



Active Distribution Networks: Canadian Example Projects

Chad Abbey



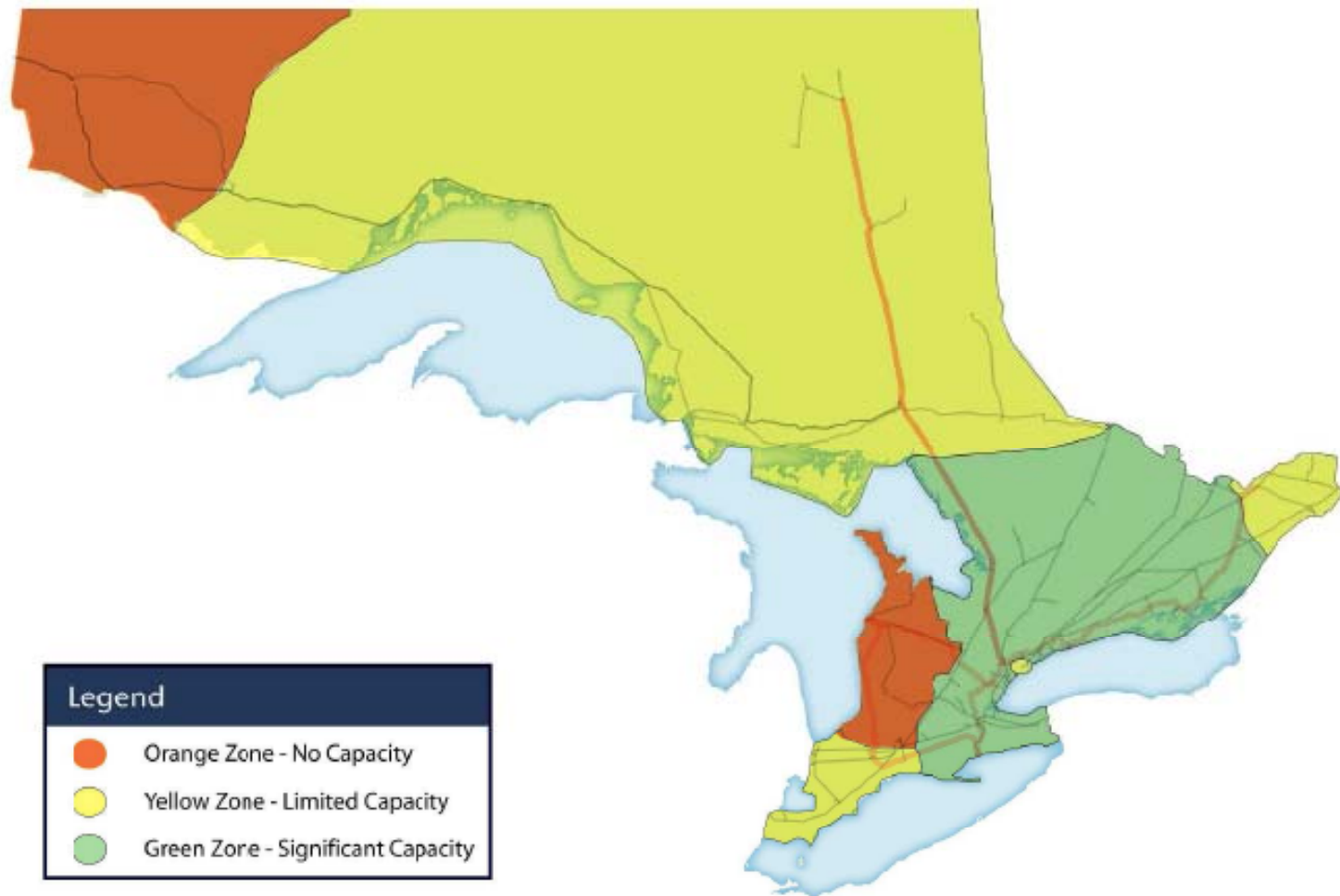
Overview

- Background
 - Active distribution networks – integration of DER and distribution automation
 - Canadian context
- Utility projects
- Natural Resources Canada initiatives
- Standardization activities
- Summary

