Distribution Management System for British Columbia Transmission Corporation

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About BCTC/BC Hydro

- As an independent electric transmission company, BCTC is responsible for the planning, management and operation of BCH's transmission assets, which include 18,000 kilometres of high-voltage wires.
- Currently, BCTC under contract from BC Hydro operates approximately 1,200 distribution feeders

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Project Objectives

- A distribution management system (DMS) is being proposed for **implementation in phases starting in 2009**
- Shift from the current practice of manually operating distribution assets to an **automated electronic decision support system**.
- Provide **centralized visibility and control of the distribution assets** with **enhanced decision support capability** that will assist in the day to day operations of the distribution system

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DMS Value Drivers

- **Financial:** Provide financial benefits stemming from feeder deferrals, energy conservation, reducing fault locating and restoration times.
- **Environmental**: rapid expansion of **energy conservation** will result in an incremental reduction in electrical intensity.
- **Reliability/Customer**: will reduce system SAIDI.
- **Employees:** the employees will be empowered with enhanced decision support capability.
- **Safety:** provide a more secure and safe environment for field personnel
- **Alignment with BC Energy Plan:** aligns with the **BC Energy Plan**, which calls for the use of innovation and technology.

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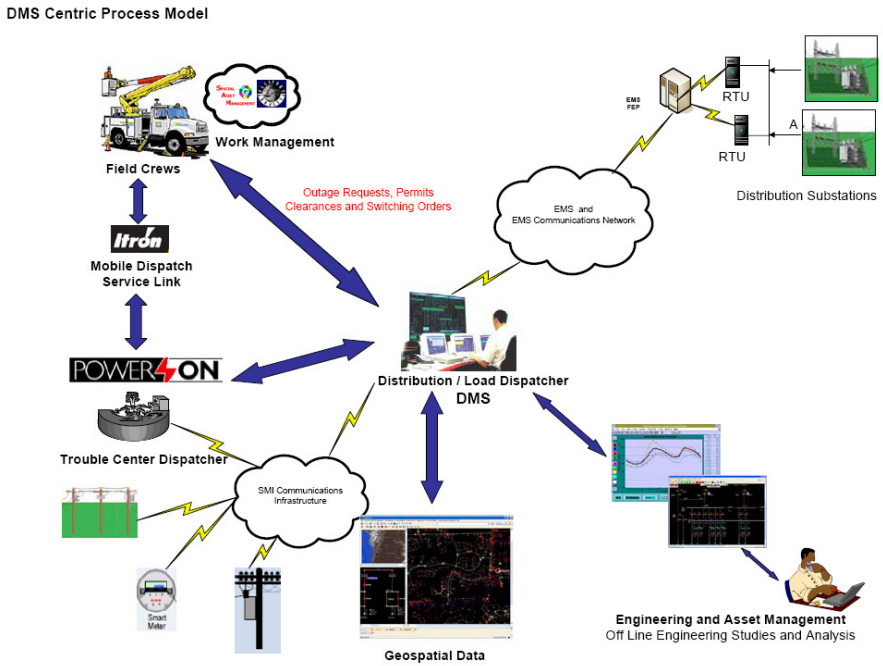
Project Overview

- **manage the operation of equipment located in**
  - distribution substations;
  - on radial and “looped” distribution feeders (overhead and underground),
  - “spot” primary networks
  - underground networks (fully meshed primary and seconda network)
  - distributed generating resources located out on the distribution feeders

- **optimize the performance and reliability of the distribution system and provide effective decision support tools for the distribution operators, including**
  - On line power flow (OLPF)
  - Switch order management (SOM)
  - Volt-VAR optimization (VVO)
  - Fault Detection, Isolation Restoration (FDIR)

- **Provide effective interfaces between DMS and othe enterprise systems, including**
  - Geographic Information System (GIS)
  - Energy Management System (EMS)
  - Outage Management System (OMS)
  - Smart Metering Infrastructure (SMI)



