SCADA

in

Water & Wastewater Systems

Scott Fausneaucht

PRO-TECH SYSTEMS GROUP

OTCO The Operator Training Committee of Ohio, Inc.

SCADA

What does it mean?

S Supervisory

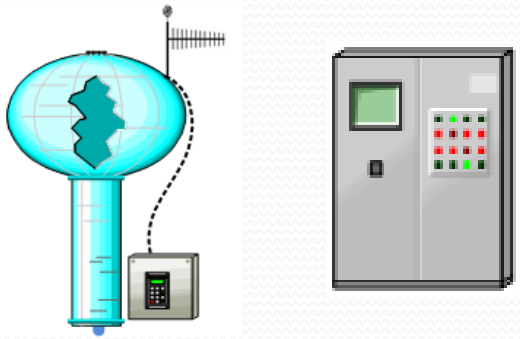
C Control

A And

D Data

A Acquisition

Three elements of a **SCADA** system…



- RTU – Remote Telemetry Units

- Communication Networks

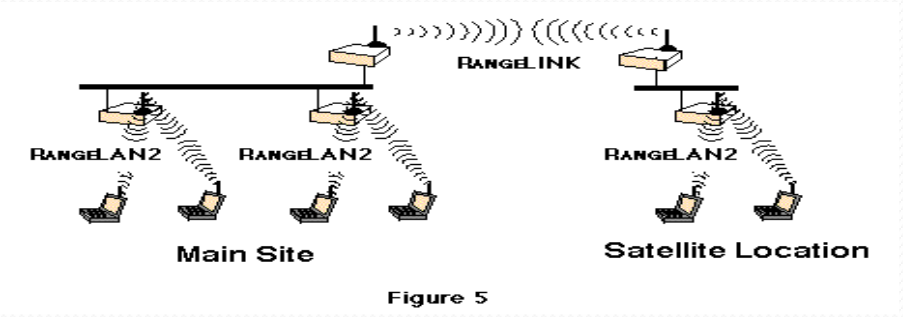
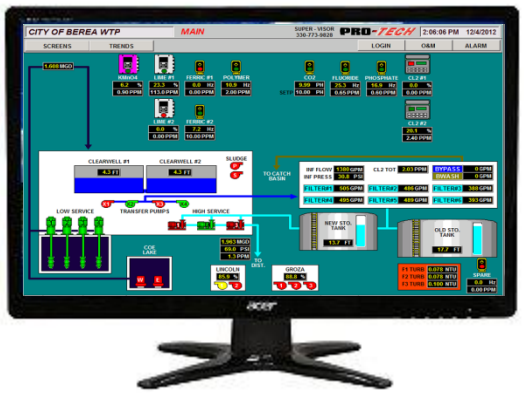
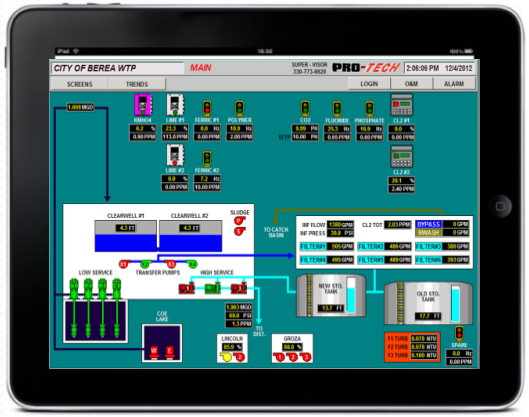
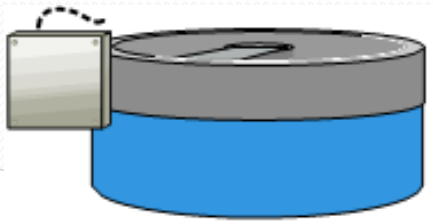


Figure 5



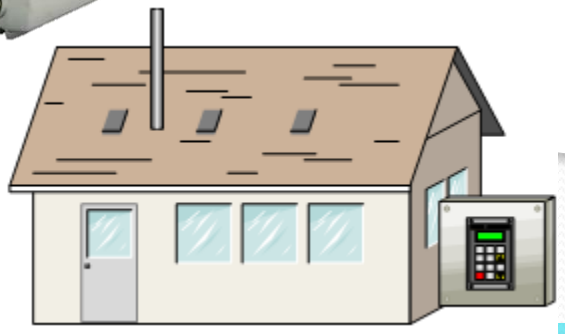
- OIT– Operator Interface Terminals

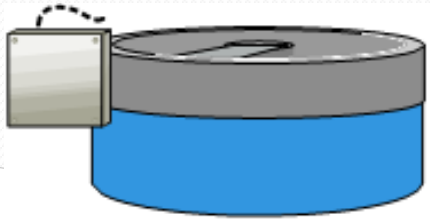


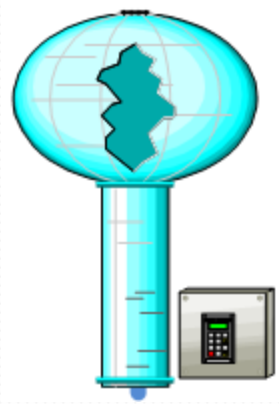


RTU – Remote Telemetry Units

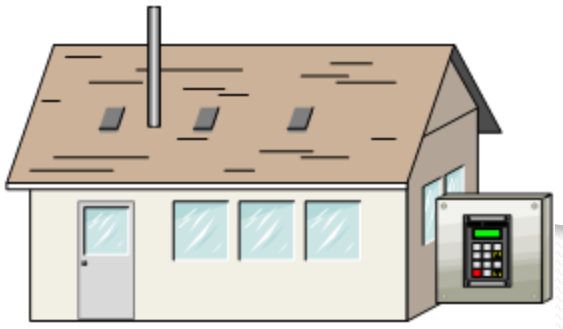
Collects Information at each remote site

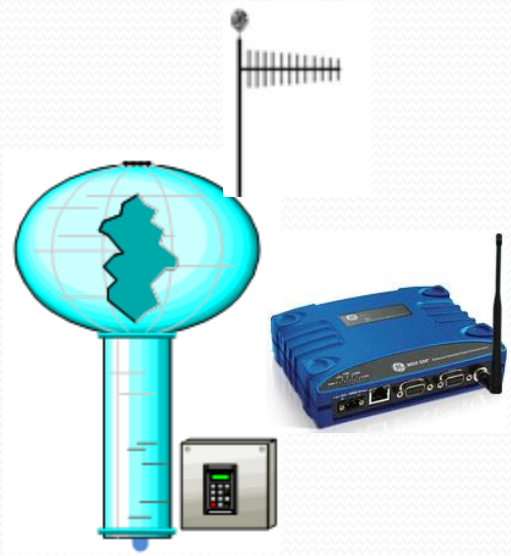


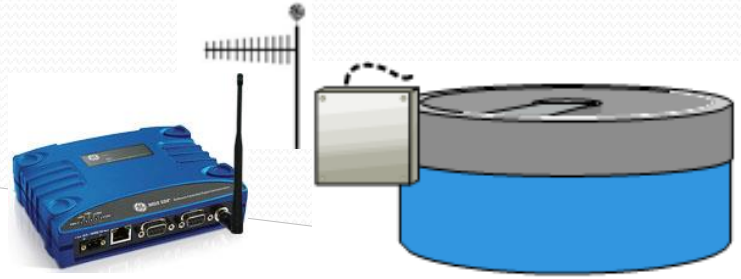




Communication Networks– Transmits information



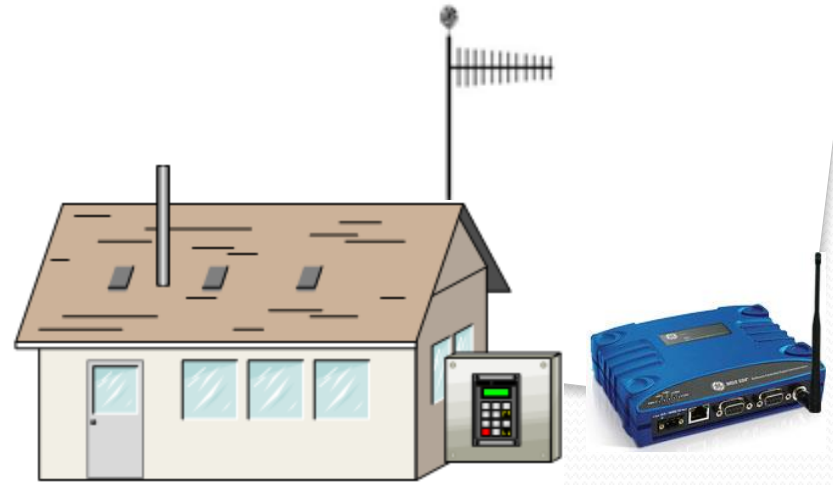




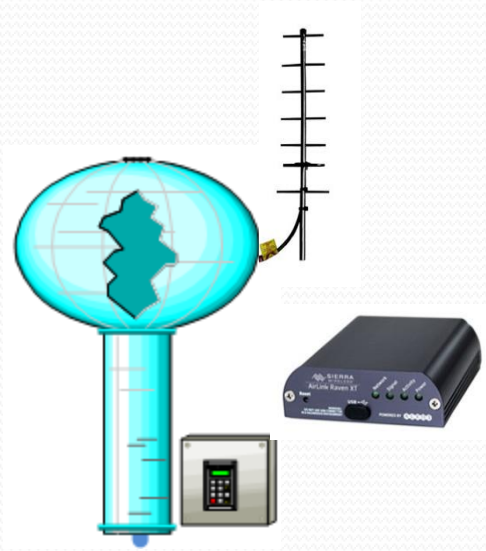
Communication Networks–
Transmits information

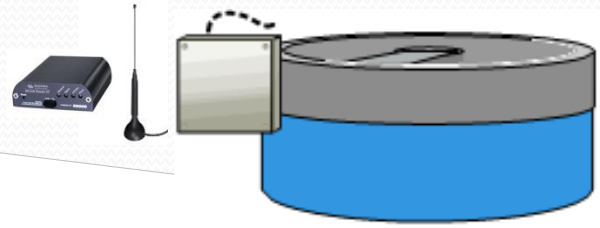
RADIO TELEMETRY

Licensed - Unlicensed



Spread Spectrum – Narrow Band

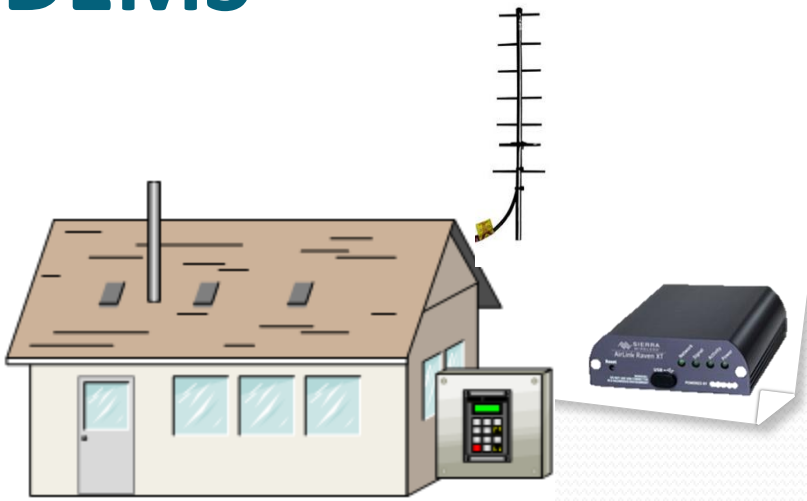




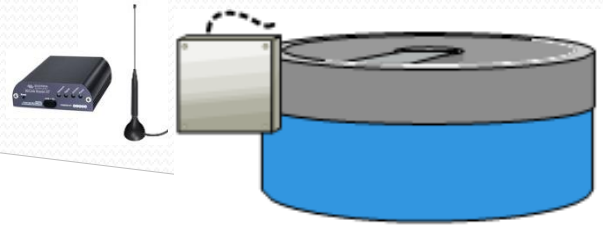
Communication Networks– Transmits information

CELL MODEMS

Very cost effective with small amounts of data



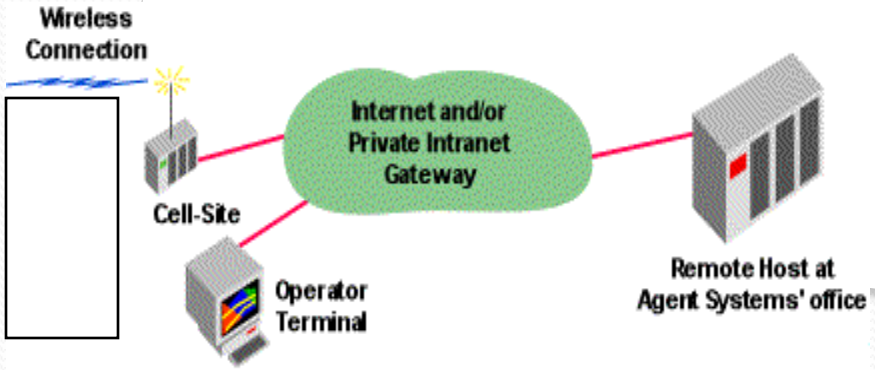
System is maintained by SP



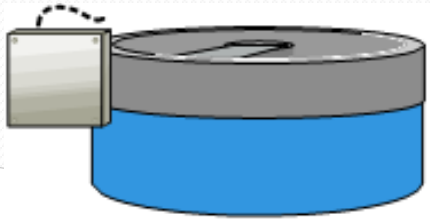
- Are an excellent backup
- Emergency as required
- Full Redundancy for critical assets
- Portability

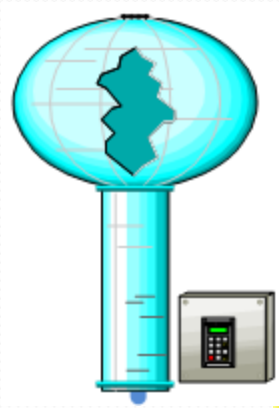
Communication Networks– Transmits information

CELL MODEMS



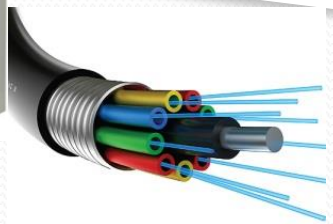
Can handle large amounts of data - Bandwidth

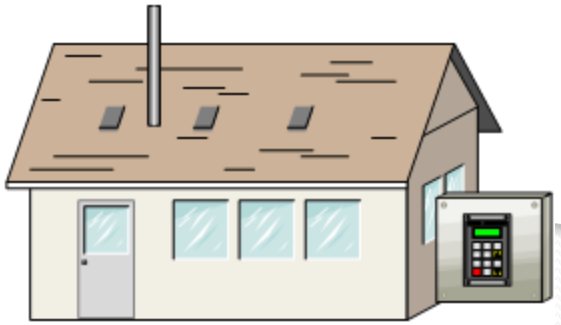


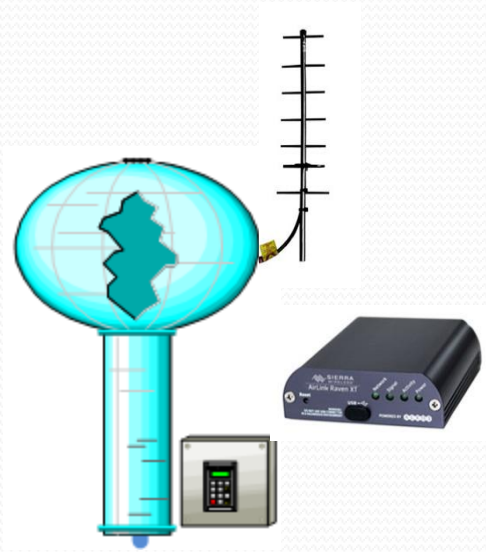


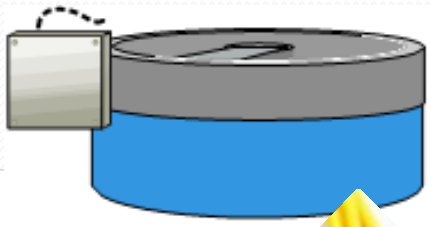
Communication Networks– Transmits information