Power Systems in Canada

- Electricity – provincial jurisdiction
 - Mix of deregulated and vertically integrated companies
 - Provincially owned: BC Hydro, Sask Power, Manitoba Hydro, Hydro-Quebec, NLH
 - Competitive markets: Alberta, Ontario
- Active distribution network drivers
 - Smart meter initiatives
 - Conservation
 - Reliability
 - Ageing infrastructure – grid modernization
 - DER – feed-in tariffs, e.g. Standard Offer Program

Ontario – DER Integration



Canadian Utility Projects

- ADA technologies being implemented
 - AMR, AMI
 - Fast reconfiguration – S&C IntelliTeam products
 - Fault locating technologies
 - Voltage reduction schemes
 - Remote monitoring
 - Planned islanding
- Initiatives: Ontario Smart Grid Forum, CEATI Taskforce on Smart Grid, dedicated spectrum
- Utility examples: Hydro-Québec, Toronto Hydro, Hydro One, ENMAX, BC Hydro

Ontario Smart Grid Forum

- Participation
 - Led by IESO
 - Utilities, suppliers, government
- Objectives
 - Develop a high level vision of Ontario Smart Grid
 - Educate industry leaders on drivers, technologies, and opportunities
 - Identify enablers and barriers
- Outputs
 - Report on findings and recommendations
 - Website:
http://www.theimo.com/imoweb/marketsandprograms/smart_grid.asp

CEATI Smart Grid Working Group

- Centre for Energy Advancement through Technological Innovation (CEATI) International
- Objectives
 - Definition of Smart Grid
 - Action plan for development of the Smart Grid
 - Identify technology gaps
 - Successful strategies for implementation of the Smart Grid
- Status
 - Initial teleconference – Aug. 2008
 - Kick-off meeting – Nov. 2008

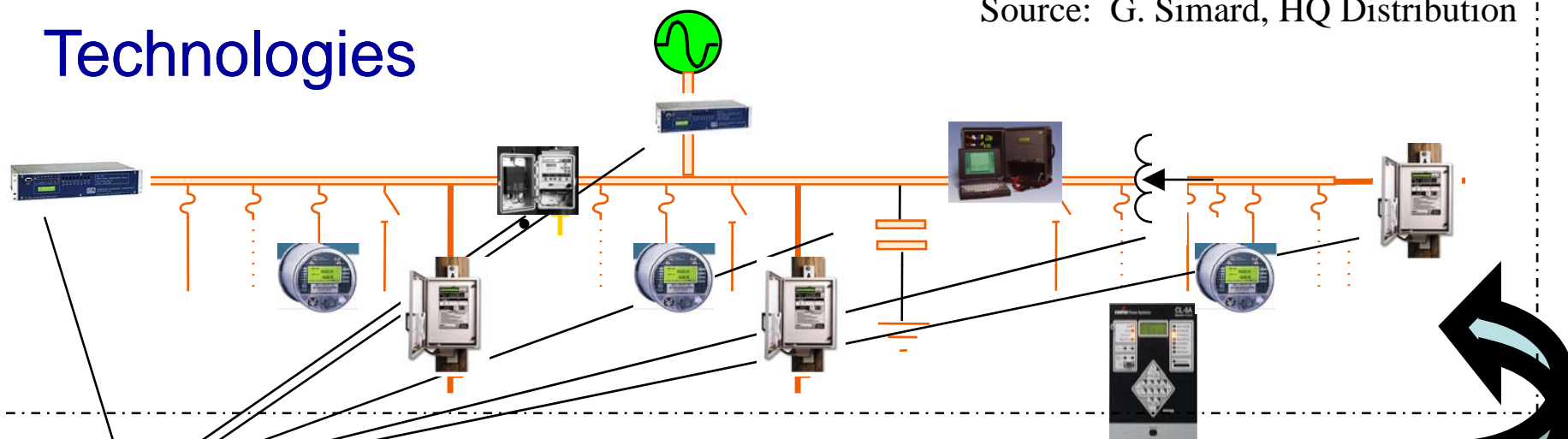
Utilities Telecom Council (UTC) Canada request dedicated CI spectrum

- Spearheaded by 5 Canadian utilities
 - Intelligent grid: energy conservation, station security, distribution automation, real time outage management, new power generation (small distributed facilities).
 - Rural networks requires spectrum with good propagation
 - 700 MHz range comes with a premium
- Industry Canada proposal
 - Consultation process – Gazette Notice SMSE-008-08:
 - <http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf08972e.html>
 - 30 MHz contiguous frequency block in the 1.8 GHz band
 - relax the SRSP (Standard Radio System Plans) 301.7 to accommodate point-to-multipoint topologies
- Widely supported by respondents