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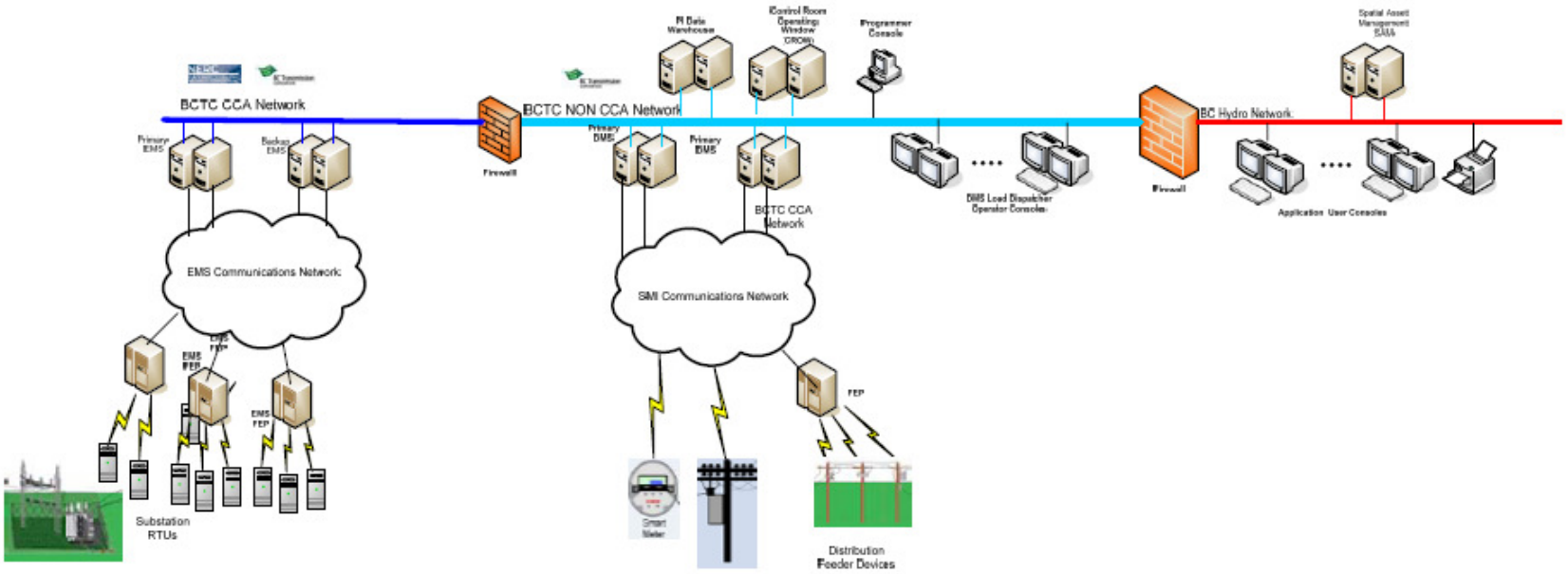
System Architecture (Preliminary)