FIBER OPTIC CABLE

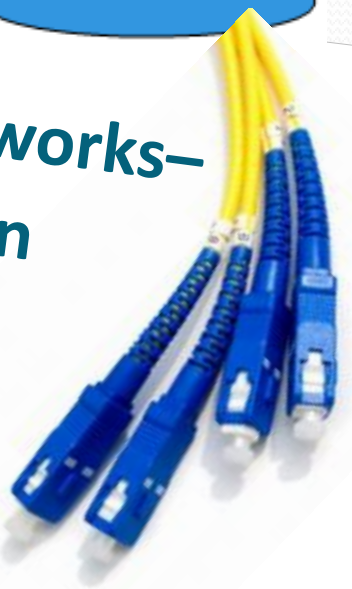




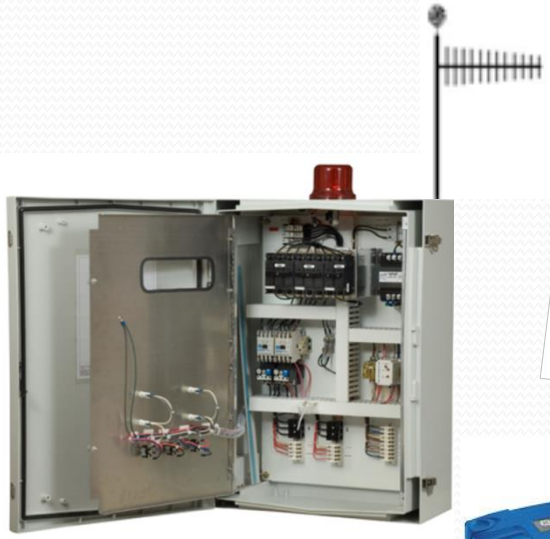


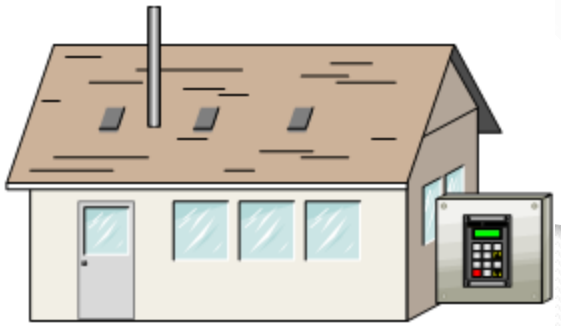


Communication Networks– Transmits information

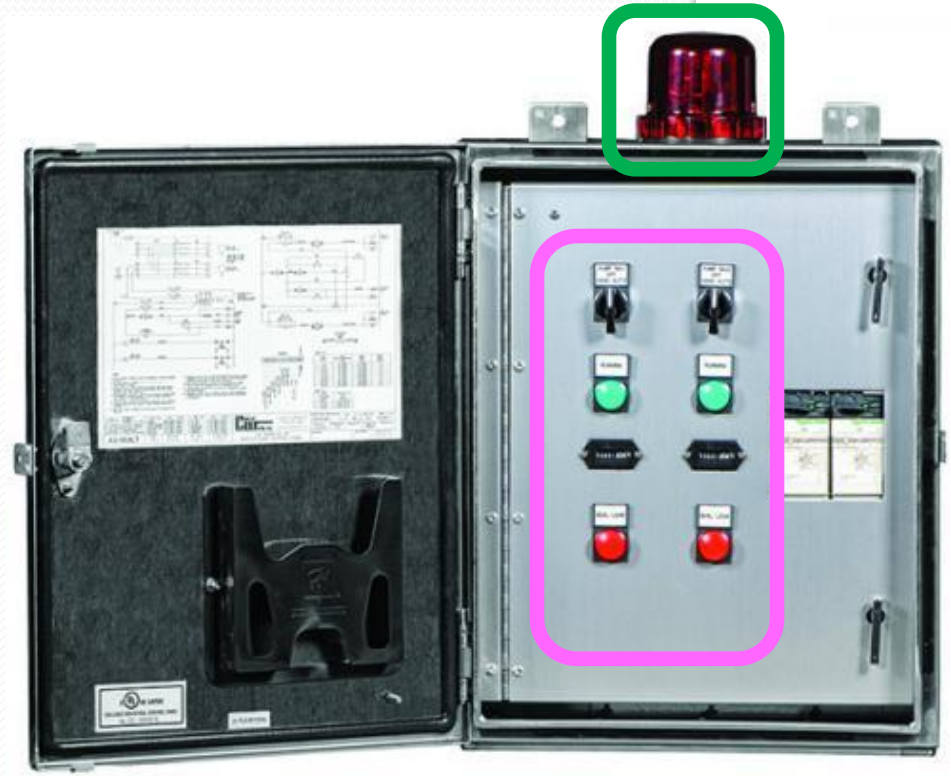


COMBINATIONS





RTU – Remote Telemetry Units
Typical Configuration

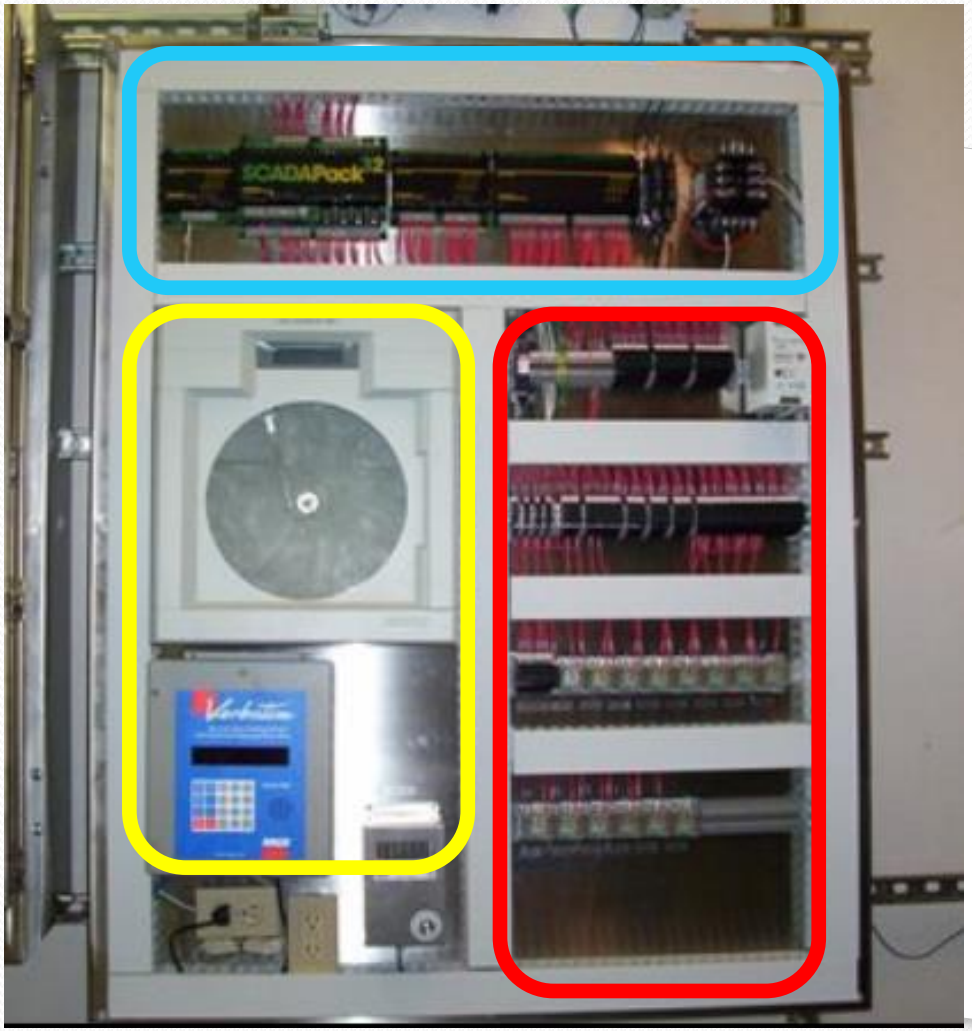


Alarming

Manual Interface

Field termination
Interface/power

Control



Control

PLC instead of
Alternating Relay
For more robust
operations

Field termination
Interface/power

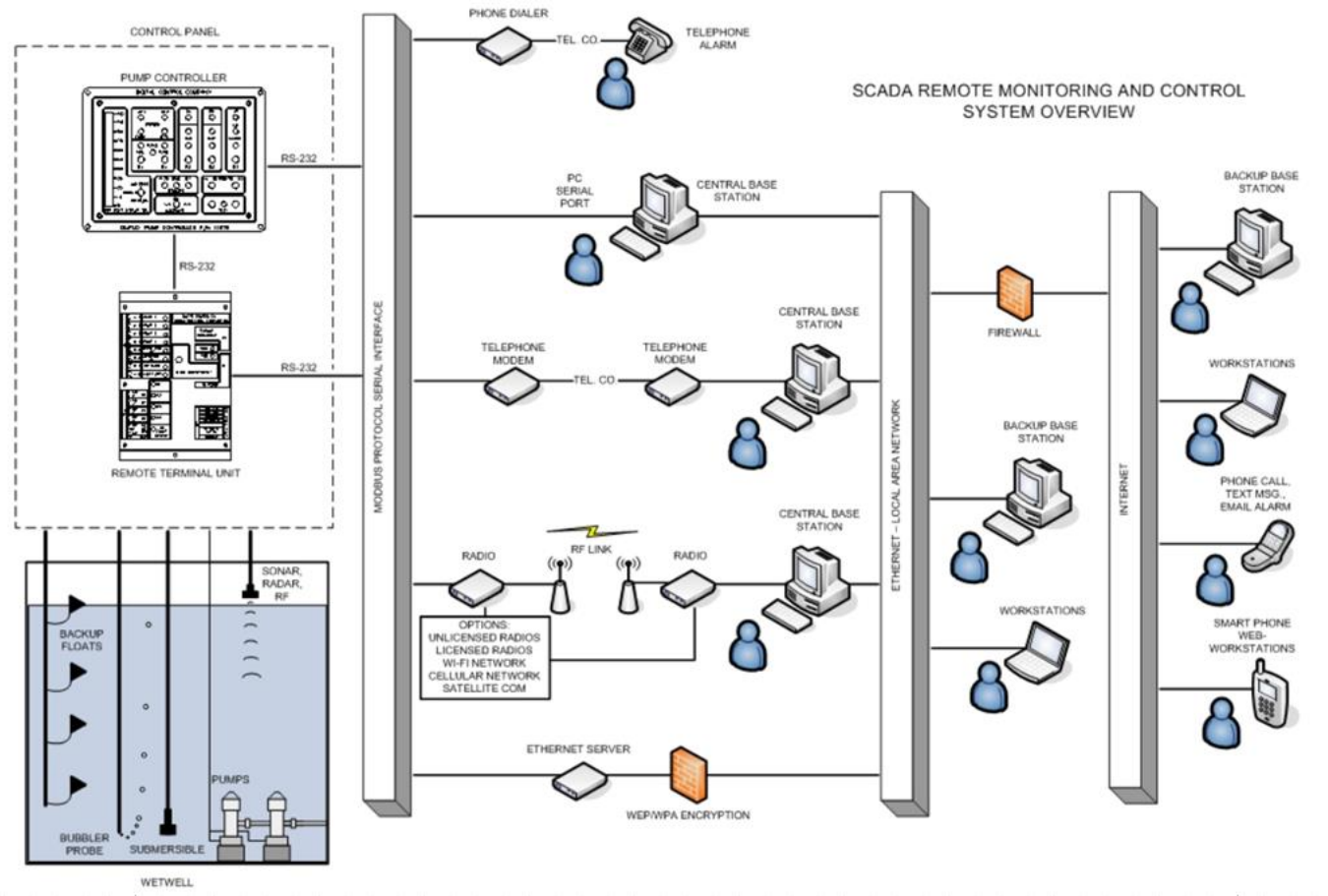
Pretty much the same

Data Acquisition/alarming

Chart recorder for history
Alarm dialer for remote alarming

Local operator interface added HMI - OIT

Then came SCADA



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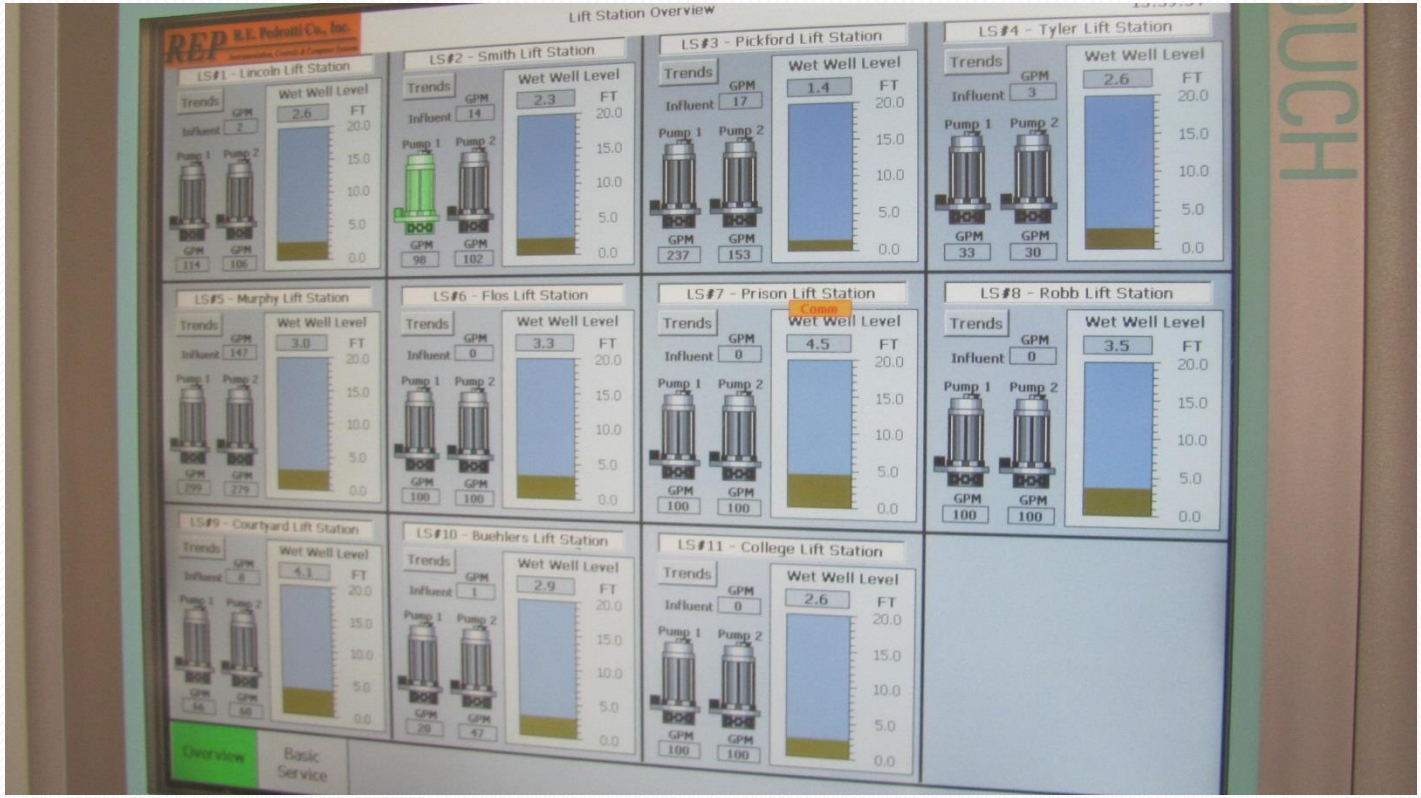


Then came SCADA

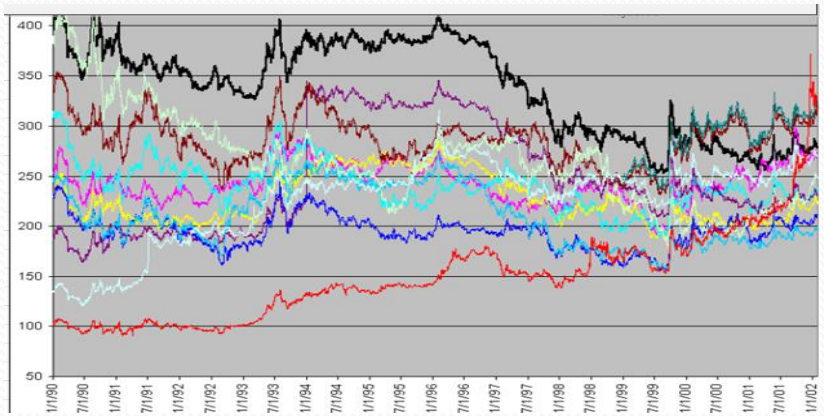
Then came SCADA

Then came SCADA

What to do with all that Data?

