Part 1
SCADA Technology Update

2015 Joint Annual Meeting

West Virginia AWWA

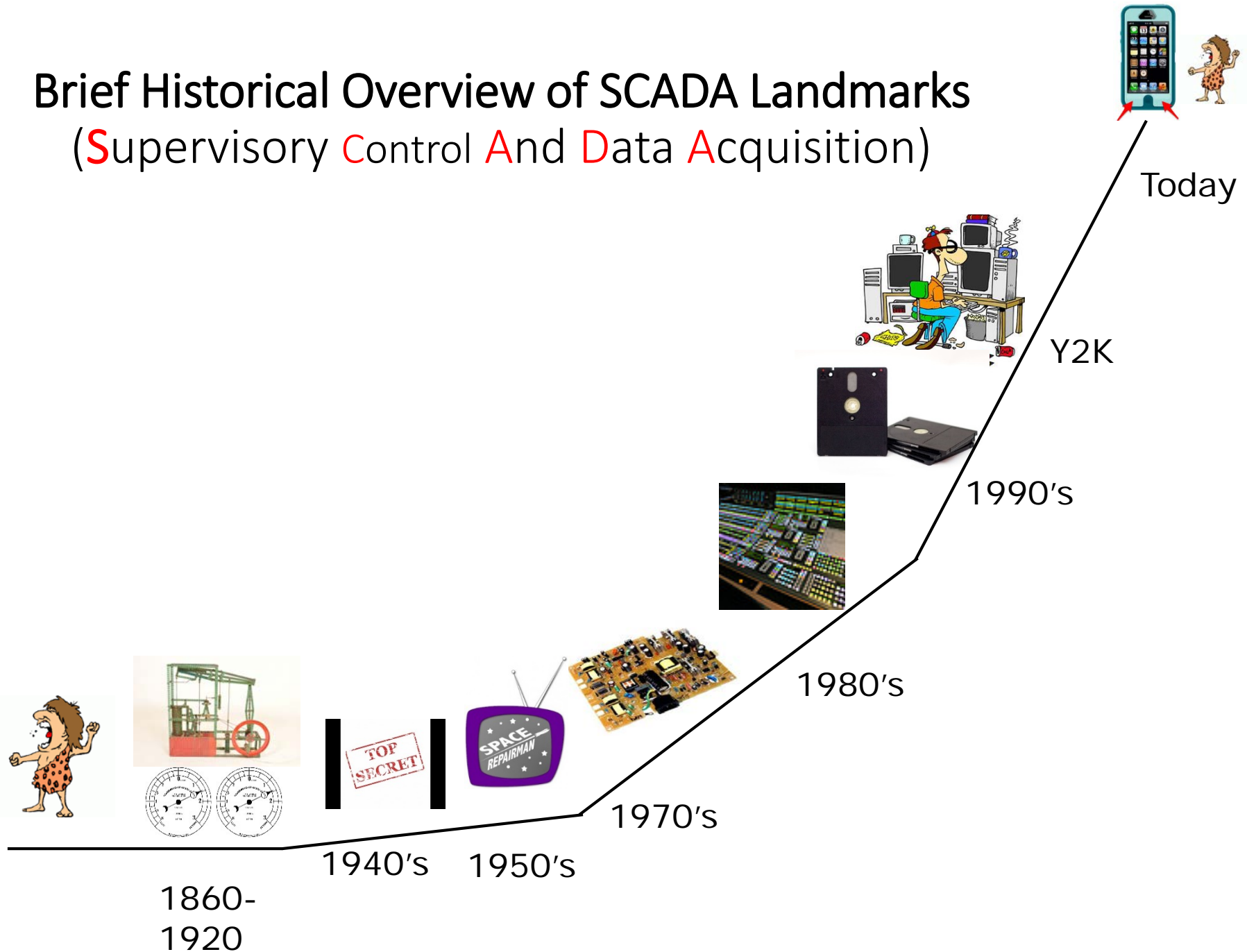*West Virginia WEA*

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Brief Historical Overview of SCADA Landmarks
(Supervisory Control And Data Acquisition)

Today

Y2K

1990's

1980's

1970's

1940's   1950's

1860-
1920

#1 Fiber optic network replaces copper pairs

- Buried conduit issues
    - Water infiltration leads to corrosion
    - Copper pairs damaged during installation
    - Space required

- In room conduits
    - High humidity and corrosion
    - Airborne corrosive dust and chemicals

