



Self-healing SCADA Communications Networks



System Configuration



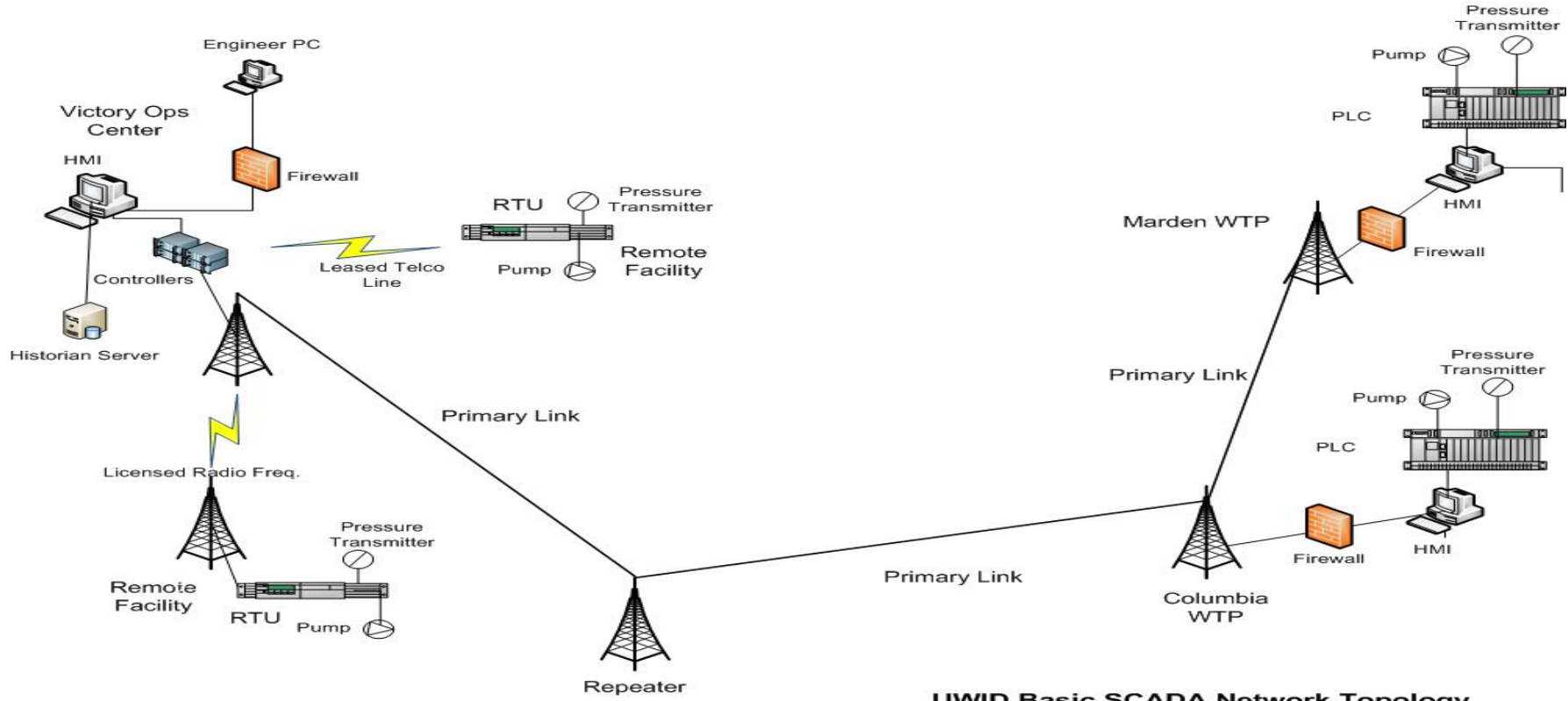
- **3 Main Operations Centers**
 - Victory Road Operations Center
 - Columbia Water Treatment Plant
 - Marden Water Treatment Plant
- **133 Remote Facilities with Control Capabilities**
 - Wells, Boosters, Reservoirs, PRVs
- **9 Licensed Radio Frequencies**
- **3 Lease Telephone Circuits**