Now we have Data History:

- **ON/OFF Cycles Frequency & Duration**
- **Pump Motor Current Draw**
- **Continuous Level VS Float**
- **Flow**
- **Rainfall Affect**



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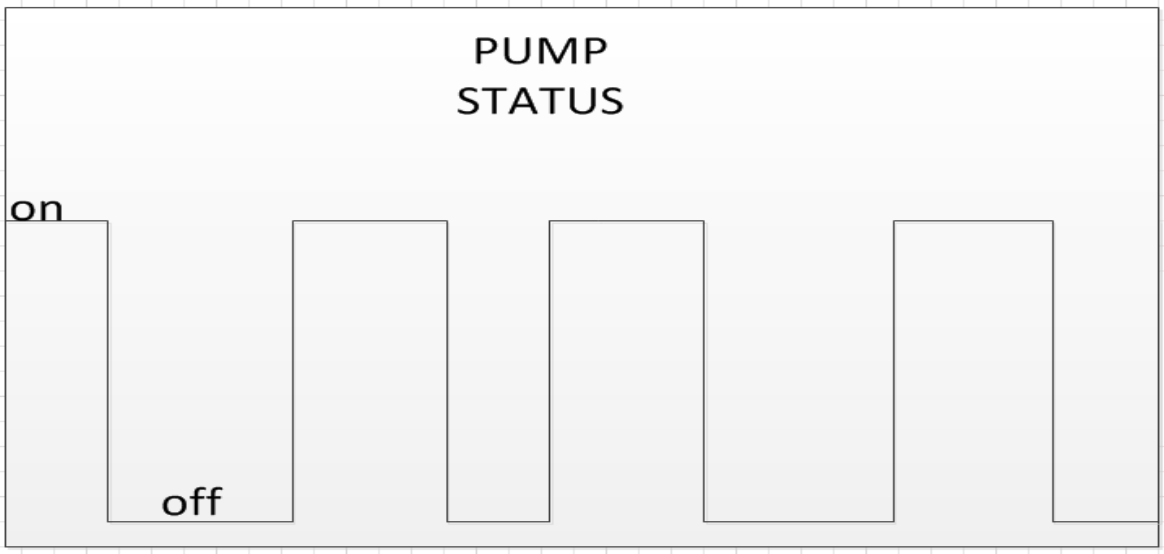


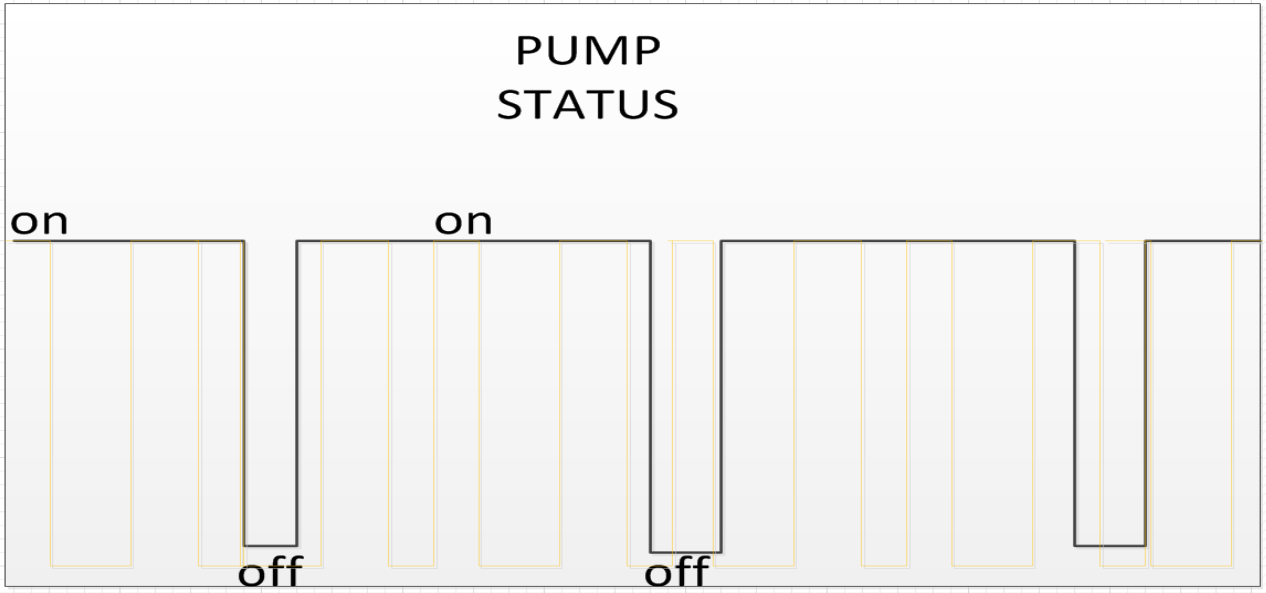
Then came SCADA

What to do with all that Data?

Now we have Data History:

- **ON/OFF Cycles Frequency & Duration**

Longer “ON” cycles and similar “OFF” cycles are an indicator of poor pump performance



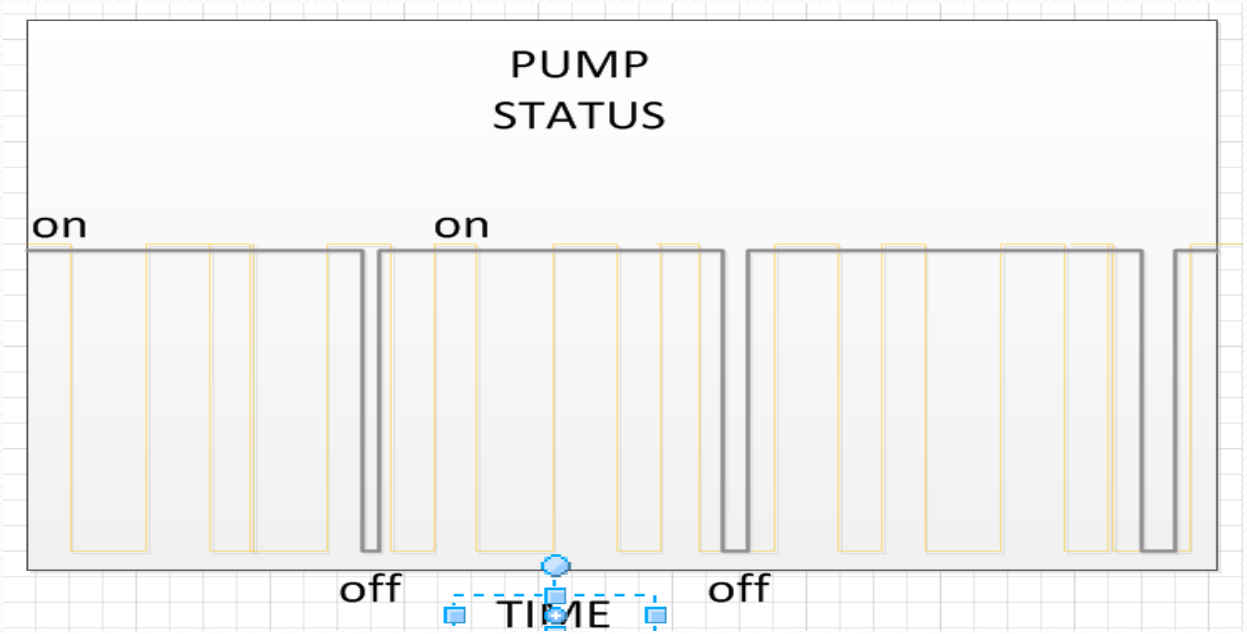
Then came SCADA

What to do with all that Data?

Now we have Data History:

- **ON/OFF Cycles Frequency & Duration**

Longer "ON" cycles and *shorter* "OFF" cycles are an indicator of higher influent flow



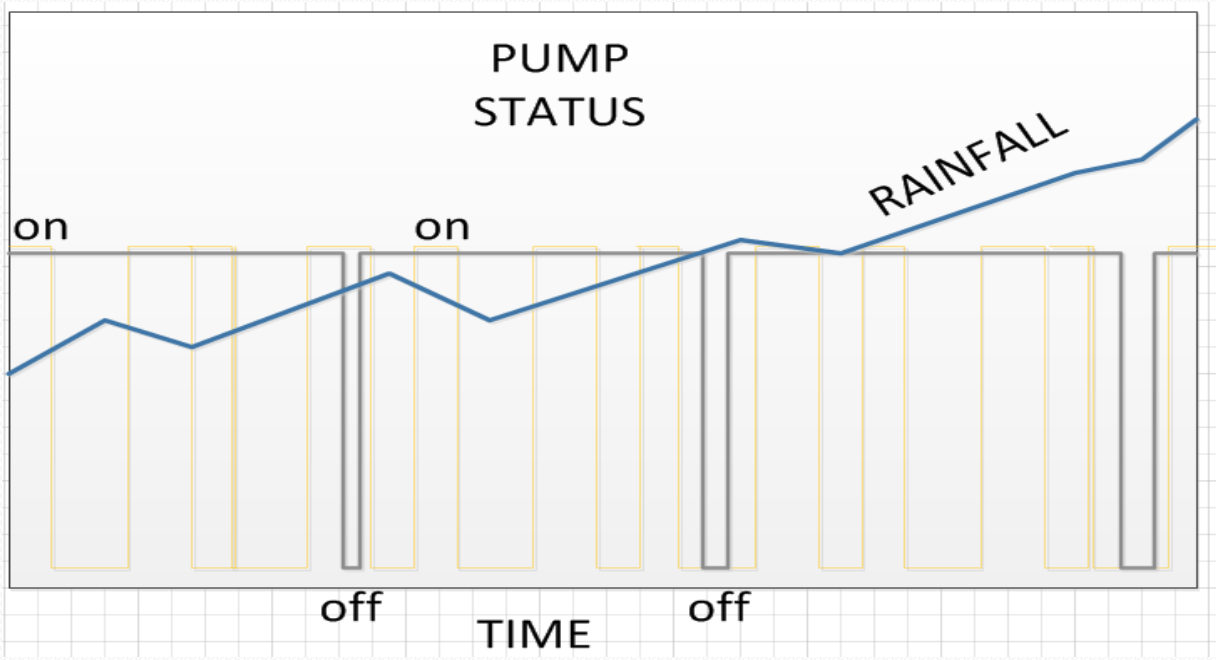
Then came SCADA

What to do with all that Data?

Now we have Data History:

- **ON/OFF Cycles Frequency & Duration**

Longer "ON" cycles and shorter "OFF" cycles are an indicator of higher influent flow. But compare to Rainfall – Possible Infiltration?



Then came SCADA

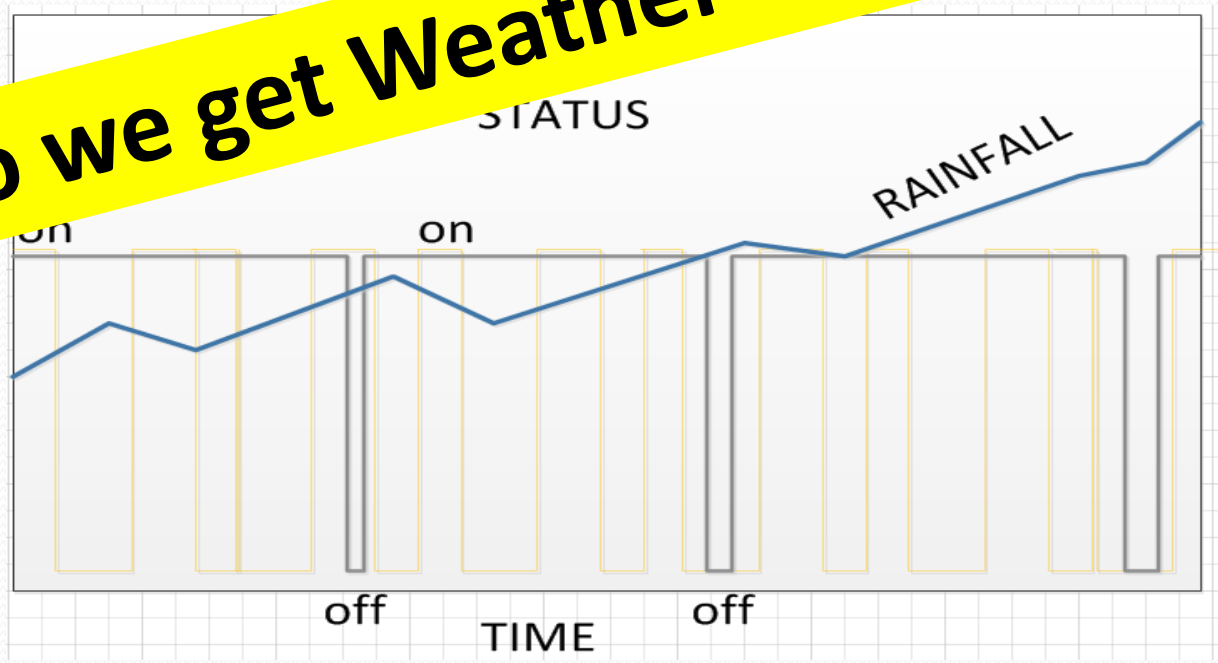
What to do with all that Data?

Now we have Data History:

- **ON/OFF Cycles Frequency & Duration**

Where do we get Weather Data???

Longer "ON" c
shorte
an indi gher
influent flow. But
compare to Rainfall –
Possible Infiltration?



Then came SCADA Weather Station

GRAINGER
FOR THE ONES WHO GET IT DONE

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PRODUCTS | RESOURCES | SERVICES | WORLDWIDE | REPAIR PARTS | Enter keyword or part number

Test Instruments > Temperature and Humidity Measuring > Weather Stations

DAVIS INSTRUMENTS Wireless Weather Station, Basic

☆☆☆☆☆ | Write a Review | Read all Reviews | Read all Ask & Answer

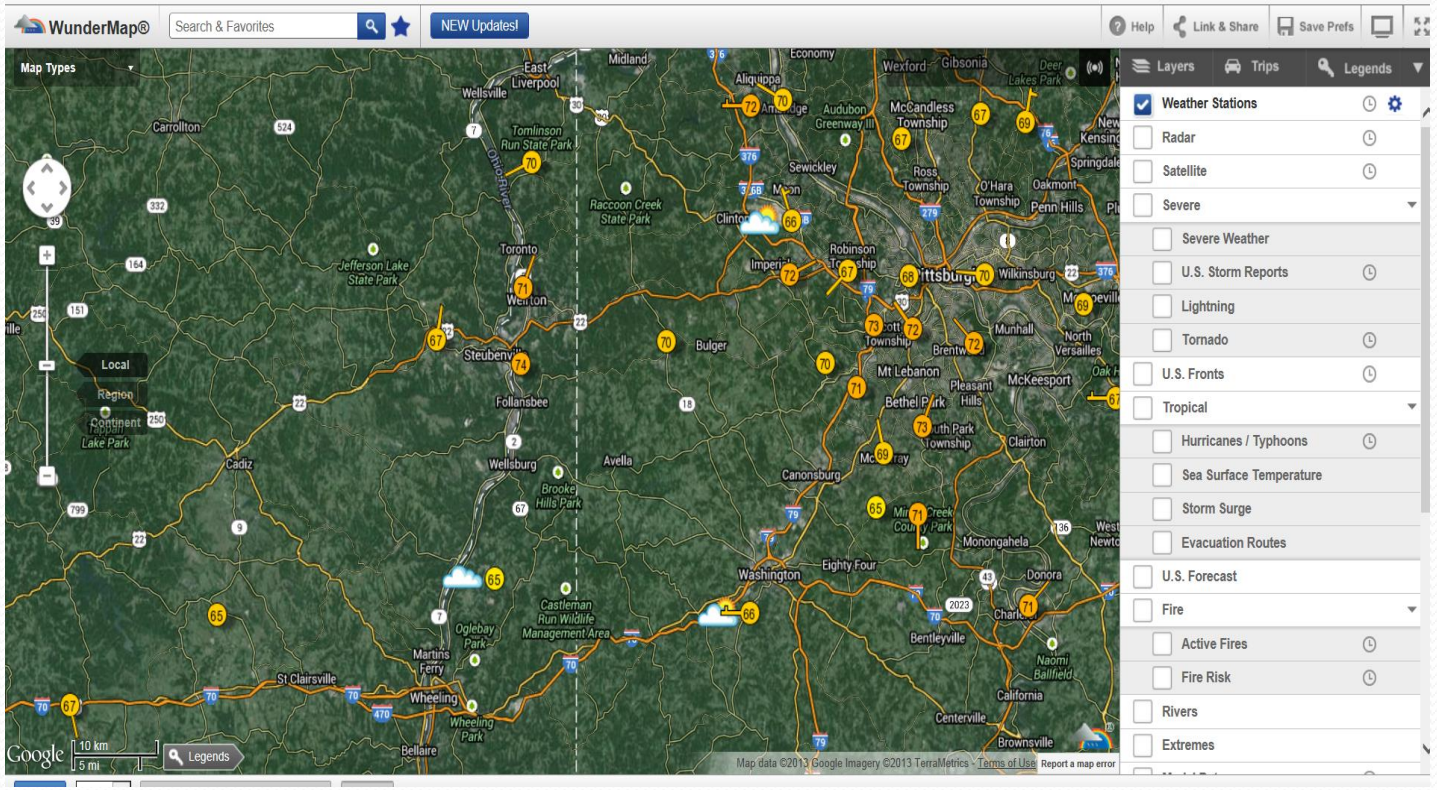
Share This Product

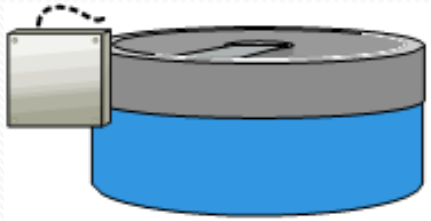
Wireless Weather Station, Indoor 32 to 140 Degrees , Outdoor -40 to 150 Degrees Temp. Range (F), Relative Humidity Range Indoor 10 to 90 Percent, Outdoor 0 to 100 Percent, Wind Velocity 2 to 180 mph, Rain Fall 0 to 99.99 In., accuracy +/-4 Percent, Special Features Onscreen Graphing, Indoor 0 to 60 Degrees , Outdoor -40 to 65 Degrees Temp. Range (C), Dew Point Yes, Wind Direction Yes, Wind Chill Yes, Heat Index Yes, Barometric Pressure 26 to 32 InHg (880 to 1080 mbar)Alarms Yes

Grainger Item #	4JRH4
Price (ea.)	**$700.00**
Brand	DAVIS INSTRUMENTS
Mfr. Model #	6152
UNSPSC #	41114410
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	13.0
Availability	**Typically in Stock**
Catalog Page No.	880
Country of Origin **(Country of Origin is subject to change.)**	USA

