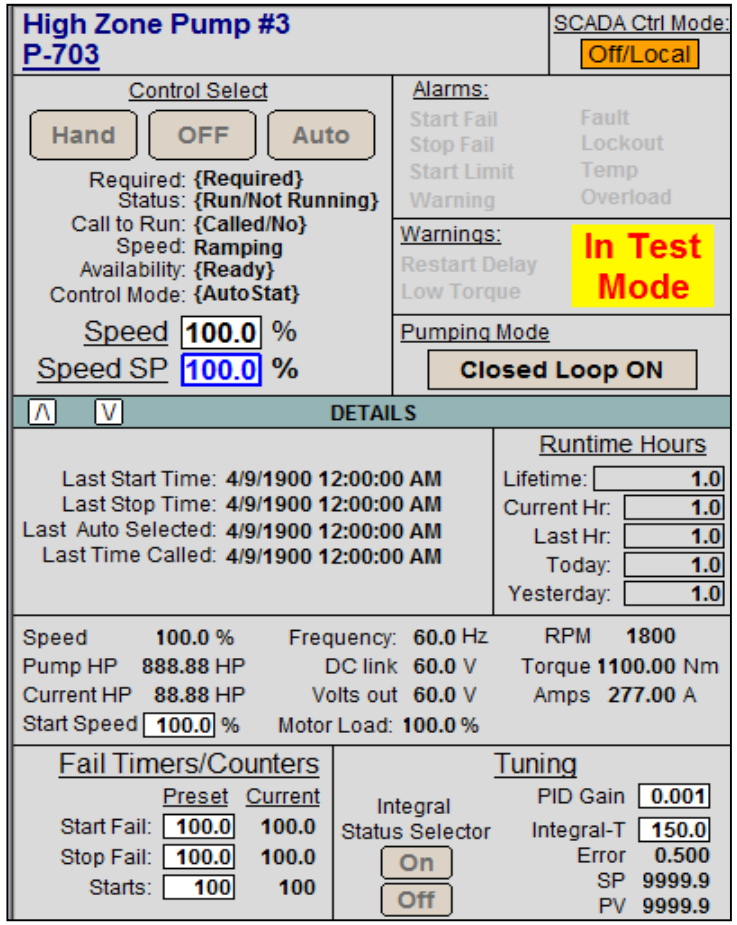
- Mitigates risk of failures.
- Able to load security patches on “standby” server without impacts to “live” server.
- Can reboot server without SCADA system downtime

Phase 3: SCADA System Design

Intelligent Field Sensors

Smart Motor Sensor

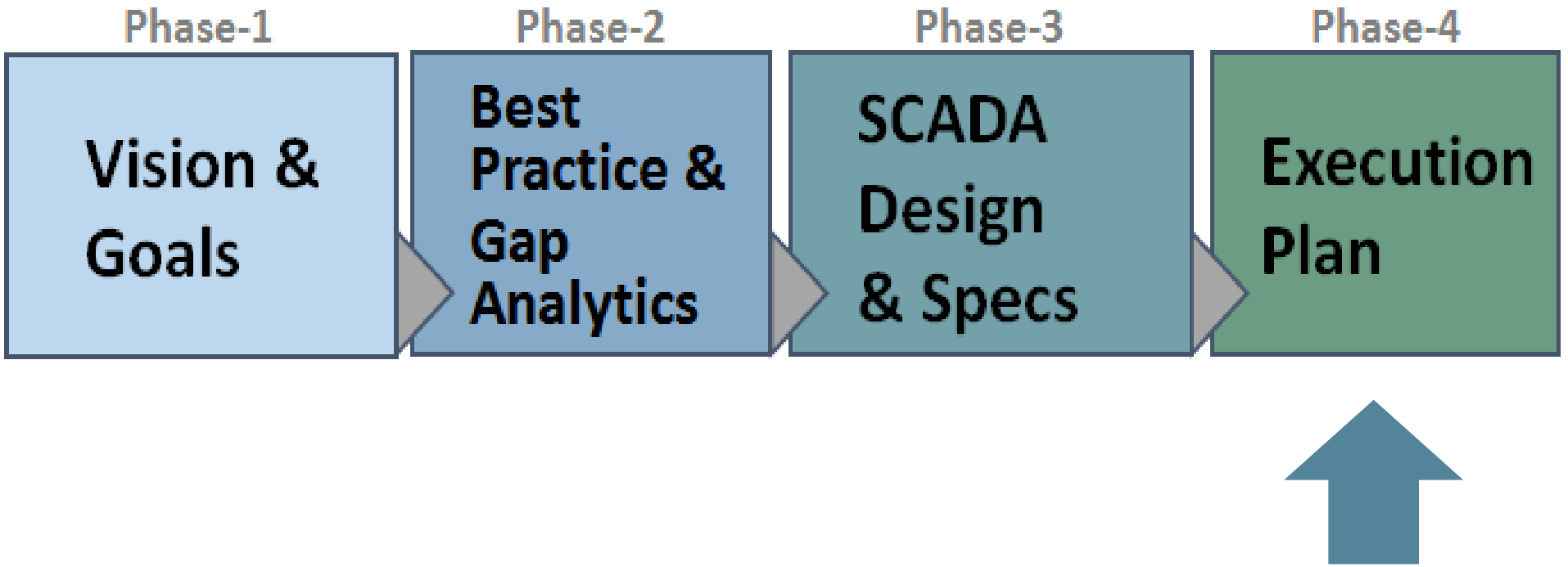
- Monitor pumping efficiency
- Calculate cost of pumping
- Automatically order replacement when performance indicates pending failure