Figure 2: DMS System Architecture



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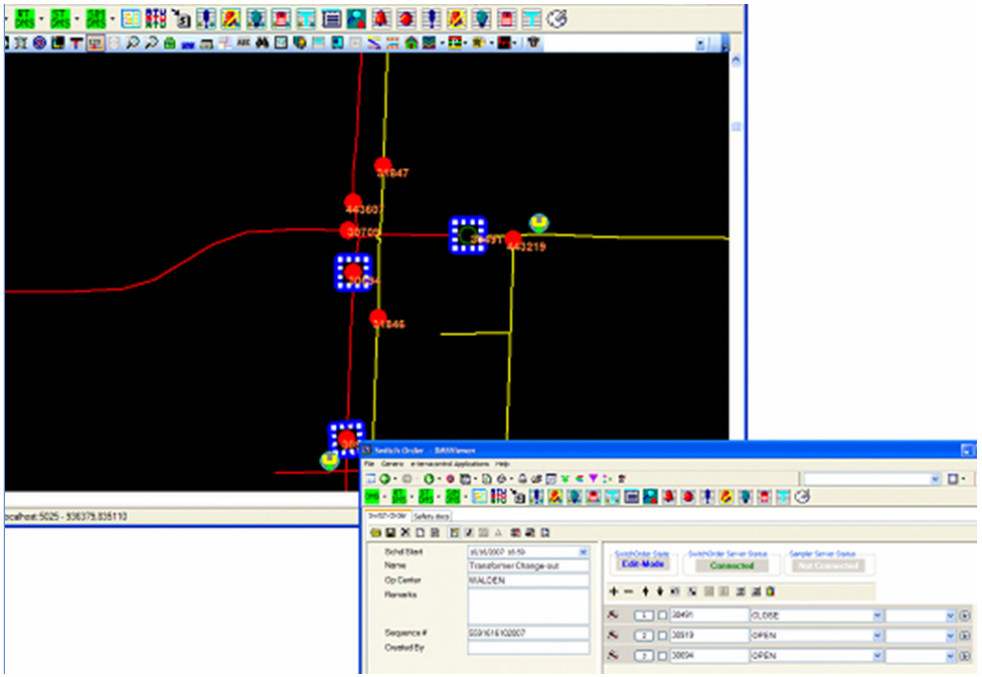
Switching Order Management (SOM)

- Software tool to assist the operators in creating switching orders

- Available modes of operation:
  - **Manual** – operator types in switch orders
  - **Computer aided** – operator creates switching steps by clicking on graphic displays, computer inserts specific detailed entry
  - **Computer generated** – operator selects components being worked on, computer generates complete switching sequence based on established safety rules.
  - **Study mode** – computer simulates execution of switch order using on line power flow to determine if adverse consequences will occur (low voltage, device overloads, etc.) when the switching actions are actually performed



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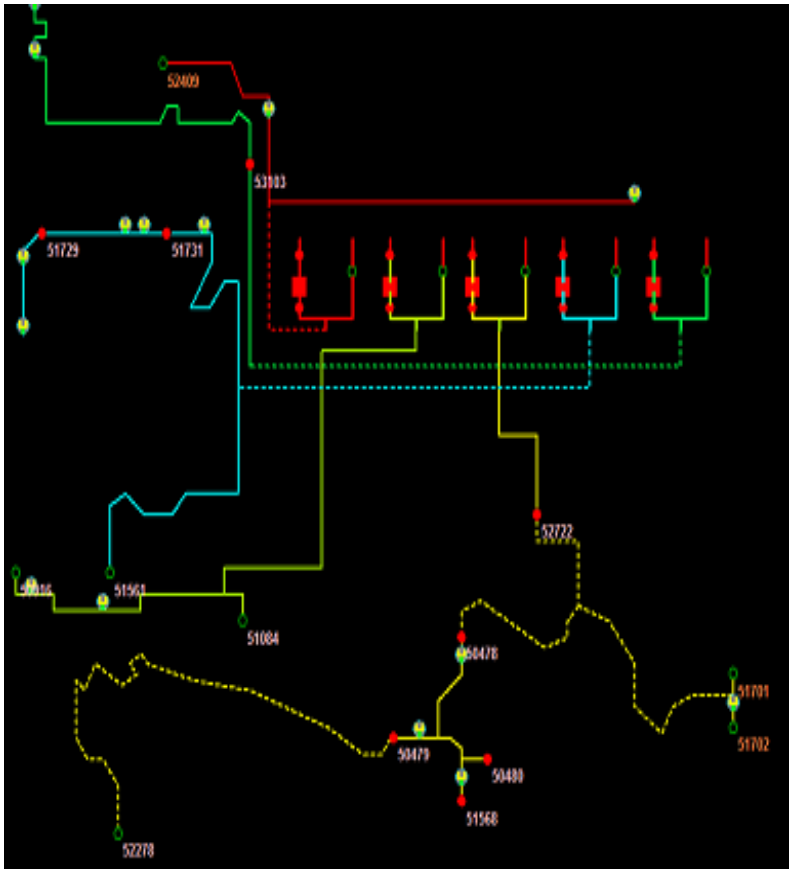
On Line Power Flow (OLPF)