Enlarge Image

Then came SCADA Weather From the Internet



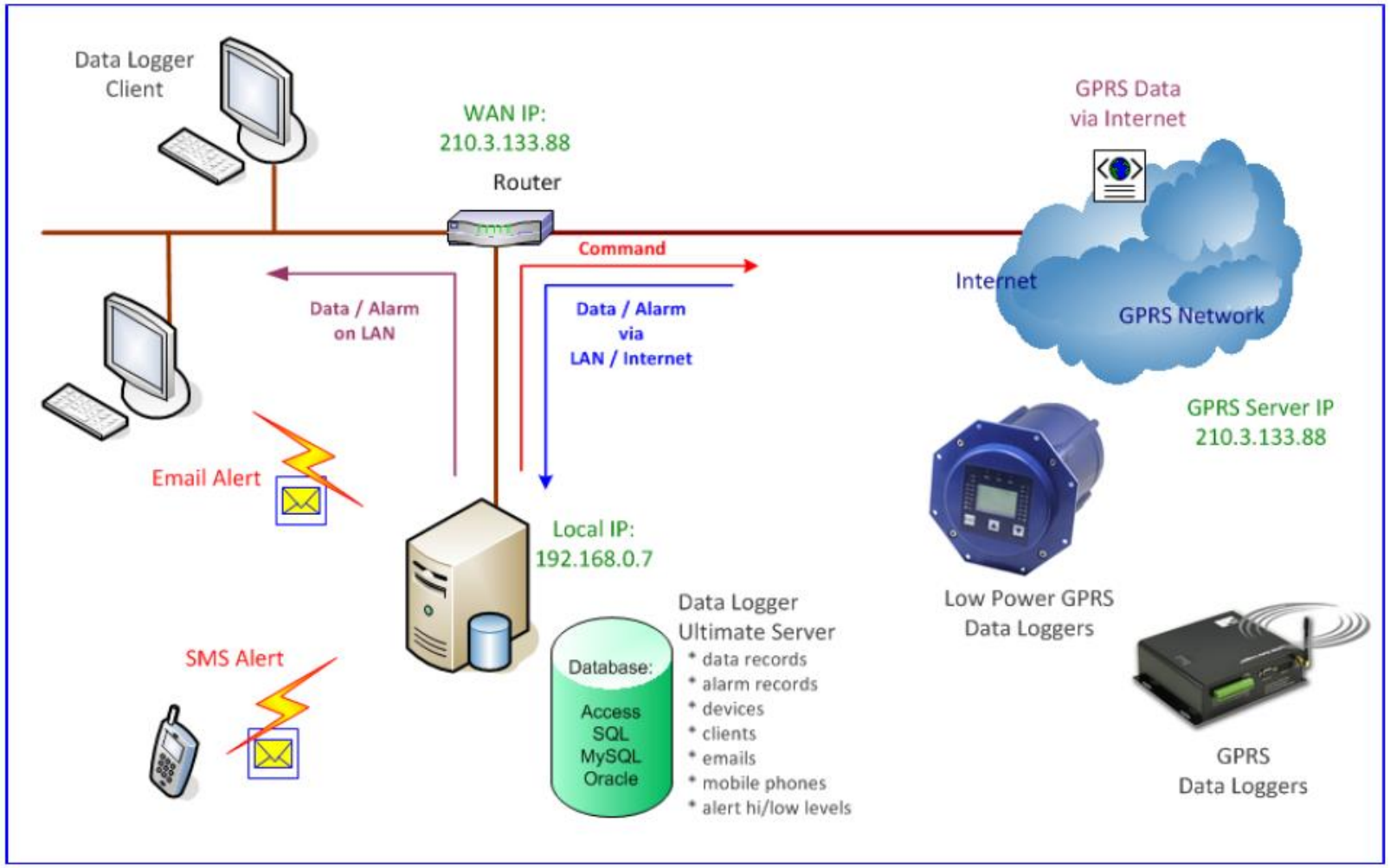


Another Type of RTU…

DATA LOGGERS

GPRS and SMS Data Logger

Primarily for Monitoring and Data Collection



Low Power Modbus GPRS Data Logger

GPRS – General Packet Radio Service

General Packet Radio Service is a packet-switching technology that enables data transfers through cellular networks. It is used for mobile internet, MMS and other data communications. In theory the speed limit of GPRS is 115 kbps, but in most networks it is around 35 kbps. Informally, GPRS is also called 2.5G.

Low Power Modbus GPRS Data Logger

SMS – Short Messaging Service

Short Messaging Service allows users to send and receive personal text messages directly between mobile phones or sometimes to email addresses. Each message can be up to 160 characters long (when using the default character set) and can be sent to and from users of different operator networks. All mobile phones support SMS.

Low Power Modbus GPRS Data Logger

- ✓ Low Power Data Logger supporting sleep mode
- ✓ Continuous operation for 5 years with internal battery
- ✓ Upload Data via GPRS and SMS on schedule
- ✓ Programmable data logging and upload interval
- ✓ Packet Data supports one time upload for multiple logged records
- ✓ Internal power for meters or sensors

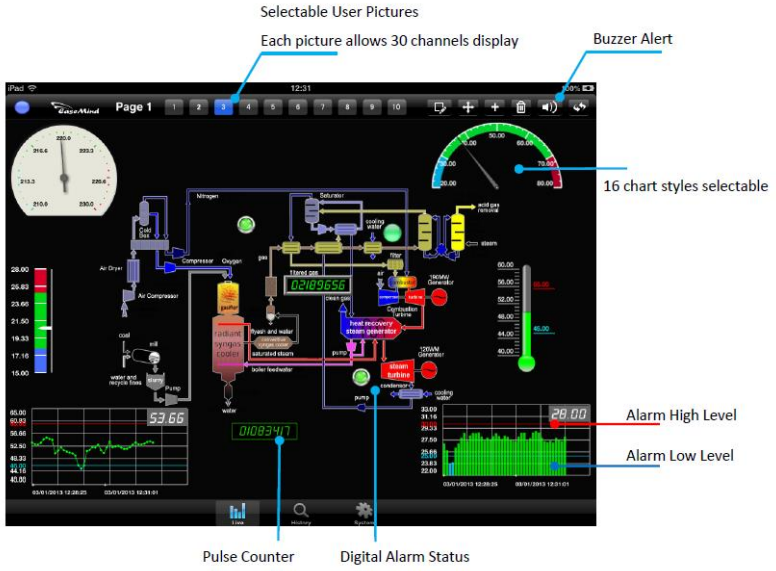
Low Power Modbus GPRS Data Logger Applications

- ✓ Water Meter Telemetry
- ✓ River / Reservoir Level Monitoring
- ✓ Water Pipeline Remote Monitoring
- ✓ Temperature
- ✓ Humidity
- ✓ (Your Imagination!!)

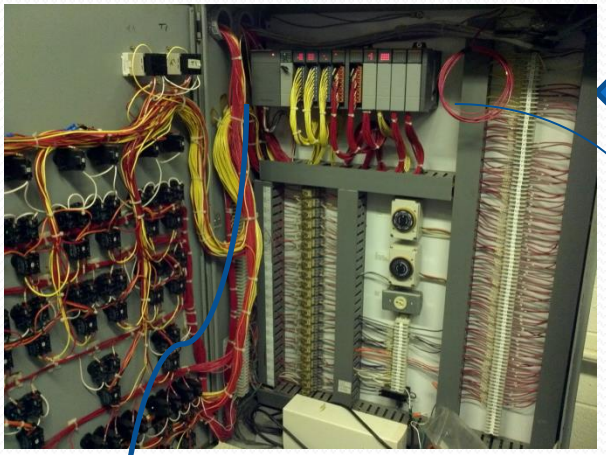
Client Software

* Same channel from 8 different data loggers

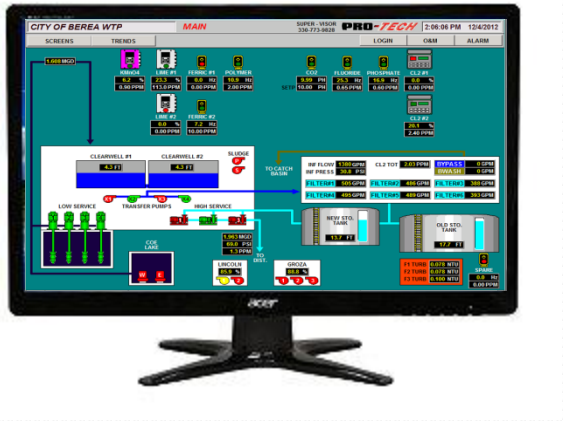
- ✓ Monitor a number of Data Loggers
- ✓ Alert users when readings are out of spec
- ✓ Alert staff with email or SMS
- ✓ Data trend review
- ✓ Web based



What's Changing in the Plant?



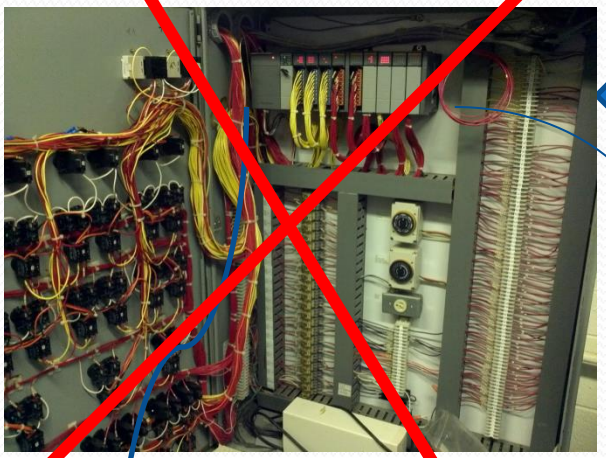
Conduit & Wire



- ✓ High Material Costs
- ✓ High Labor Costs
- ✓ Restricts Future Enhancements

The "Old Way"

What's Changing in the Plant?

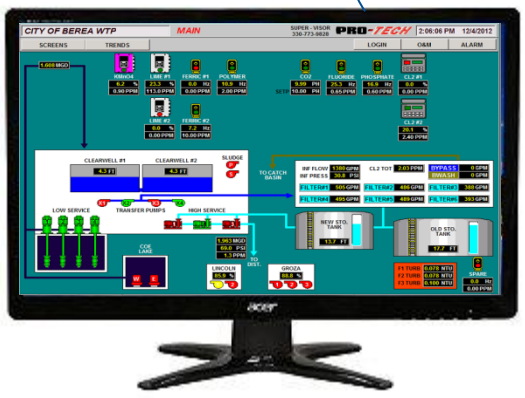


Conduit & Wire

- ✓ High Material Costs
- ✓ High Installation Labor Costs
- ✓ Restricts Future Enhancements

The "Old Way"

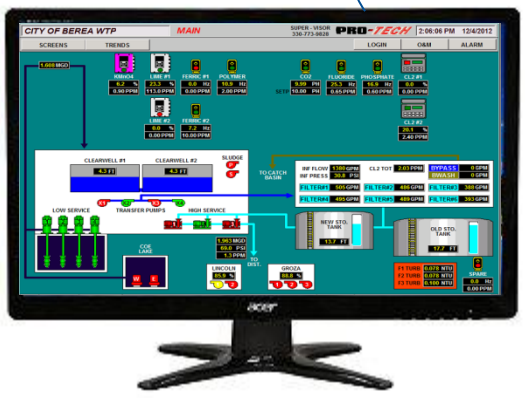
What's Changing in the Plant?



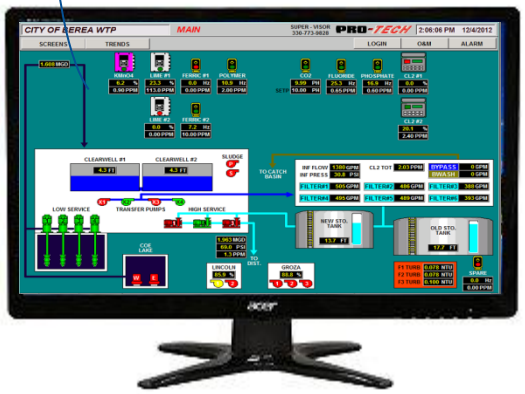
- ✓ Lower Material Costs
- ✓ Lower Installation Labor Costs
- ✓ Adapts to Future Enhancements

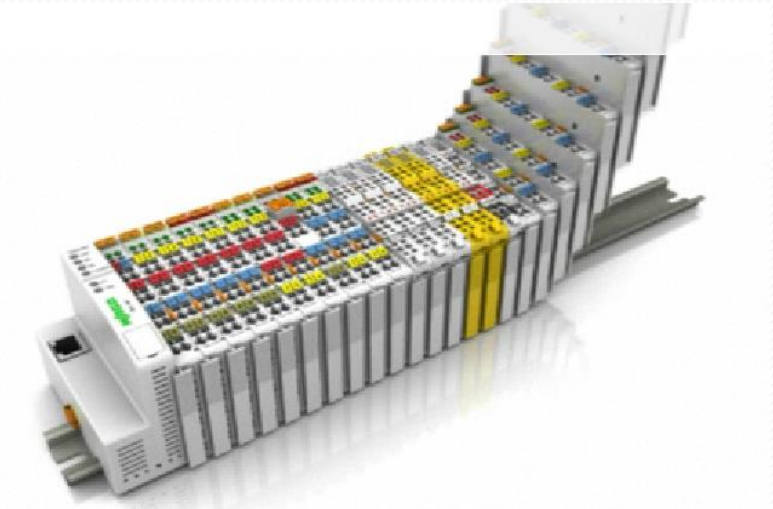
The "New Way" Distributed I/O

Add an iPad and Walk Around with an HMI



Connect to the Device Directly

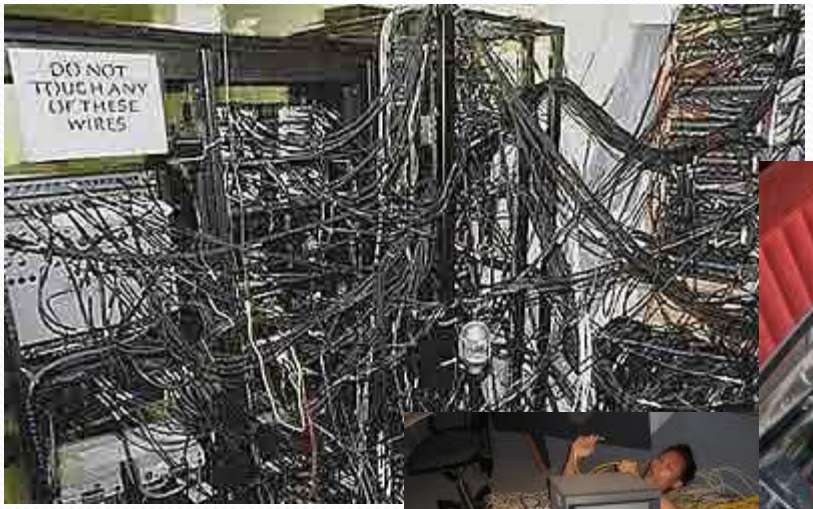




Connect to the Device Directly
No PLC Needed

This – Rather than…..

… This!!!



Smaller footprint – Direct wire terminations

PLC’s with Imbedded Web Pages

Remote Connections direct to imbedded web pages. No need for a PC.

DEALING WITH
MANUAL DATA

- What about the good old **LOGBOOK ????**

Op 10

DataView - Operator10® Wastewater - [~ WasteWater Sample Data - Plant Effluent Monthly]

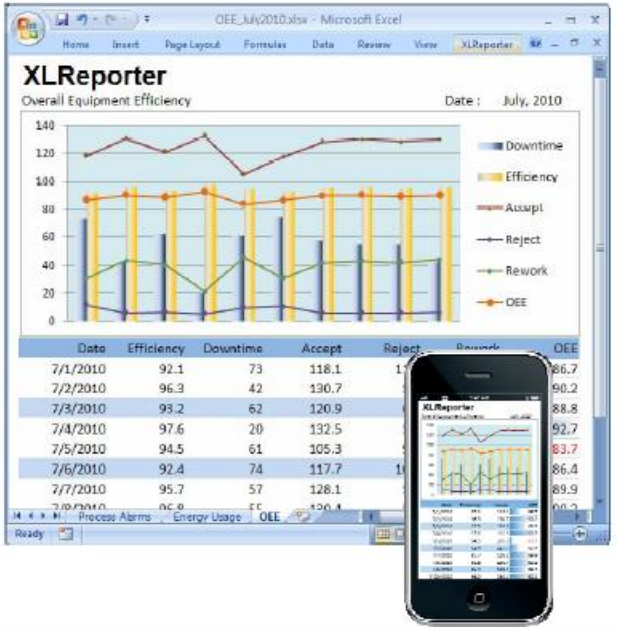
File Edit Window Help

<< Select Month >> GoTo January, 2020 - Refresh

Monthly	Plant Effluent Meter Number Daily	Plant Effluent Flow Mgd MGD Formula	Plant Effluent pH SU Hourly	Plant Effluent Temp Water C Degrees C Daily	Plant Effluent Diss Oxygen MG/L Daily	Plant Effluent BOD 5 MG/L Daily	Plant Effluent Solids TSS MG/L Daily
1 Wed	65878279	4.2690	7.5	7.5	6.00	2.30	
2 Thu	65878322	2.8110	7.5	8.2	6.80	3.20	
3 Fri	65878350	2.3900	7.4	8.5	10.10		
4 Sat	65878374	2.2300	7.7	9.3	5.40		
5 Sun	65878396	1.9300	7.6	10.0	8.40		
6 Mon	65878415	2.1000	7.4	11.5	9.50		
7 Tue	65878436	2.2000	7.4	11.3	8.50	2.20	
8 Wed	65878458	2.2200	7.7	10.2	10.50	2.60	
9 Thu	65878481	2.5900	7.4	10.3	10.70	2.60	
10 Fri	65878507	2.5900	7.1	10.5	10.00		
11 Sat	65878532	2.5300	7.4	9.5	10.20		
12 Sun	65878558	2.7800	7.5	9.8	9.40		
13 Mon	65878586	2.7300	7.6	9.4	8.50		
14 Tue	65878613	2.8400	7.4	9.8	9.50	3.29	
15 Wed	65878641	2.5200	7.9	9.7	8.70	2.50	
16 Thu	65878666	4.6200	7.9	10.1	8.80	2.25	
17 Fri	65878713	8.1400	7.4	10.5	7.90		
18 Sat	65878794	10.8200	8.1	10.4	9.80		
19 Sun	65878902	7.4400	8.2	10.3	9.80		
20 Mon	65878977	4.8700	7.9	10.7	9.60		
21 Tue	65879025	4.3700	7.4	10.5	10.20	3.10	3
Sum		123.9870	236.5	309.9	285.60	55.94	17
Avg		3.9996	7.6	10.0	9.21	4.00	1
Max		10.8200	8.2	11.5	10.70	11.50	6
Min		1.9300	7.1	7.5	5.40	2.20	
Count	31						

cnt=1; sum=65879336; avg=65879336; max=65879336; min=65879336; gmn=65879336; std=0

XL Reporter



WHY NOT MANAGE DATA INSTEAD OF JUST DEALING WITH IT?