- 69% of Water Stations
  - 26 motors remaining
- 5% of Wastewater Stations
  - 68 motors remaining

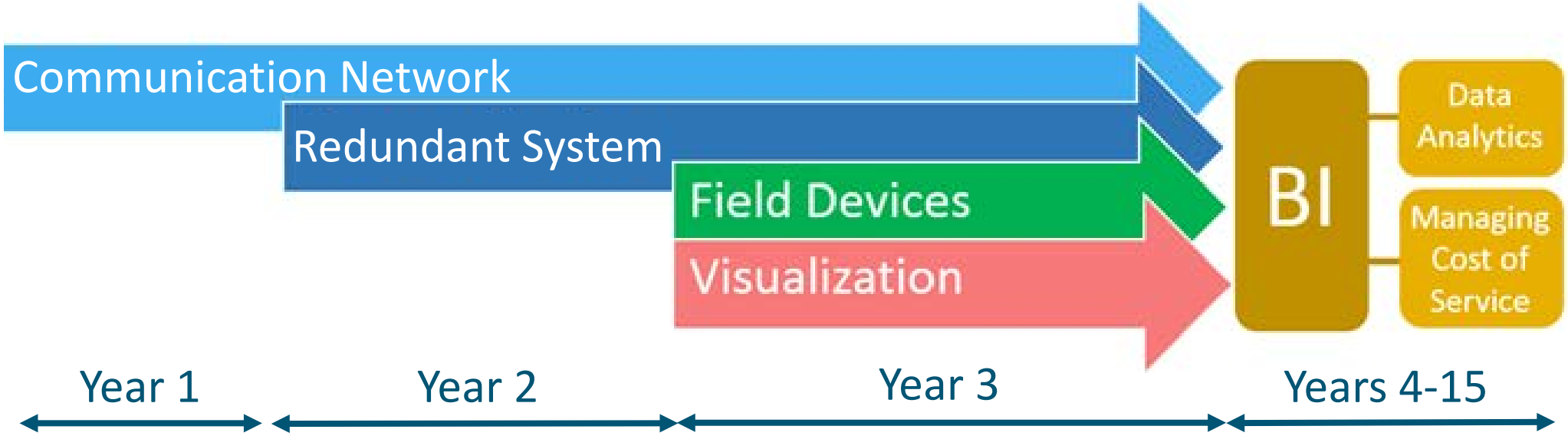
SCADA Master Plan

Phase 4: Execution Plan



Phase 4: Execution Plan

In order to realize the vision of using SCADA data for Business Intelligence (BI), Bellevue must modernize the SCADA communication network, process control systems, field devices, and visualization software.



BACK UP SLIDES

Phase 2: Gap Analysis

Remote Site Process Control

Remote Telemetry Unit – Current Digital Upgrades

- Water: 24 of 31 Sites

- Wastewater: 2 of 47 Sites

- Storm: 0 of 11 Sites

Phase 2: Gap Analysis

Critical Field Sensors

Efficiency Monitoring

Need sensors to collect actionable data and improve control

- Suction pressure sensors
- Discharge pressure sensors
- Discharge flow meters

Flow Monitoring:

- 28 of 33 Water Stations
- 4 of 37 Wastewater Stations
- 0 of 11 Surface Water Stations

Pressure Monitoring:

- 1 of 147 PRVs has a pressure transducer
- No Wastewater sites monitor discharge pressure

Implementation Cost

Rough Order of Magnitude costs estimates, in present value, required to meet the Ideal State envisioned by city.

	Potable Water	Wastewater	Storm Water	Total Costs
Communication & Process Control	$310,425	$873,415	$328,670	$1,512,510
Software & Security	$417,623	$417,623	$92,805	$928,050
Field Sensors	$349,260	$1,014,140	$318,730	$1,682,130
Total Cost:	$1,077,308	$2,305,178	$740,205	$4,122,690

SCADA Network Architecture Design