Hydro-Quebec Plan Advanced Distribution Automation

Source: G. Simard, HQ Distribution

Technologies



Data

- Voltages
- Load currents
- Fault currents
- Temperature
- Operations monitoring

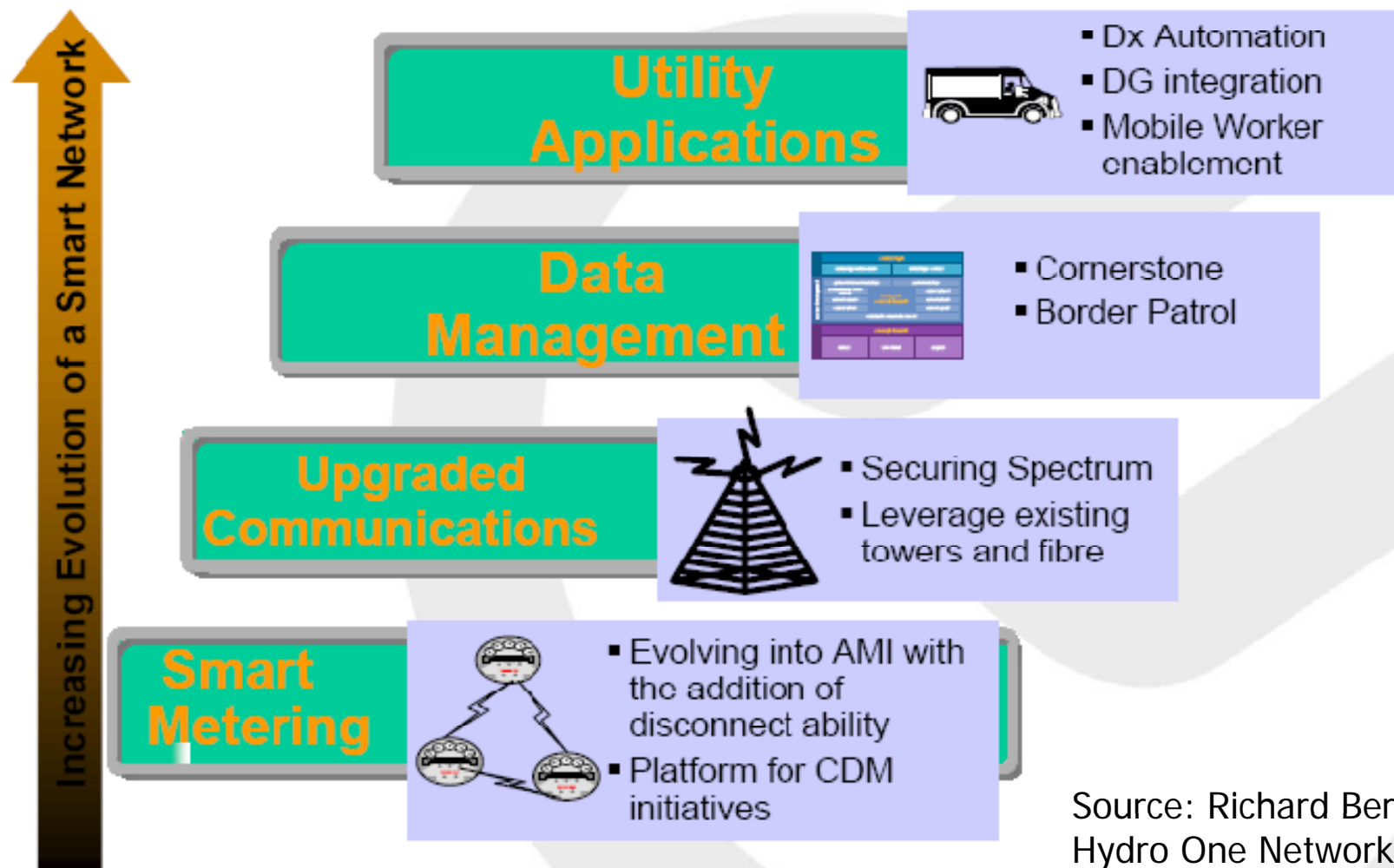
Functionalities

- Voltage control
- Optimised load flow
- Fault location
- Equipment failure detection
- Power Quality evaluation