LAB ANALYSIS REPORTS

Welcome **Elyria**!
[Log Out]

Home | Samples

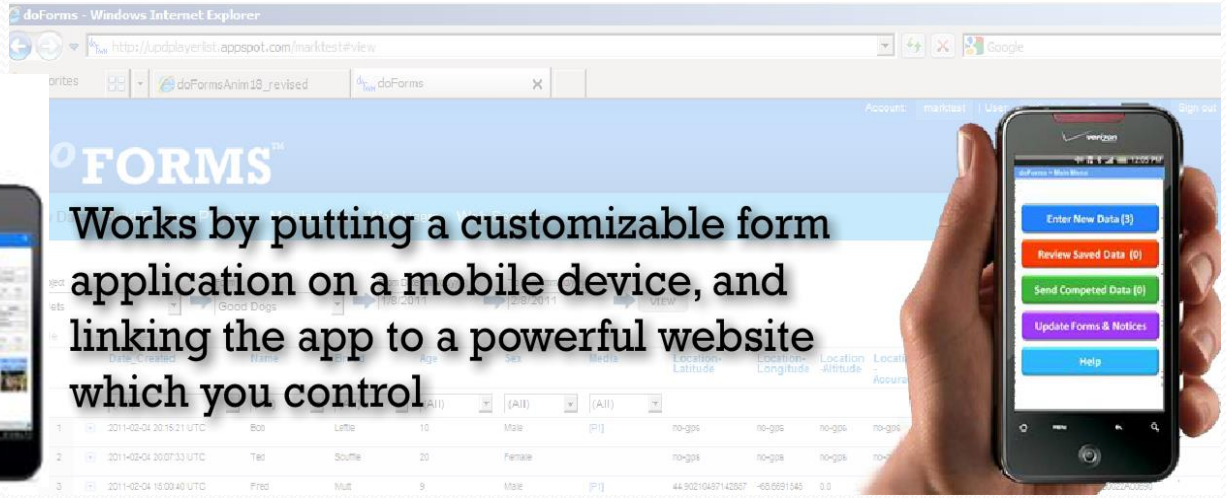
Export to Excel

Search Report: Elyria Report 1

Search Dates: This Week

Lab_ID	Date_Collected	Date_Incub	Time_Incub	Analyst	Sample_Location	Test_Method	CL2_Free	CL2_Total	Total_Coliform
848-84	23								
85-86	85-86	85-86	85-86	85-86	85-86	85-86	85-86	85-86	85-86
4-0868	4-0868	4-0868	4-0868	4-0868	4-0868	4-0868	4-0868	4-0868	4-0868
58658	58658	58658	58658	58658	58658	58658	58658	58658	58658
67675466894	67675466894	67675466894	67675466894	6.768E+10	67675466894	67675466894	67675466894	67675466894	67675466894
34892348	34892348	34892348	34892348	34892348	34892348	34892348	34892348	34892348	34892348
4465828-	4465828-	4465828-	4465828-	4465828-	4465828-	4465828-	4465828-	4465828-	4465828-
7590734057	7590734057	7590734057	7590734057	7.591E+09	7590734057	7590734057	7590734057	7590734057	7590734057
505490579	505490579	505490579	505490579	505490579	505490579	505490579	505490579	505490579	505490579
79079097	79079097	79079097	79079097	79079097	79079097	79079097	79079097	79079097	79079097
779788	779788	779788	779788	779788	779788	779788	779788	779788	779788

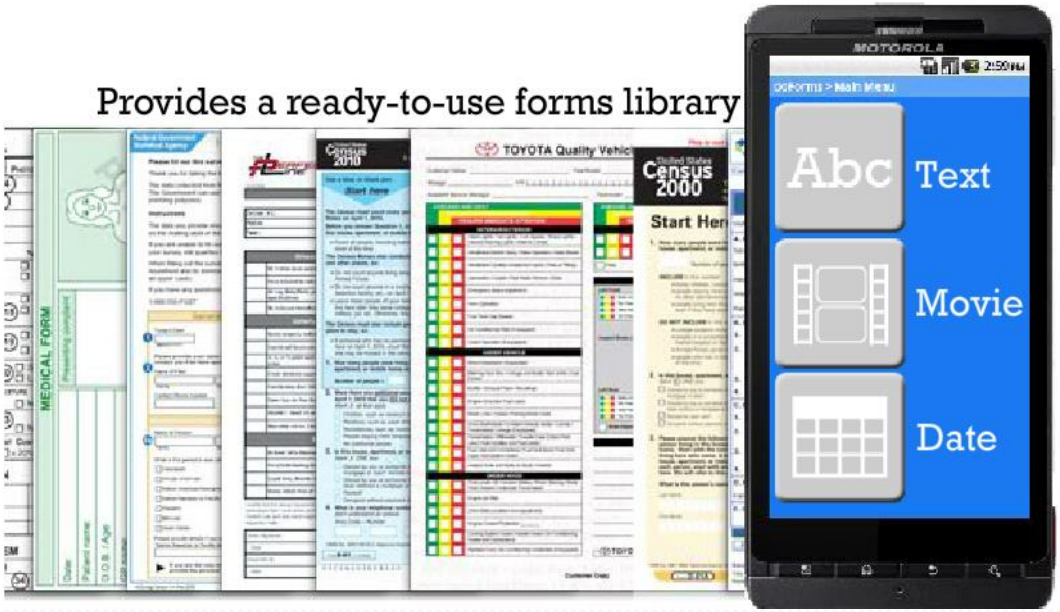
"Smart-forms" for smartphones and tablets

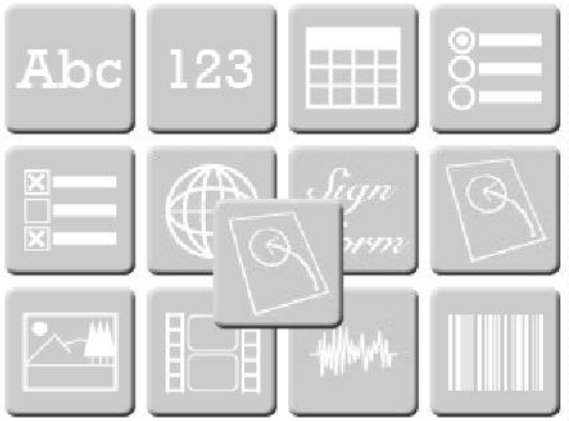


Works by putting a customizable form application on a mobile device, and linking the app to a powerful website which you control

"Smart-forms" for smartphones and tablets

Provides a ready-to-use forms library





Or easily create your own forms.

Use Your Existing Mobile Device Hardware

Android (OS version 2.1 and higher - models from Motorola, HTC, Samsung, Sony Ericsson, LG, Acer, Dell; Garmin)

Blackberry (OS version 5.0 and higher - all Bold, Curve, Tour, Storm, and Torch models)

iPhone - Available Soon

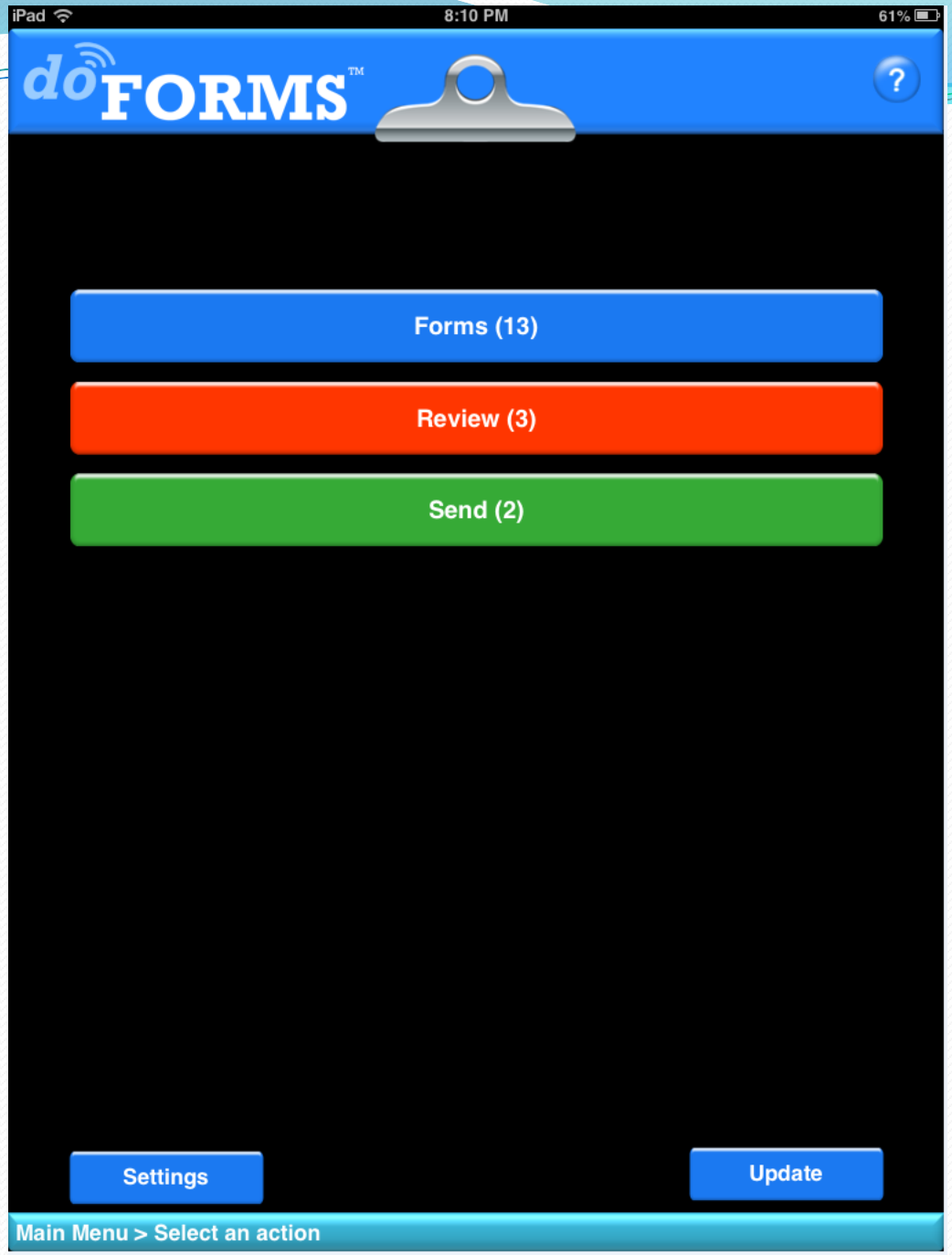
iPad - Available Soon

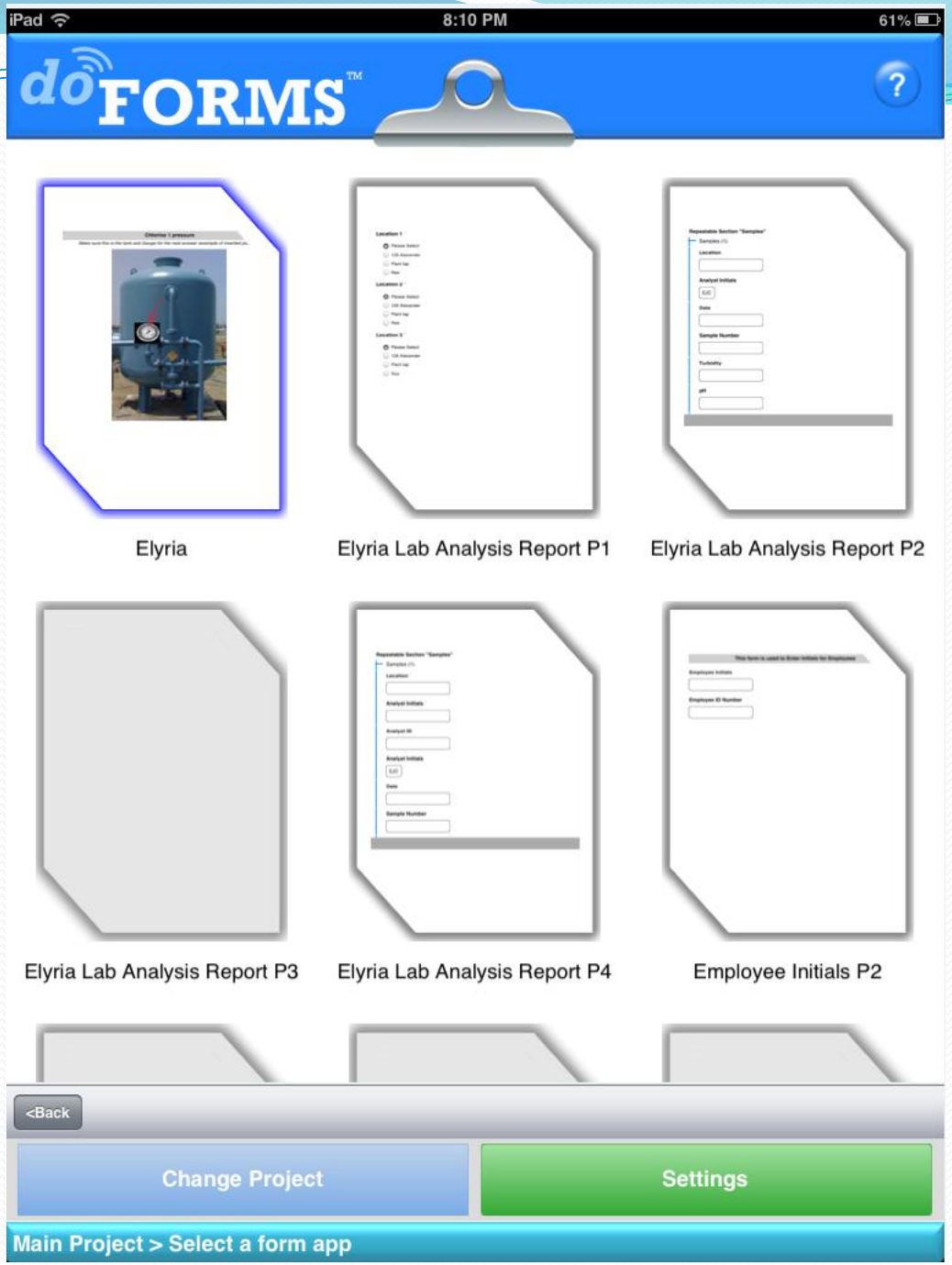
Use Mobile Forms in Both Connected or Disconnected Environments

Workers can still collect data when Internet connectivity is slow, unreliable or unavailable

Data are stored on the mobile device until Internet connection is available, then deleted after successful transmission

Use cellular, WiFi, satellite or wired Internet connections based on availability and cost


iPad
8:10 PM
61%
doFORMS™
?
Forms (13)
Review (3)
Send (2)
Settings
Update
Main Menu > Select an action


iPad
8:10 PM
61%
doFORMS™
Elyria
Elyria Lab Analysis Report P1
Elyria Lab Analysis Report P2
Elyria Lab Analysis Report P3
Elyria Lab Analysis Report P4
Employee Initials P2
<Back
Change Project
Settings
Main Project > Select a form app

iPad 8:11 PM 61%

doFORMS™

*Required

Furnace Street Tank

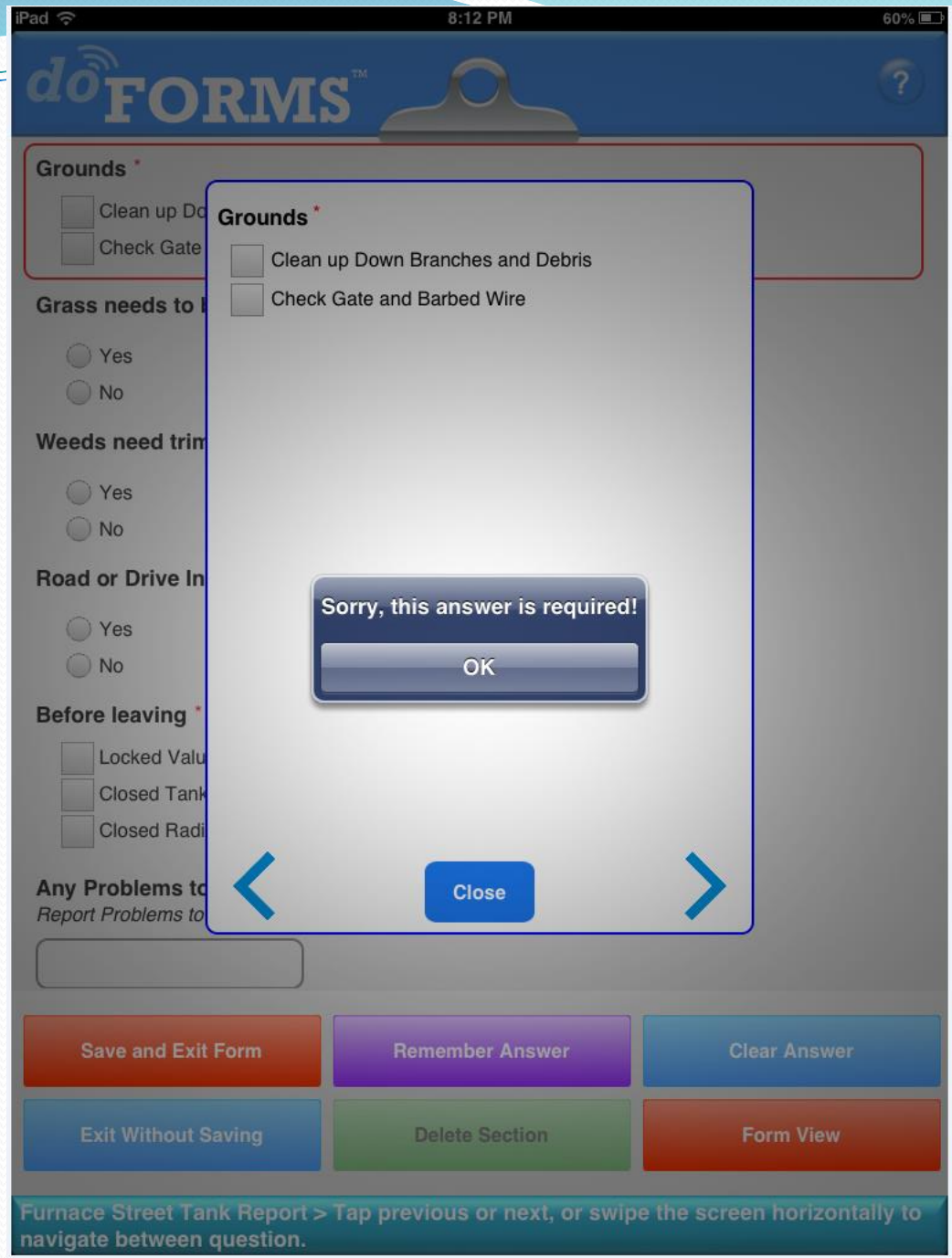
Have Cell phone and City radio on in Vehicle