- **What is OLPF?**
  - A real-time version of the well known engineering power flow tool (“off line” power flow)
- **What does it do?**
  - Calculates electrical conditions (voltage, current, real/reactive power) at all points along the feeder.
- **OLPF objectives:**
  - Provide operators with nearly continuous “visibility” of all points along the feeder where no SCADA measurements exist (“state estimator” for distribution circuits)
  - Provide feeder electrical information needed by other DMS applications (FLISR, IVVC, Switch order management, etc)



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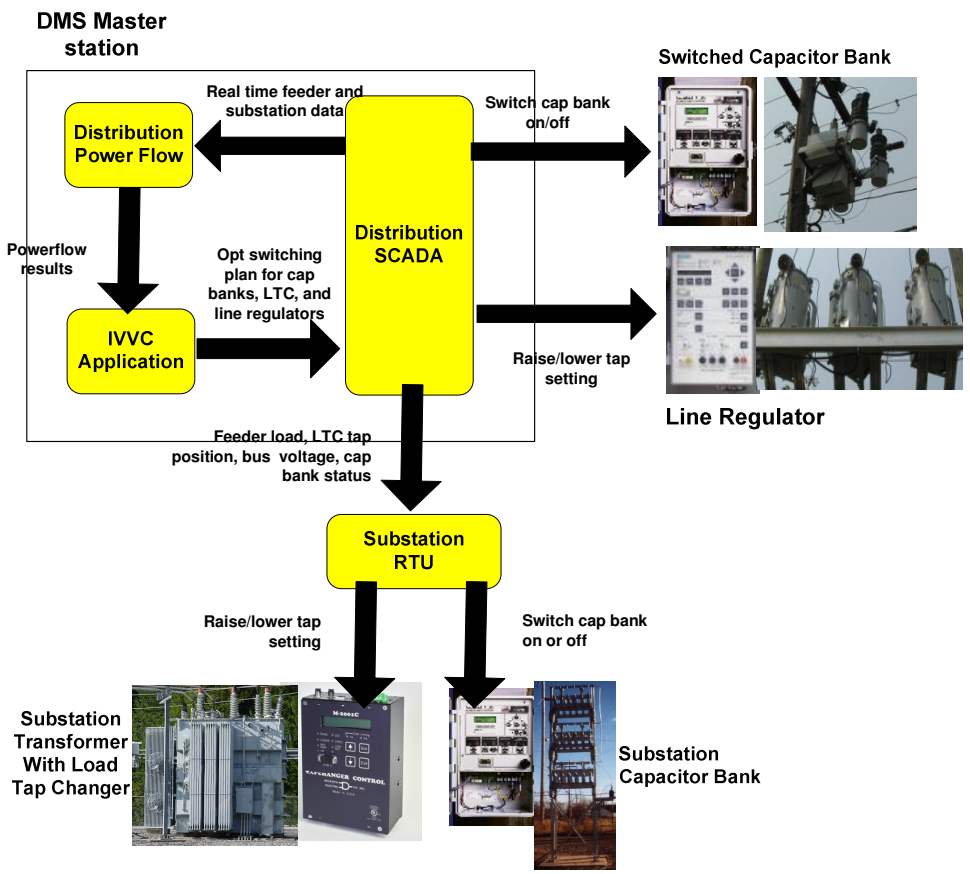
Volt-VAR Optimization