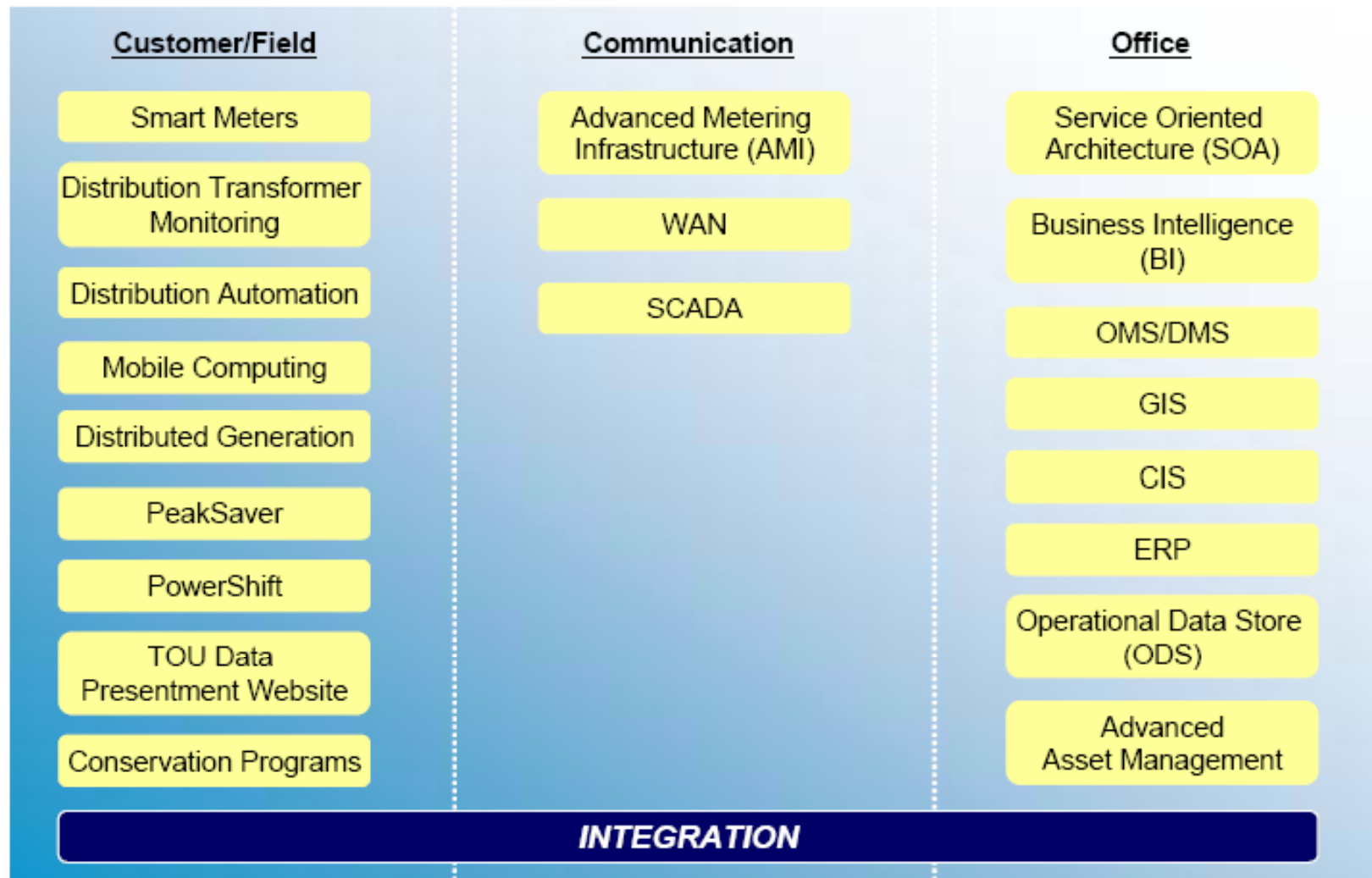
Business needs

- Improving reliability
- Reduce costs
- Energy efficiency
- Customer satisfaction...