Todays Date

Current Date and Time

Save as Incomplete | Save as Complete | Exit Without Saving

Furnace Street Tank Report > Swipe the screen vertically to navigate page, then tap on a question. Or swipe page horizontally to navigate between pages.


iPad
8:12 PM
60%
doFORMS™
Grounds *
Clean up Do
Check Gate
Grass needs to
Yes
No
Weeds need trim
Yes
No
Road or Drive In
Yes
No
Before leaving *
Locked Valu
Closed Tank
Closed Radi
Any Problems to
Report Problems to
Grounds *
Clean up Down Branches and Debris
Check Gate and Barbed Wire
Sorry, this answer is required!
OK
Close
Save and Exit Form
Remember Answer
Clear Answer
Exit Without Saving
Delete Section
Form View
Furnace Street Tank Report > Tap previous or next, or swipe the screen horizontally to navigate between question.

iPad 8:12 PM 60%

doFORMS™

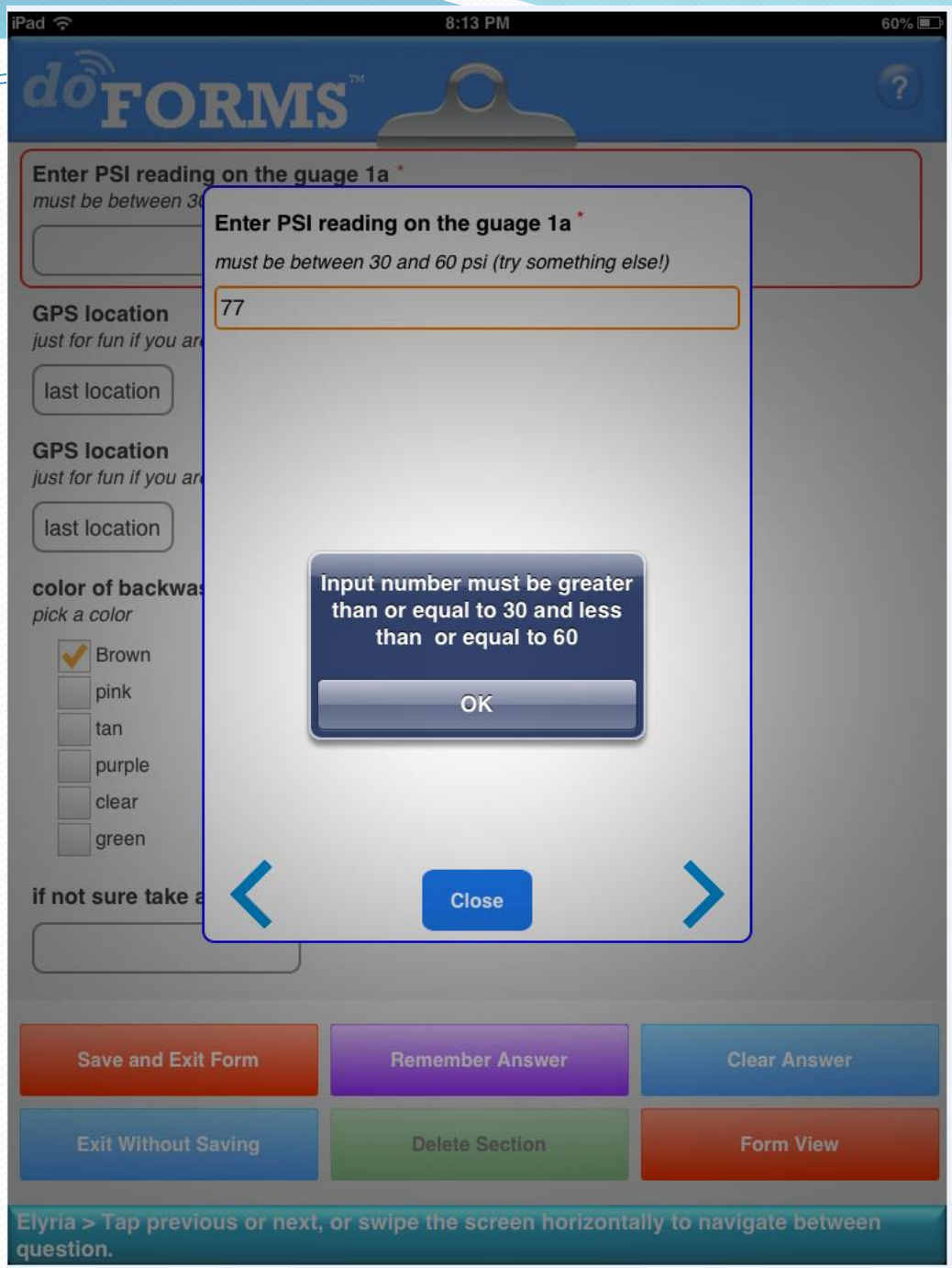
*Required

Chlorine 1 pressure

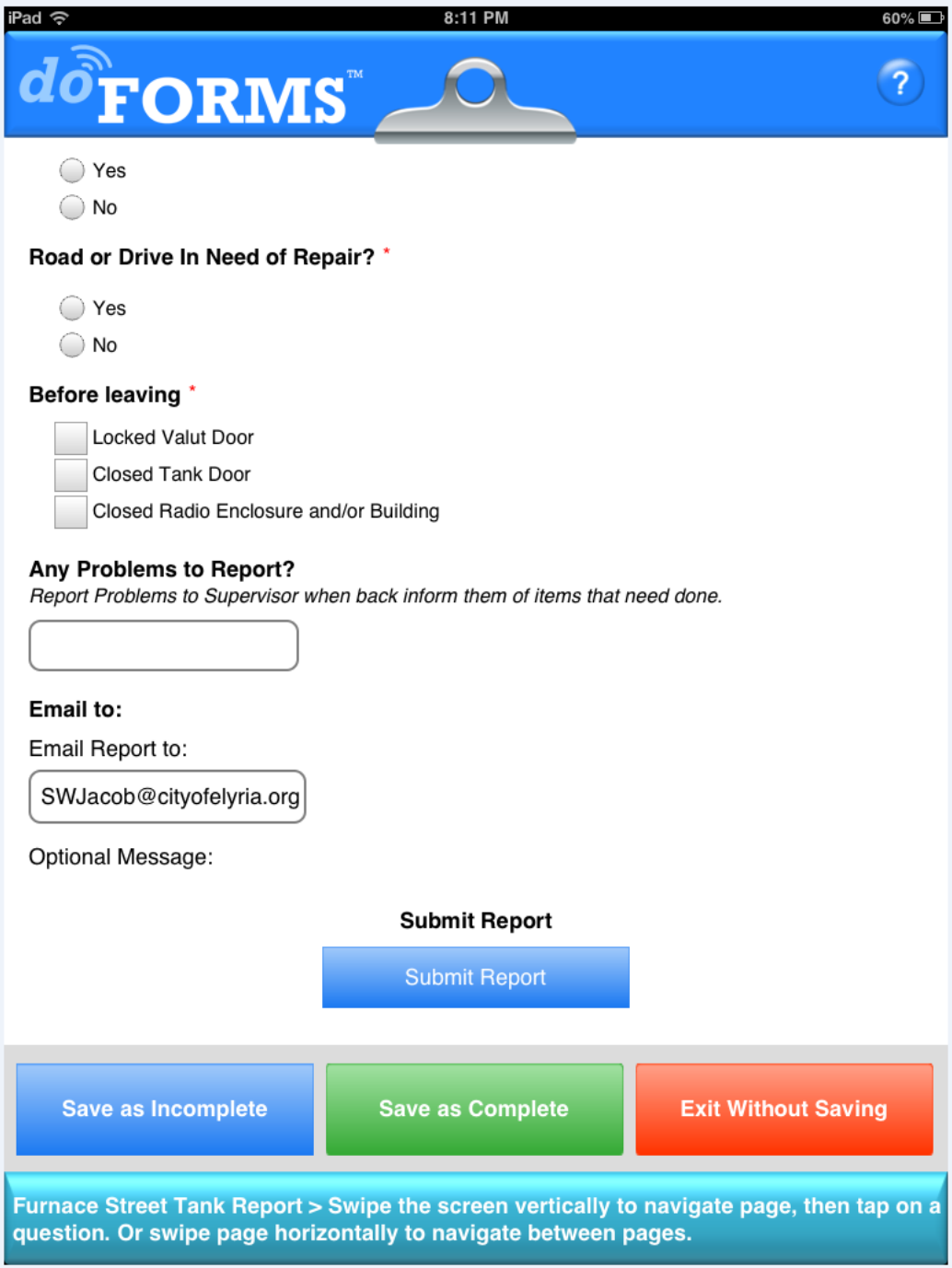
Make sure this is the tank and Gauge for the next answer (example of inserted pictures)

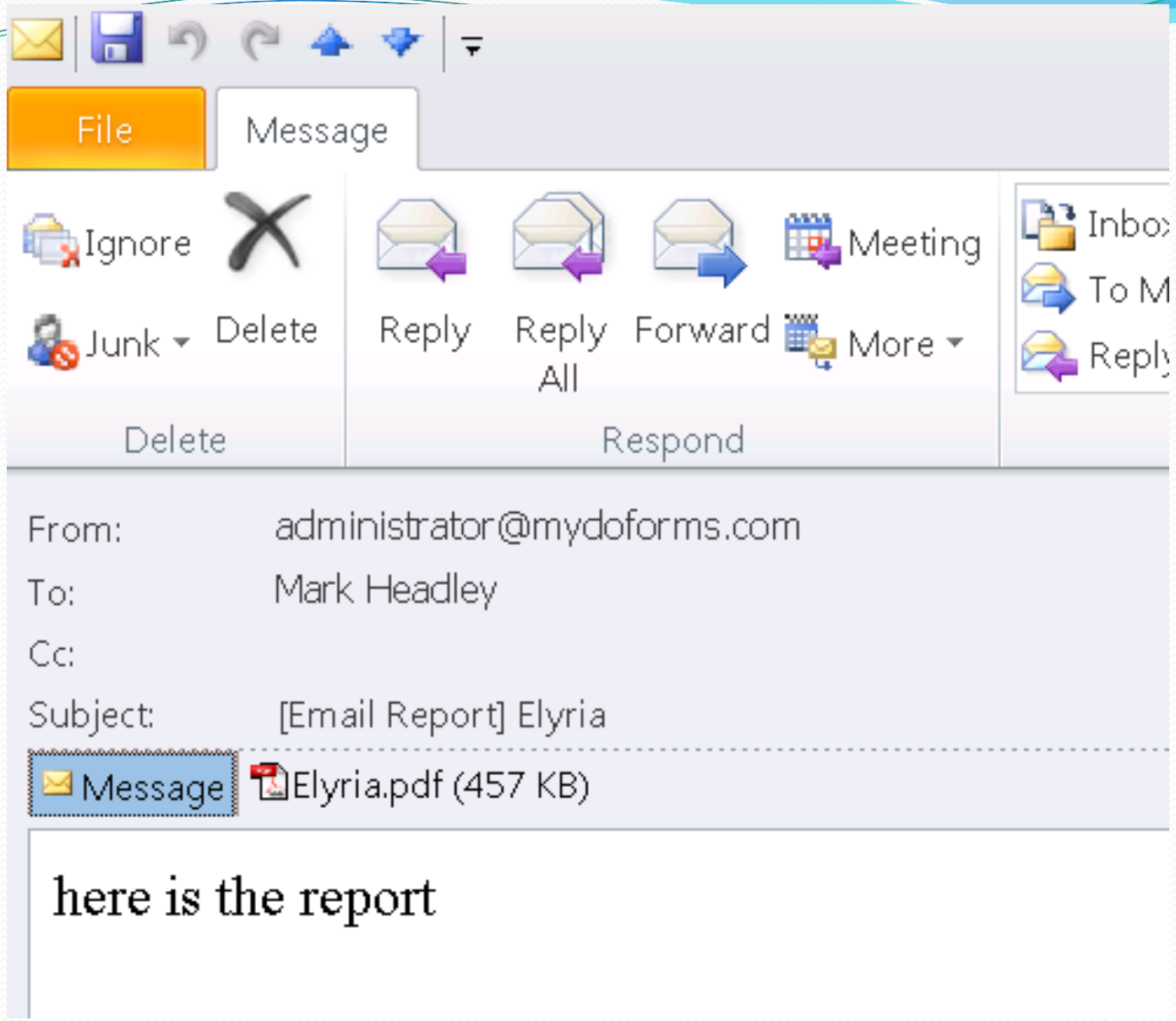
Save as Incomplete | Save as Complete | Exit Without Saving

Elyria > Swipe the screen vertically to navigate page, then tap on a question. Or swipe page horizontally to navigate between pages.


iPad
8:13 PM
60%
doFORMS
Enter PSI reading on the guage 1a *
must be between 30
GPS location
just for fun if you ar
last location
GPS location
just for fun if you ar
last location
color of backwa
pick a color
Brown
pink
tan
purple
clear
green
if not sure take a
Enter PSI reading on the guage 1a *
must be between 30 and 60 psi (try something else!)
77
Input number must be greater than or equal to 30 and less than or equal to 60
OK
Close
Save and Exit Form
Remember Answer
Clear Answer
Exit Without Saving
Delete Section
Form View
Elyria > Tap previous or next, or swipe the screen horizontally to navigate between question.

iPad
8:13 PM
60%
doFORMS™
Brown
pink
tan
purple
clear
green
if not sure take a pic
Capture Image
Sketch
Close
if not sure take a
please enter tim
look at your watch b
t time
Please email this
should email you th
Email Report to:
mark@pteinc.co
Optional Message
here is the repor
Save and Send t
just press the butto
Save and Send
Save and Exit Form
Remember Answer
Clear Answer
Exit Without Saving
Delete Section
Form View
Elyria > Tap previous or next, or swipe the screen horizontally to navigate between question.


iPad
8:11 PM
60%
doFORMS™
Yes
No
Road or Drive In Need of Repair? *
Yes
No
Before leaving *
Locked Valut Door
Closed Tank Door
Closed Radio Enclosure and/or Building
Any Problems to Report?
Report Problems to Supervisor when back inform them of items that need done.
Email to:
Email Report to:
SWJacob@cityofelyria.org
Optional Message:
Submit Report
Submit Report
Save as Incomplete
Save as Complete
Exit Without Saving
Furnace Street Tank Report > Swipe the screen vertically to navigate page, then tap on a question. Or swipe page horizontally to navigate between pages.


File
Message
Ignore
Junk
Delete
Reply
Reply All
Forward
Meeting
More
Delete
Respond
From: administrator@mydoforms.com
To: Mark Headley
Cc:
Subject: [Email Report] Elyria
Message
Elyria.pdf (457 KB)
here is the report

Elyria.pdf - Adobe Acrobat Pro Extended

File Edit View Document Comments Forms Tools Advanced Window Help

Create Combine Collaborate Secure Sign Forms Multimedia Comment

1 / 1 Find Sticky Note Text Edits

Chlorine 1 pressure

Make sure this is the tank and Gauge for the next answer (example of inserted pictures)

Enter PSI reading on the guage 1a: 44

must be between 30 and 60 psi (try something else!)