- Addressable hubs for control and troubleshooting

- Redundant pairs for reliability

- Bi-directional vs. uni-directional
    - Self healing reliability

#1 Fiber optics replaces copper

- Pro's
  - Life cycle cost
  - Life cycle reliability
  - Fast
  - Networked devises and panels
  - RJ-45 or coax connector is plug and play connectivity to media convertor

- Con's
  - Potentially higher initial cost but flexible fiber has helped
  - Actual fiber installation and repair requires a specialist

#2 Redundant processors and store and forward

- Focus on critical facilities
  - Processors are essentially computers and will fail at the least convenient time
  - Term redundant processor is loosely used
    - Parallel, parallel and redundant, fully redundant are not all the same capability
    - Bottom line is the degree of seamless control. If everything shuts down until the "redundant" processor assumes control, process issues can occur, pump start limitations can be created
  - Remote sites will loose connectivity at times, count on it
    - Store and forward architecture holds the data that is still being generated at the remote site like water quality and uploads it as soon as communications is restored.

#3 What is proprietary hardware, and why is that an issue?

- All processor and I/O hardware is fundamentally "proprietary"
  - Major brand PLC's are not interchangeable and do not share I/O cards
  - Major brand DCS are not interchangeable and do not share I/O cards
  - Issue is not the hardware but application and support

- Connectivity to the processor is interchangeable at different system price points
  - Industry standard communication protocols
    - Modbus
    - Profibus
    - TCP-IP
    - Serial
  - Addressability
    - Get the basic data from a device, send a command to the device
    - Communicate and control a device seamlessly

#3 What is proprietary hardware, and why is that an issue?

- Key point is to always specify a developer license in the spec so that you or a instrumentation tech can modify and create new code, screens, alarms etc.
- Anyone who is comfortable programing on Platform A can quickly get up to speed on Platform B. Major manufacturers all offer significant training opportunities and some offer college credits for the training.

#4 Integrator or system supplier?

- A bit of full cycle
  - 1960's to ~1980's virtually all systems came from 4-5 major vendors
    - Complexity; military, industrial, power, very large municipal
    - Component manufacturing limits
    - Technical repairs
  - Late 1970's into 1980's
    - Spin off companies found niche markets like smaller muni plants
    - Printed circuit board technology costs came down
    - Early "small" processors
  - Mid to late 1980's to Y2K
    - Early PC's, grass roots programmers, birth of "integrators"
    - Reduced component manufacturing
    - Y2K illustrated challenges for smaller manufactures and integrators using off the shelf computers and software

#4 Integrator or system supplier?

- Integrators…are independent businesses
  - Buy and resell proprietary processors, I/O cards, support devices like PC's **from** a manufacturer
  - Selects and buy proprietary software from the processor, MMI and PC manufacturer
  - Provides engineering, programming, testing, startup, post sale support with their employees or subcontractors

#4 Integrator or system supplier?

- System suppliers…are manufacturers
  - Design, manufacturer and sell proprietary processors, I/O cards and support devices develops proprietary software for the processor, MMI
  - Selects and supplies support PC's; manufacturer or purchase and resell
  - Provides engineering, programming, testing, startup, post sale support with their own employees

#4 Integrator or system supplier?
Differentiation points:

- Depth
  - Most integrators are small independent businesses, 5-10 employees
    - Loss of a key engineer or tech can decimate the company or reputation
    - Unexpected success or problems can stretch resources
  - Major system manufactures are large multinational players
    - Employ market specialists
    - Regional engineering teams
    - Regional and national technical support
    - Dedicated training facilities

#4 Integrator or system supplier?

Differentiation points:

- Experience
  - Integrators tend to know their core market and preferred product family, may or may not be on top on new methods, materials etc.
  - System manufactures participate in multiple industries, multiple markets and are forced to keep up with newest trends and expectations to survive

- Life cycle support
  - Integrators are at the mercy of the vendors they rep
  - Integrators incur costs to continue support legacy equipment or to migrate forward can cost $$$ bucks, Costs can lead to cut and paste issues
  - Manufacturers can design migration into products and map out phase outs and end of lifecycle support like exchange stock

#4 Integrator or system supplier?
Differentiation points:

- Security
  - Water sector approach to security varies widely
    - Close the new gate to encrypted padlock keys
    - Post it note passwords to rolling code devices

  - Integrator approach to overall security varies greatly
    - Employee screening
    - Employee training
    - Overall security and backup practices, office and field; the guy YOU know and trust may or may not be the problem

  - System suppliers driven by the highest risk industry they serve; military, nuclear, chemical, pharmaceutical, water
    - All employees screened and trained
    - All systems and practices documented

#5 Managed Cellular Data SCADA

How Does Work?