- Determine optimal control actions to accomplish specified operating objectives:
  - Do not violate operating constraints:
  - Minimize energy consumption
  - Reduce demand
- VVO control actions include
  - LTC setting changes
  - Capacitor bank switching
  - Voltage regulator control.
- Optimal power flow-based solution
- Accurate modeling of load-voltage sensitivity
  - Customer load models
  - Transformer no load losses
- “Failsafe” design



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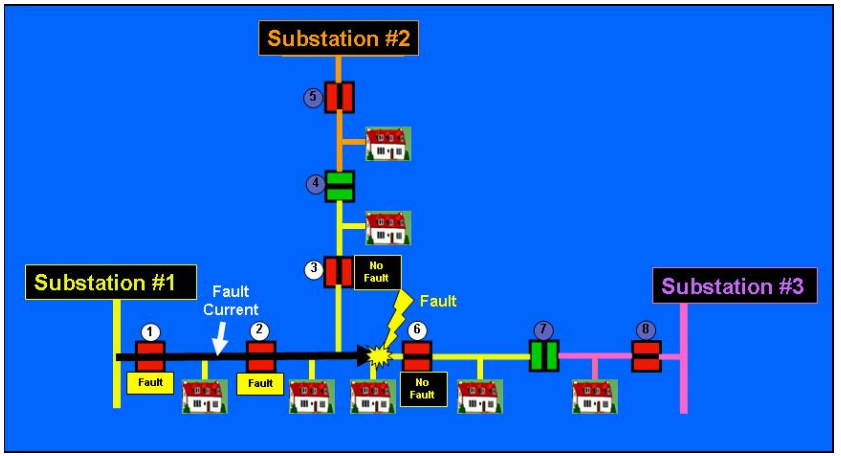
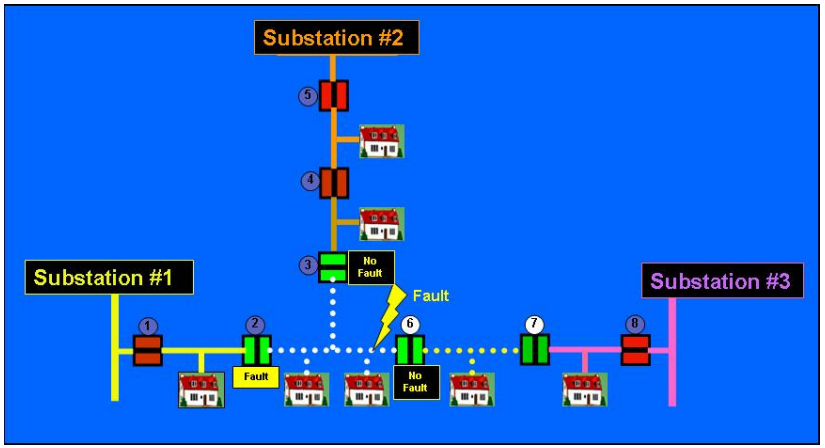
Fault Detection Isolation Restoration (FDIR)

- FDIR Objectives
  - Improve System Average Interruption Duration Index (SAIDI)
  - Improve System Average Interruption Frequency Index (SAIFI
- FDIR functions:
  - Automatically detect feeder faults,
  - Isolate the faulted section of the feeder (between two field switches),
  - Restore service to as many customers as possible
  - Do not overload backup sources
- Fault Location - “Reverse short circuit” analysis
  - Obtain fault magnitude and type (A, B, C, A-B, etc) from relay IED
  - Determine possible fault locations using DMS short circuit analysis tool and associated feeder model