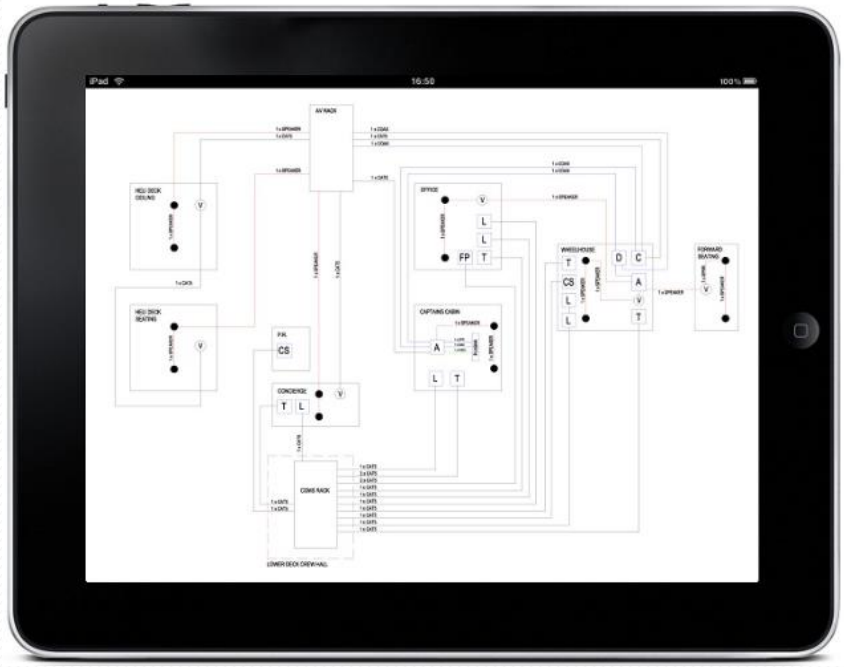
What are these markings called?

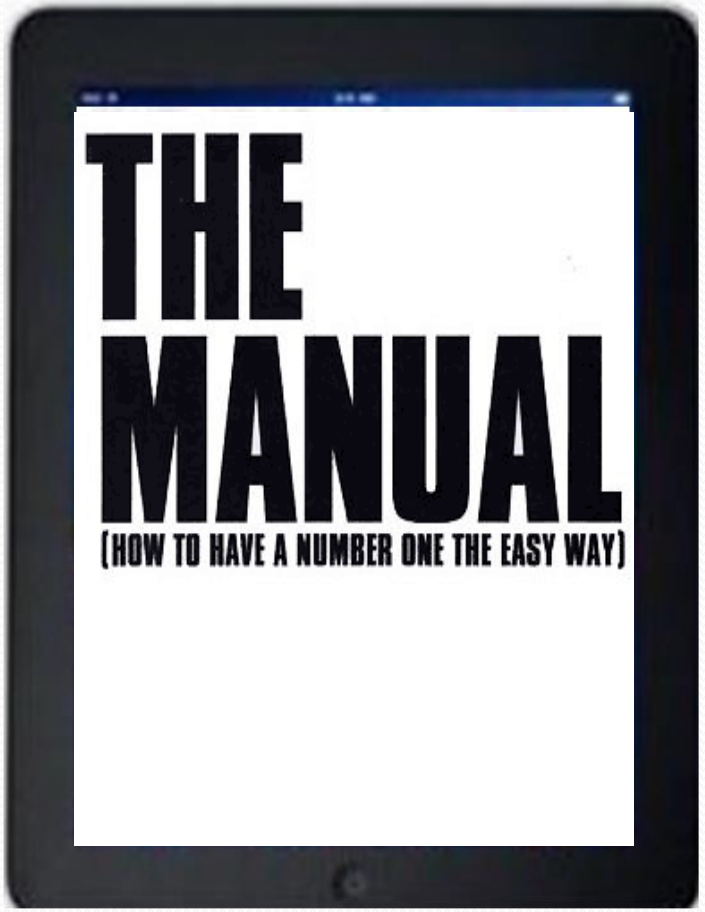
QR codes

Quick Response codes

Prompted data entry
Time Stamped
Photographic backup
Database Synchronizations

Start generating!


iPad
16:50
100%


THE
MANUAL
(HOW TO HAVE A NUMBER ONE THE EASY WAY)

2 way synchronization

INTERNET

Google Drive

Keep everything. Share anything.

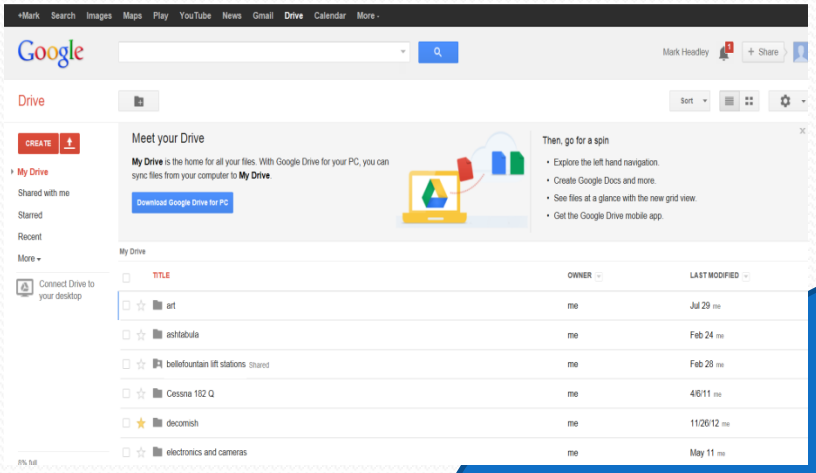
Find everything in Google Drive you've recently opened or edited.

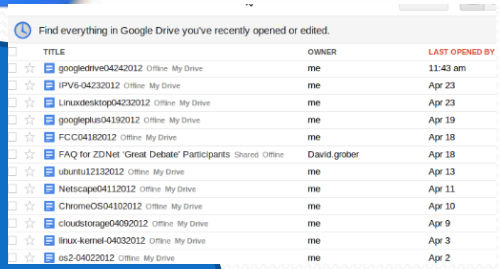
TITLE	OWNER	LAST OPENED BY
googledrive04242012 Offline My Drive	me	11:43 am
IPV6-04232012 Offline My Drive	me	Apr 23
Linuxdesktop04232012 Offline My Drive	me	Apr 23
googleplus04192012 Offline My Drive	me	Apr 19
FCC04182012 Offline My Drive	me	Apr 18
FAQ for ZDNet 'Great Debate' Participants Shared Offline	David.grober	Apr 18
ubuntu12132012 Offline My Drive	me	Apr 13
Netscape04112012 Offline My Drive	me	Apr 11
ChromeOS04102012 Offline My Drive	me	Apr 10
cloudstorage04092012 Offline My Drive	me	Apr 9
linux-kernel-04032012 Offline My Drive	me	Apr 3
os2-04022012 Offline My Drive	me	Apr 2

Find everything in Google Drive you've recently opened or edited.

TITLE	OWNER	LAST OPENED BY
googledrive04242012 Offline My Drive	me	11:43 am
IPV6-04232012 Offline My Drive	me	Apr 23
Linuxdesktop04232012 Offline My Drive	me	Apr 23
googleplus04192012 Offline My Drive	me	Apr 19
FCC04182012 Offline My Drive	me	Apr 18
FAQ for ZDNet 'Great Debate' Participants Shared Offline	David.grober	Apr 18
ubuntu12132012 Offline My Drive	me	Apr 13
Netscape04112012 Offline My Drive	me	Apr 11
ChromeOS04102012 Offline My Drive	me	Apr 10
cloudstorage04092012 Offline My Drive	me	Apr 9
linux-kernel-04032012 Offline My Drive	me	Apr 3
os2-04022012 Offline My Drive	me	Apr 2

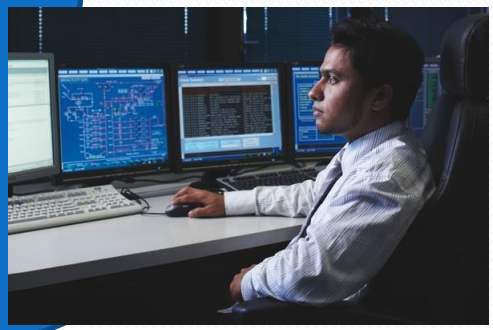
Microsoft® SkyDrive®





INTERNET

Mobile operations



Remote Office

Home

Security?

Security?

Web -Based SCADA

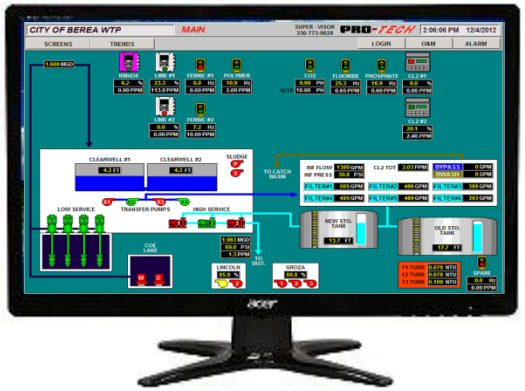
Advantages WEB-BASED SCADA

- Wide area connectivity
- Routable
- Parallel Polling
- Redundancy and Hot Standby
- Large addressing range
- Integration of IT to Automation and Monitoring
- Networks Standardization
- Cost Savings