Has 5 Parts:

1. Field RTU
   - Standardized
   - Power supply, radio, I/O
   - Cell tower
   - Data cellular... not voice
   - 4G Data: GPRS & CDMA
   - Available on all 3 types of cell data
2. National, wireless data networks
   - Private "pipes", increased security
   - Flexibility for permanent connections
3. Managed Central Servers
   - All carrier issues/data managed
   - Flat fees
4. OPC Database at customer MMI
   - MMI scans RTU tags
   - Redundant servers can retrieve data

3.

Cell Carrier Network

4.

Central Managed Servers

Private Network

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2.

Local Cell Tower

VPN, Frame and Internet Backup

5.

OPC Database and Customer HMI
(With Redundancy)

Managed RTU

Integrated Hardware With Cell Radio and Digital/Analog I/O
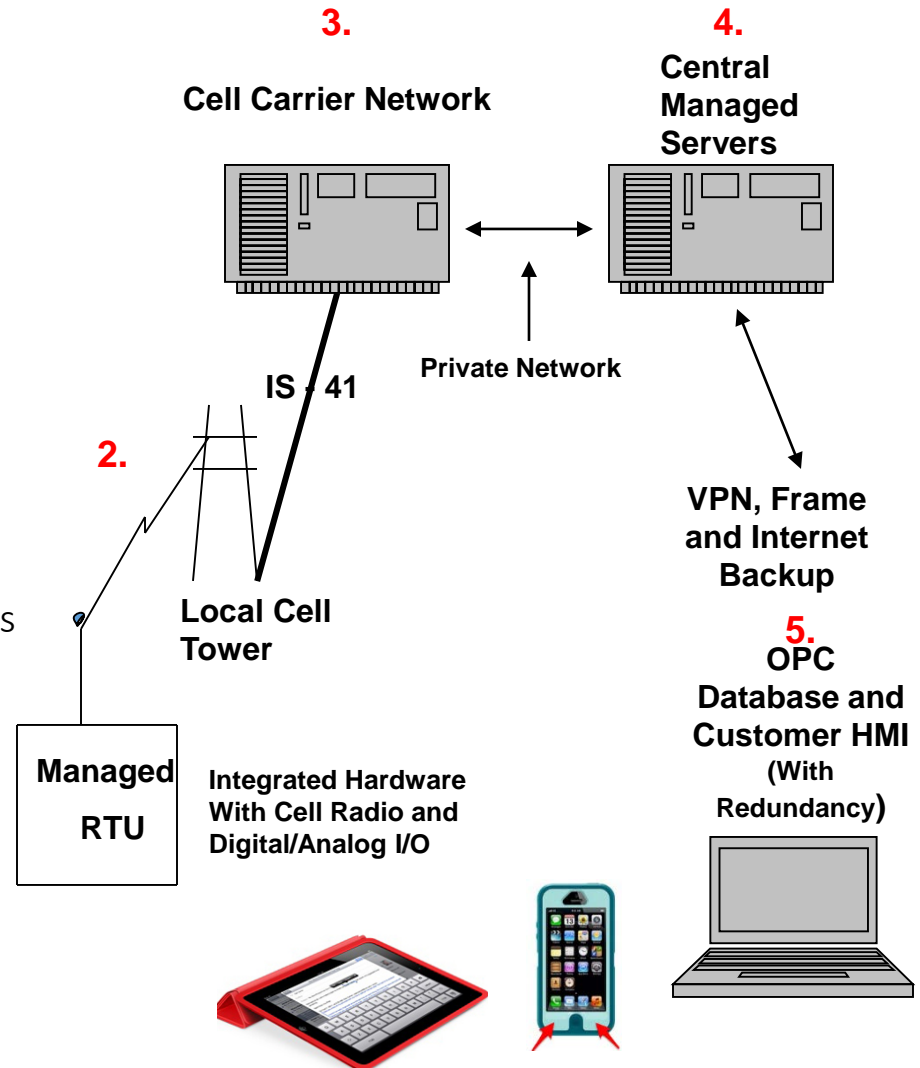
#5 Managed Cellular Data SCADA