Hydro One



Toronto Hydro



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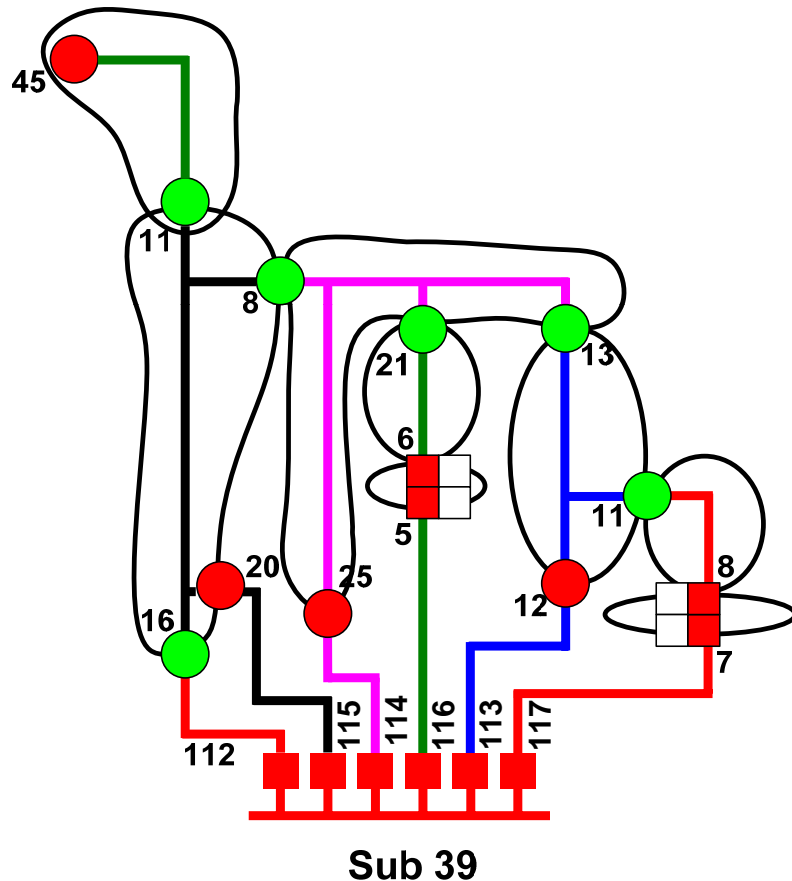
Natural Resources
Canada