Disadvantages of WEB-BASED SCADA

- IP Performance Overhead
- Security concerns
- Not Universal browser capable

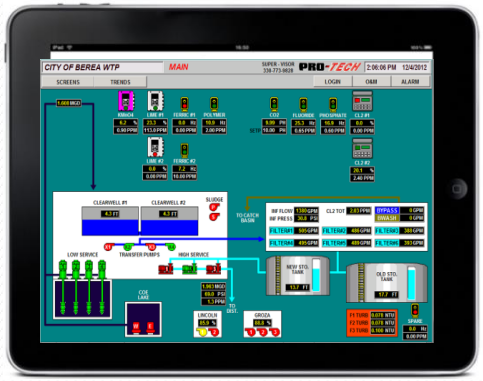
Traditional SCADA PC



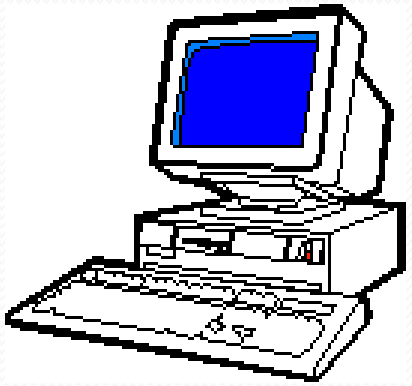
Other PC Nodes

Wired
Or
Wireless

Remote Devices

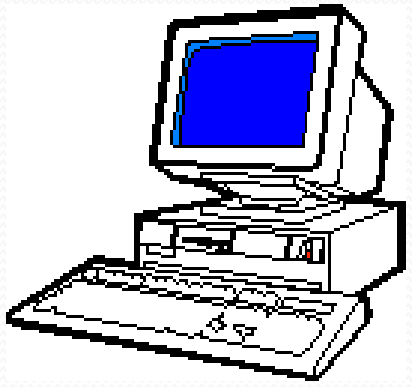


Traditional SCADA PC License



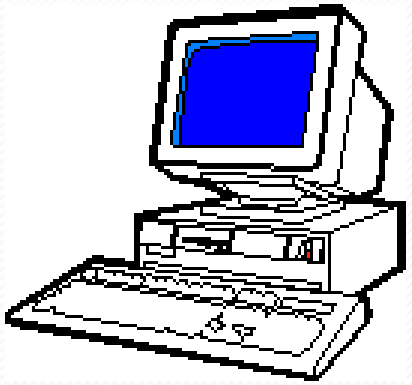
SCADA 1

$3k-$10K



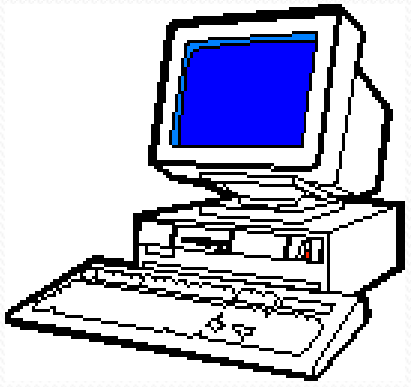
SCADA 3

$3k-$10K



SCADA 2

$3k-$10K

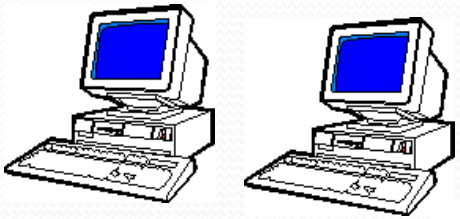


SCADA 4

$3k-$10K

Had to Reside on Local network

Web based SCADA



SCADA

Web Browser machine

Web based SCADA

Local Office

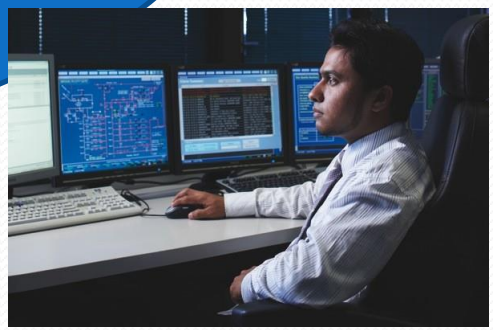
Web Browser machine

SCADA

Local Area Network

Firewall

internet

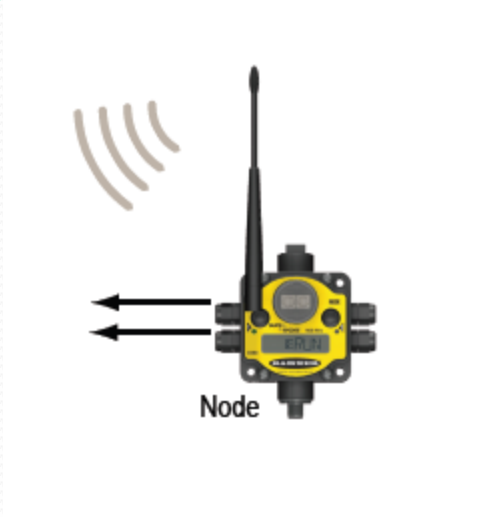


Remote Office

Mobile operations

Home

Wireless Networks



Wireless Networks

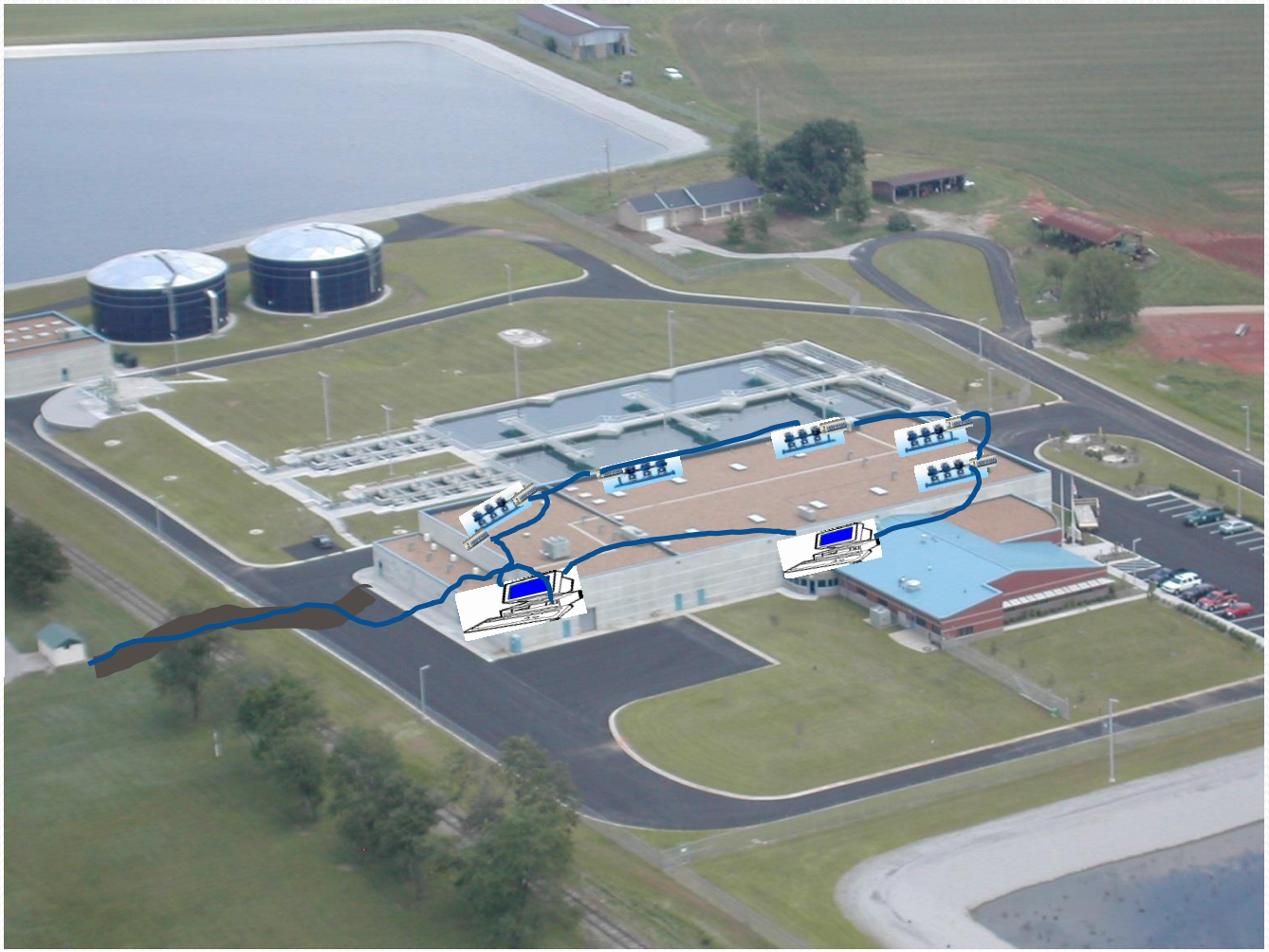
Wireless Networks

Wireless Networks

Wireless Networks

20 Years ago

$20,000

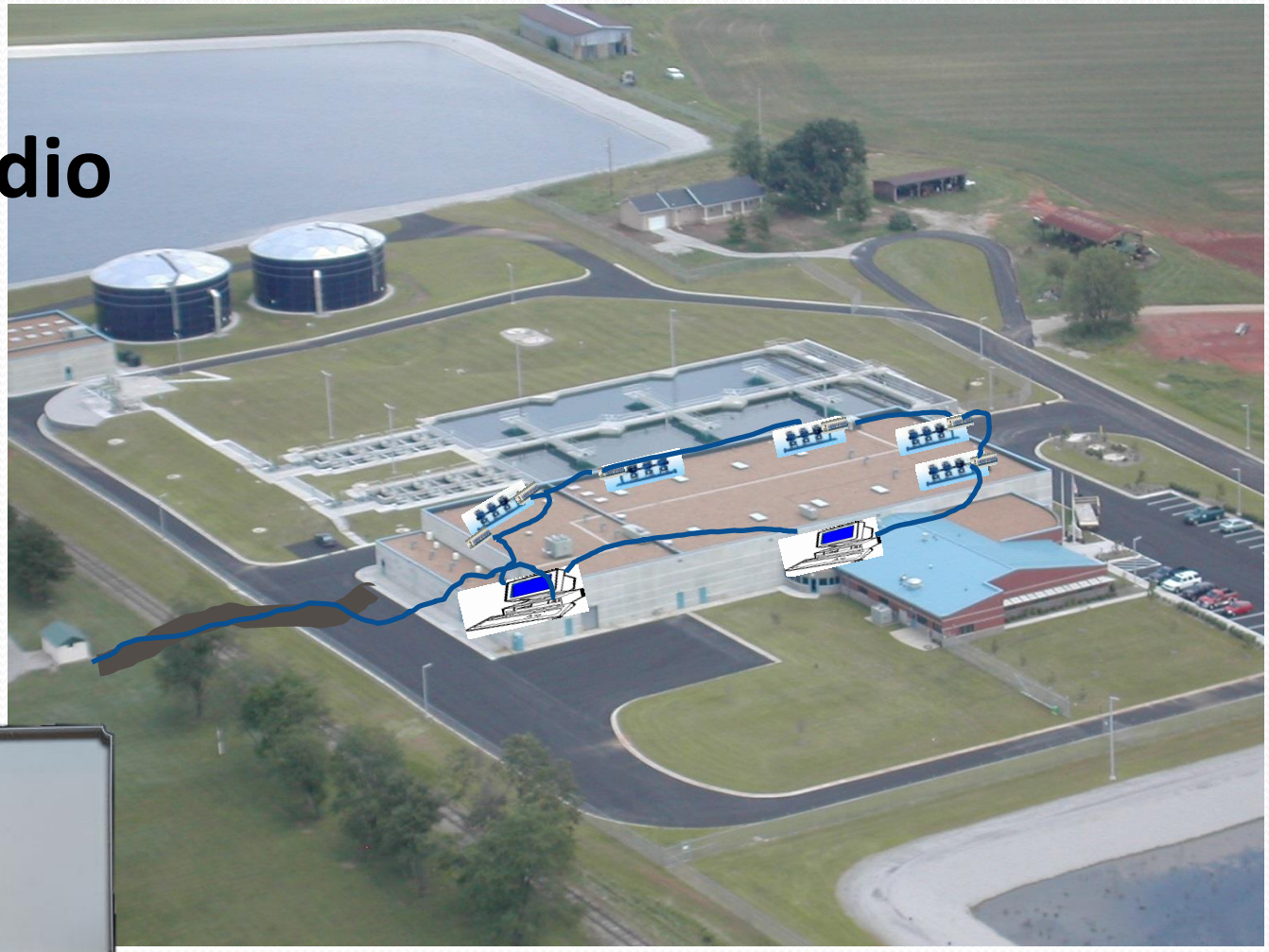


Wireless Networks

10 Years ago

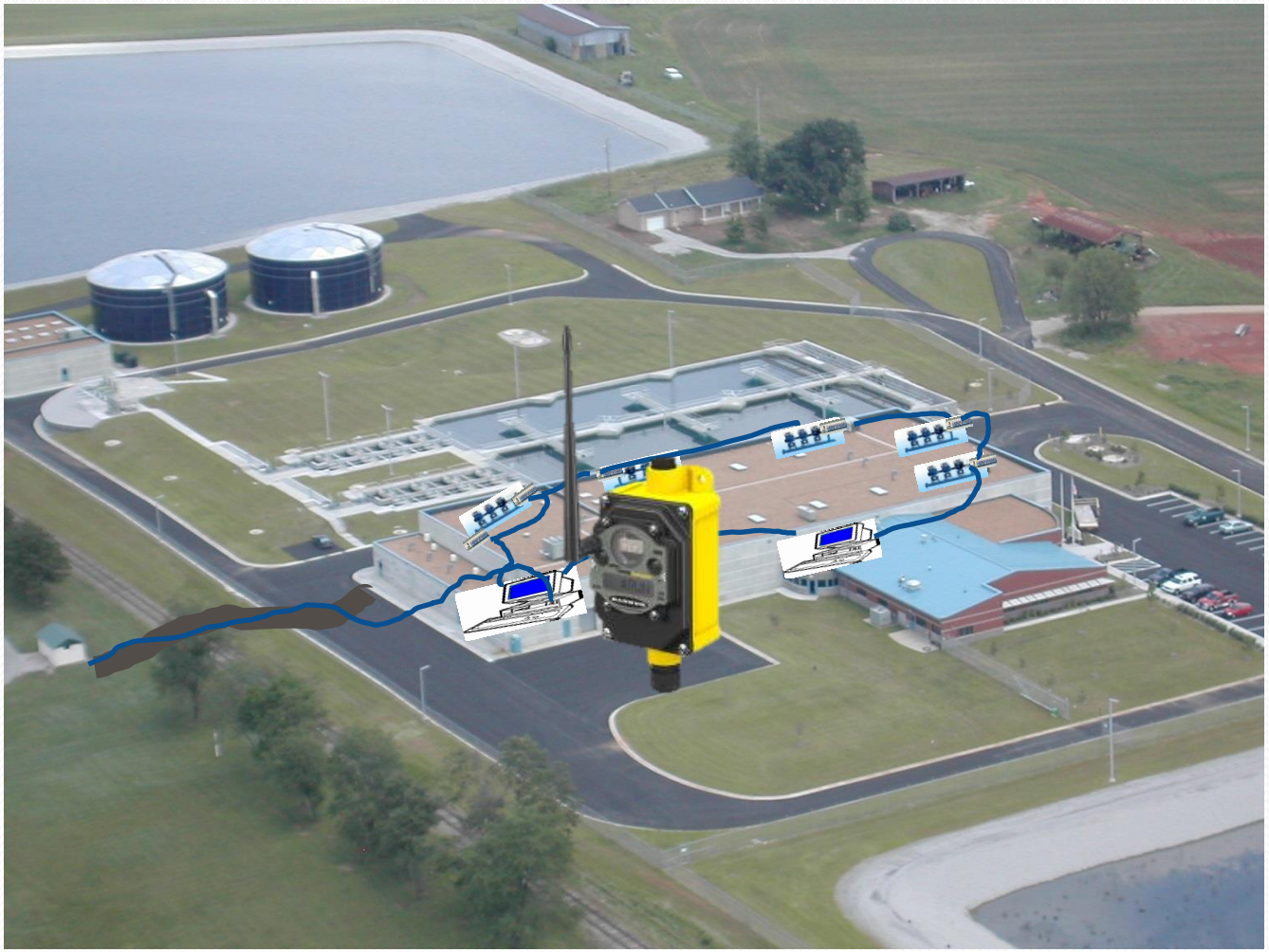
$6,000

RTU / Radio



Wireless Networks

Today - $1,500



Wireless Sensors

Wireless Temperature Sensors

- Accurate to +/- 1°C (1.8°F).
- Temperature Range of -20°C to 85°C.
- Good for slower changing temperature
- User defined thresholds.

Wireless Water Sensors

- Senses immediate presence or non-presence of water.
- Can be used for detection of any non-combustible liquid.
- Variety of lead lengths available.
- User defined notifications.

Wireless Activity Sensors

- Detect sudden movement.
- Tell if a motor or machine is on or off.

Wireless Sensors

Wireless Button Sensors

- Manually triggered push button.
- LED response indicator.

High Accuracy Humidity Sensor

Buy Now $99.00

900 MHz - Commercial (Coin Cell)
PN: MNS-9-HA-W1-ST

The high accuracy wireless humidity sensor allows you to monitor relative humidity, temperature and dew point from 10% - 90% RH. Ideal for monitoring humidity within greenhouses, industrial spaces, museums and humidors. They can also be used for residential applications such as controlling mold, mildew or dust mites. User customization allows you to set the frequency of readings and the ability to set thresholds for alerts.

Wireless Sensors

Inexpensive

Less than 300 ft wireless range

Operate 2 years on internal Battery
NO EXTERNAL POWER REQUIRED

Not intended for critical operations!

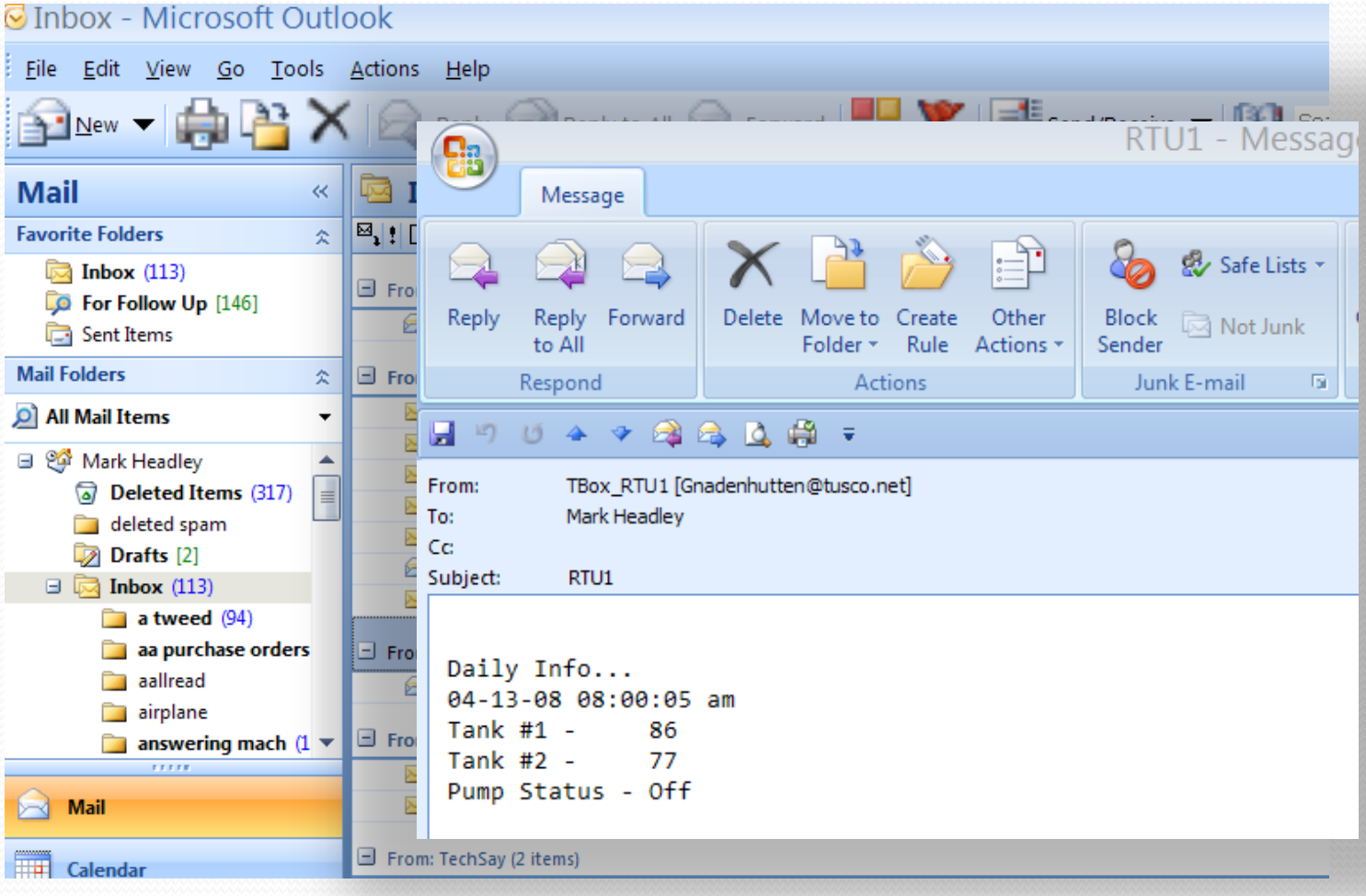
Asset Sensor

Buy Now $49.00

900 MHz - Commercial (Coin Cell)
PN: MNS-9-RF-W1-ST

The Monnit Wireless Asset Sensor outputs an RF signal at set intervals to be received by the gateway and monitoring system. The sensor can be used determine if an asset is removed from the premesis and send notifications via SMS text or email from the system to alert the user.

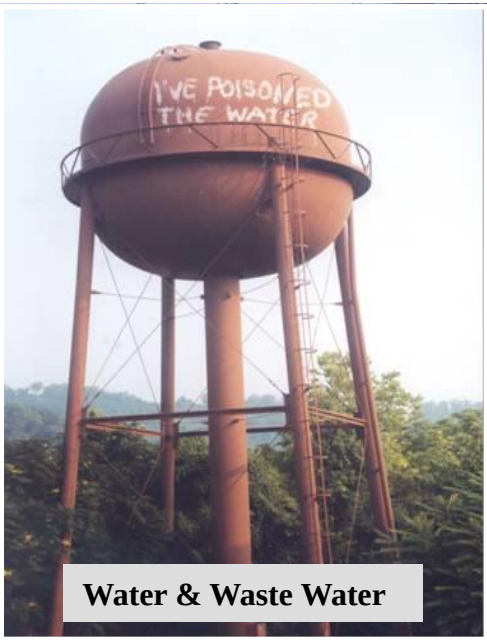
Have Your Devices Check to in you



Video

Key Benefits From Video

- Deter Vandalism
- Improve Safety
- Reduce Liability
- Reduce Labor Costs
- Improve Response
- Improve Decision-Making
- Share Expertise



Water & Waste Water

Electric Power

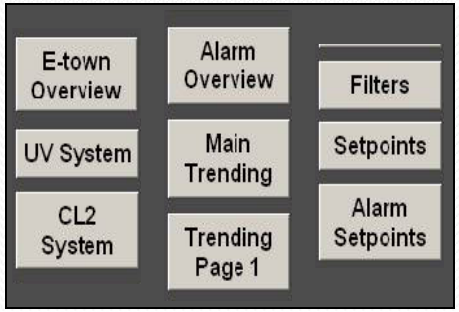
Gas

Oil

Integrated Video Alarms and Monitoring

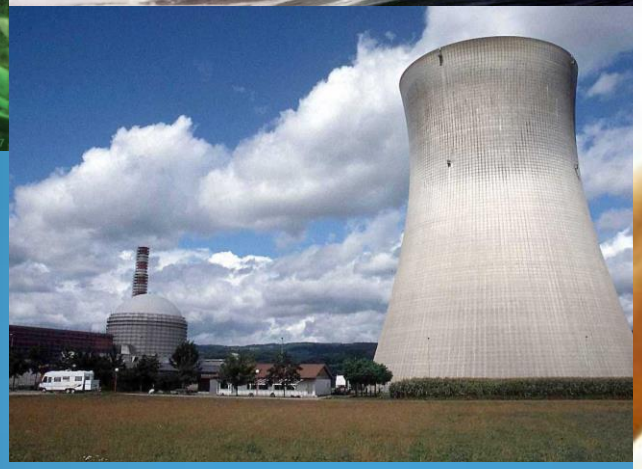
Guard Tour Mode and streaming live video from multiple sites

Click on an icon to see the video associated with the alarm.



C	A	Date Time	Name	Event	Description
■	☑	4/13/2006 9:31:42 AM	WTP	DI-3	Reservoir Hatch
■	☑	4/13/2006 8:48:53 AM	WTP	Video-2	Low Lift Camera
■	☑	4/13/2006 8:47:12 AM	WTP	Video-2	Low Lift Camera
■	☑	4/13/2006 7:04:08 AM	WTP	DI-1	Front Door Open

ENERGY



Why Conserve Energy?

- Save Money
  - Better to save energy than cut staff
- Straight to Bottom Line
- No Lost Value to Product or Service
- Carbon Risk Mitigation
- Public Relations

Sizing the Opportunity

Program/Activity	Potential Savings
Energy Efficiency	5-30% subject to current operations
Rate Optimization	Typically 10-15% for small accounts (less or none for large)
Power Shopping	Varies by account and utility 5-20%
Demand Response	$0 – 30,000 / MW yr
Power Factor Correction/Demand Controls	5-15%
Renewables	0-10%
Total	**Typically 5-25% overall**

CONCLUSION

- **Let your *Automation* system grow**

- **New Technologies**
  - **Software**
  - **Hardware**
- ***Imagination***

Thank You!

The Operator Training Committee of Ohio, Inc.

Scott Fausneaucht

PRO-TECH SYSTEMS GROUP