- Pro's
  - Affordable
    - Distributed design and engineering
    - Minimal customization
    - Flat rate annual services and support contracts
  - Reliable
  - Shared infrastructure costs
  - Fast to ship and install, often installed by the operator
  - Access from any WEB enabled device
- Con's
  - Distributed design and engineering
  - Minimal customization
  - Technology too accessible, leads to uneven product performance
  - Limited control capability

#5 Managed Cellular Data SCADA

- Secret Weapons: Distributed design and engineering
  - Traditional SCADA systems are ala'carte and every feature and function carries a cost, average is about $1000 per applied point. Managed SCADA is typically 1/3 that cost per point Traditional modern SCADA resides on multiple Windows based PC's that require upgrades every 4-8 years.
  - Windows updates may drive replacement of otherwise non-obsolete hardware. Managed SCADA processing and data storage occurs on shared, secured service and main frames maintained by the supplier, data is accessed from any WEB enabled device.
  - All subscribers receive all updates and enhancements as part of the annual contract. Costs are shared across 1000's of units.

#6 Hybrid SCADA

- Best of both worlds!
  - Power for process control and customization possible with traditional SCADA
  - Affordable pre-engineered managed SCADA for redundancy and remote sites with limited or no control
  - Consolidated control room presentation using secure OPC/VPN connection to the MMI screens
  - Substantial potential savings
    - Major public water company standard PLC based pump station RTU $55,000 typically
    - Managed SCADA RTU with connectivity to plant SCADA essentially the same data and control ~$3,500
    - NOT identical, but close enough?

#6 Hybrid SCADA

Tuscaloosa Alabama

- 100+ Water and Waste Water Sites
- Original Quotes Were $6 million +
- CH2M Hill mixed managed cellular in at 35% of the sites and winning bid was approx. $4.5 million

#6 Hybrid SCADA

Why Data Cellular SCADA:

- Usability
  - Very Simple & Flexible

- Reliability
  - End To End Uptime: Can Be 99.7+%. Dependency by public safety agencies and lost billing revenue results fast repairs

- Cell carriers provide tower sites and maintenance, no tower rentals, construction or repeaters

#6 Hybrid SCADA

- Survivability
  - Proven In Hurricanes And Severe Storms
- Security
  - Meets AWWA & Homeland Security Standards with 128 bit encryption automatically. Leading "real time" units use secure socket connections the same as banks and ATM's

#6 Hybrid SCADA

Some New Ways It Can Help:

- Use it for:
  - Stand alone sites where this is all you need
  - Backup to existing SCADA sites using PC based alarm software
  - Fill-in for hard to reach or lower priority sites which might take an expensive tower and or repeater

Unit I
Water Plant Office
Computer H/S

WONDERWARE
HISTORIAN

PRIMARY
IO SERVER
DEVELOPMENT

STANDBY
IO SERVER
RUNTIME

ETHERNET PLANT NETWORK

SuddenLink DSL
Demarc Point

Critical Alarm
Mission M800
RTU

Plant
Secure
WiFi

iPad
w/Secure VPN Access

EVOQUA
PCP

Plant Laptop w/
Secure VPN Access

ETHERNET CONTROL NETWORK – FIBER RING

Unit A EPAC
Water Plant (Main Rack)
Redundant Processors
30 Minute UPS
Thin Net HMI

Unit F EPAC
Potable Water Booster PS
Thin Net HMI
30 Minute UPS

Unit G EPAC
Belt Press Building
Thin Net HMI
30 Minute UPS

Unit H EPAC
Pre-Sedimentation Basin
30 Minute UPS

Unit B EPAC
Clearwell Water Storage Tank
30 Minute UPS

SuddenLink DSL
Demarc Point

Midland PBS

Ethernet

Compressor
House

Copper Pairs

Generator
Building

Copper Pairs
RS- 485 Modbus RTU

Unit C EPAC
Raw Water Pump Station
Redundant Processors
EYCON-20 HMI
DSL Connectivity

Mission M800 RTU
Wireless Data Connection to
Mission Communications Server
User access to Mission Secure
Web Site
VPN/OPC data link to EPAC PC's

Booster Station
Demarcation Box

Unit D RTU
Leadsville Water Booster Station

Mission M800 RTU
Wireless Data Connection to
Mission Communications Server
User access to Mission Secure
Web Site
VPN/OPC data link to EPAC PC's

Booster Station
Demarcation Box

Unit E RTU
Bear Mountain Water Booster Station