Ressources naturelles
Canada

Source: Joshua Wong, Toronto Hydro

Canada

ENMAX – IntelliTEAM II – A Distributed Control System



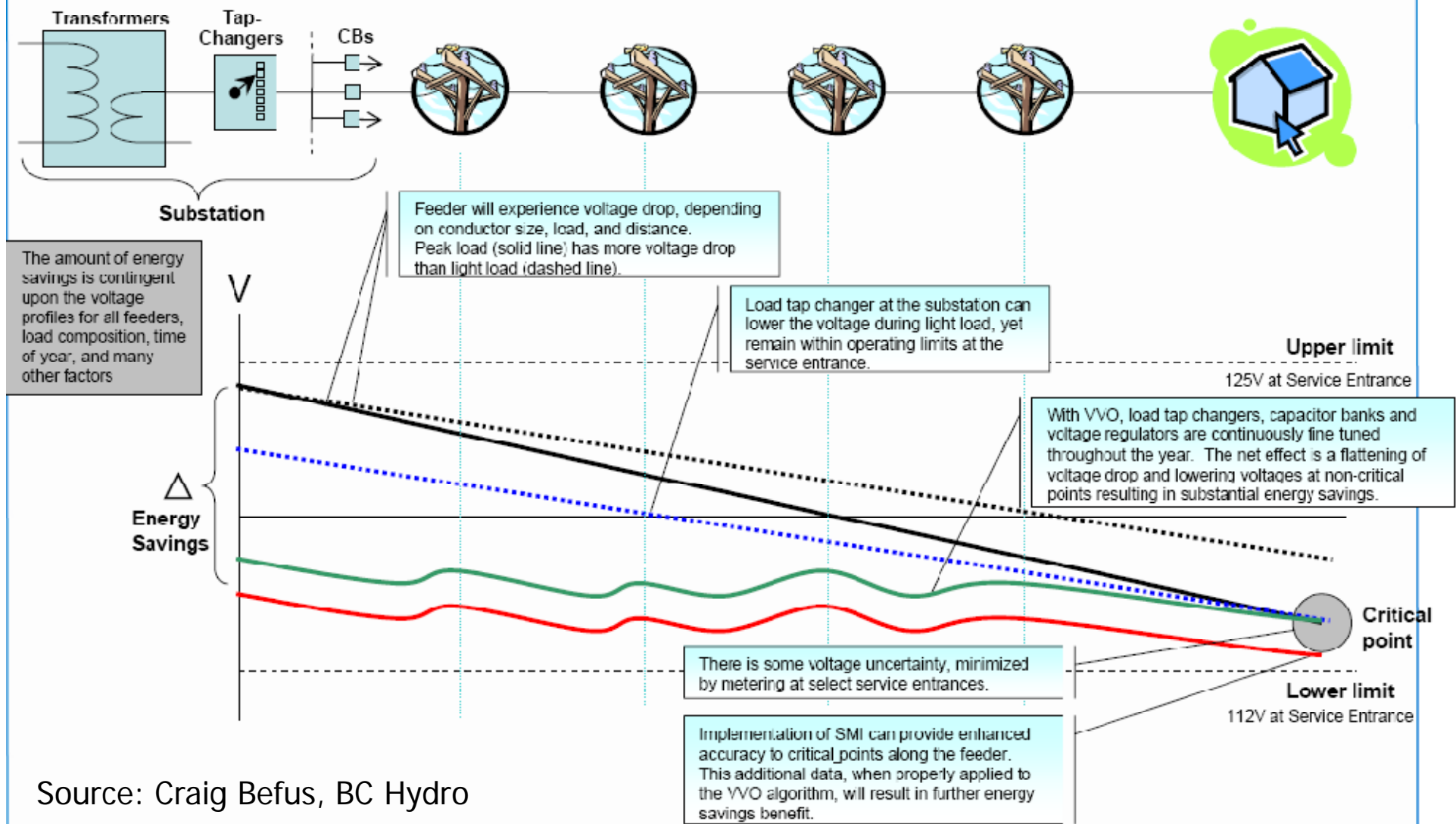
Team Structure

- A team consists of a line segment bounded by intelligent switches
- Switches can belong to one or two teams
- A team may have may have from one to eight switches
- Teams are building blocks
- Interconnected teams form a self-healing electrical network

Source: Dean Craig, ENMAX

BC Hydro – Volt/Var Optimization

VVO - In very basic terms:



Source: Craig Befus, BC Hydro

NRCan - Grid Integration Program

- Role of governmental lab
 - Address technical and regulatory barriers to DG
 - Provide much needed research support to many distribution companies
 - Coordinate collaboration nationally and internationally
- Relevant projects (2007 – 2011)
 - Active distribution networks
 - Modeling, simulation and validation of DER
 - Communication and DER standards support

Test Facilities

➤ Low voltage test facility (CETC-V):

- Multiple inverters and interconnection testing
- 120-kVA, 3ph Grid simulator
- 5kW/15kW Solar Simulator
- Adjustable RLC loads



➤ Medium voltage test facility (IREQ-HQ):

- Distribution automation network testing
- A radial 25-kV feeder (20 poles, 370m)
- 300-kW, 600 V, resistive, inductive and motor loads
- 15. ▪ Power quality meters



Natural Resources
Canada

Ressources naturelles
Canada

Canada

DA / DER Standards Development

- IEC TC 57 – Extension of IEC 61850
 - WG 17 – object models for DER
 - Common information models (CIM) for distribution automation
 - Interoperability (near-term), Plug-and-play (long-term)
- IEEE 1547 series
 - IEEE 1547.2 – Application guide
 - IEEE 1547.3 – Communication models
 - IEEE P1547.4 – Design and operation of DER Islands
 - IEEE P1547.6 – DG in meshed/spot networks

Summary

- Two technology pushes
 - DER – policy driven
 - ADA – utility efforts to modernize the grid
- Improved integration needed
 - Support utilities in DER integration – pilots and demonstration, regulatory, standards
 - Leverage information communication technology investments
- NRCan project activities: Active distribution networks, modeling tools, communications, and support for harmonization of standards

Questions ?

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