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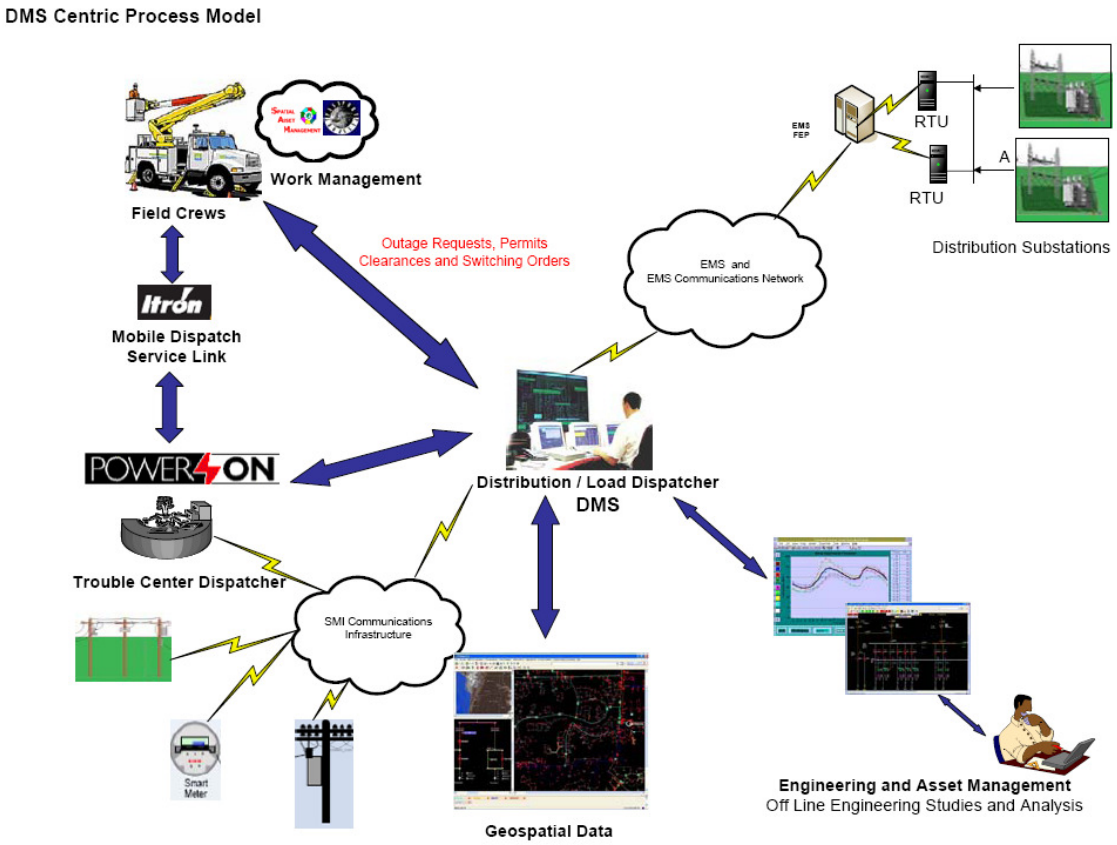
External Interfaces

- Geographic Information System (GIS)
- Corporate data warehouse (PI)
- Outage Management System (OMS)
- Smart Metering Infrastructure (SMI)
- Control Room Operating Window (CROW
- Spatial Asset Management (SAM)
- Others



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Project Team

- Multi-disciplined core project team
  - BCTC Manager, Distribution Operations
  - BC Hydro Operations Planning Leader
  - Distribution system operators
  - Information Technology Experts
  - Distribution Engineering (application specialist)
  - Consultants
    - Quanta Technology (SCADA/DMS functions)
    - Enspiria Solutions (IT architecture and external interfaces)

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Project Status

- Planning and design phase
  - Information exchange meetings with DMS stakeholders (completed)
  - Functional requirements
  - Interface definitions
  - Conceptual architecture
  - Implementation strategy
  - Industry survey of best practices (reviewing results)
- Procurement phase
  - Request for qualifications (vendor prequalification) (reviewing results)
  - “Select” Request for Proposal (only those short listed)
  - Bid evaluation and contract negotiation
- Implementation phase

Questions?

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