Initial Communications Configuration

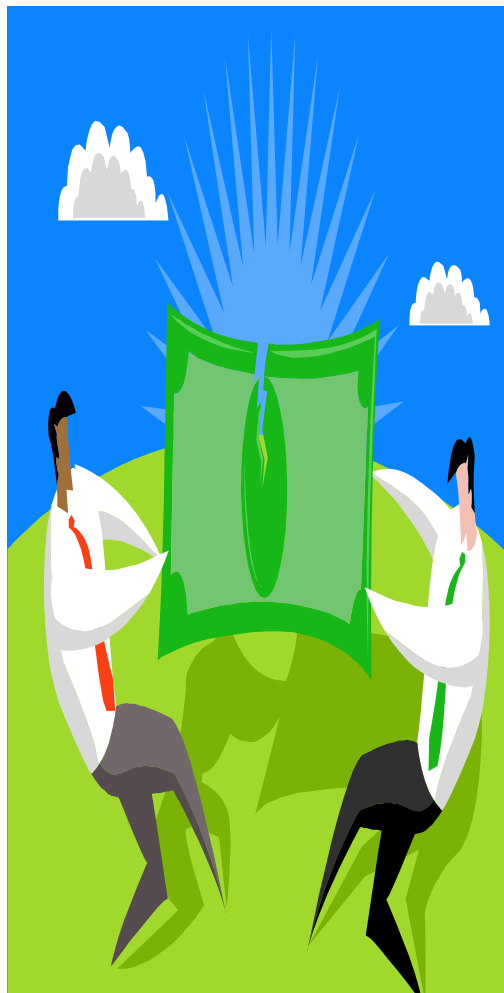
- One 10 MB 2.4 GHz Radio circuit

- Motorola Canopy System
- 3 separate segments



UWID Basic SCADA Network Topology

Challenges



- Limited high speed data circuits in area
- Intermittent outages
- Limited tower access for repairs
- Cost vs Benefit

Options



○ T1 Telephone Circuit

- Ready available
- Single line too slow
- Bonded set of T1s too costly vs benefit

○ Fiber Optic

- Fiber availability area growing
- Capacity to cost good and getting better
- Provider still needed substantial investment to connect up UWID facilities

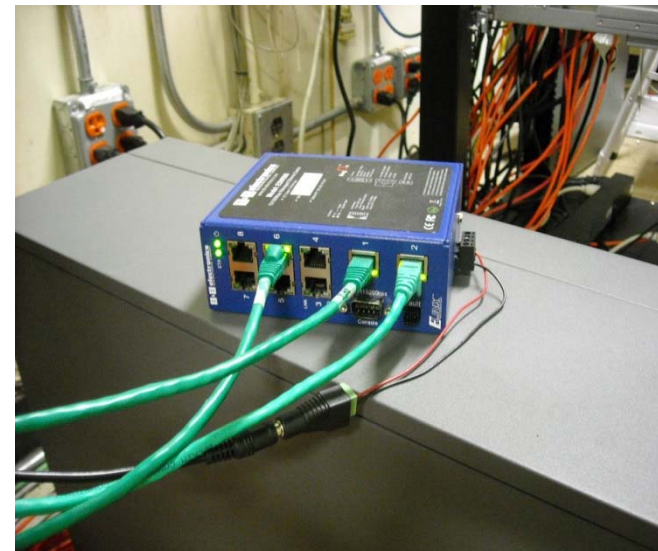
○ Radio link

- Good capacity for dollars invested
- Need to located a repeater site with power or where me could install solar panels

Technology Options



- **Load Balancing**
 - Separate physical networks
 - Balance throughput
- **Switching**
 - Same network
 - Routes between ports
- **Link Balancing**
 - Separate networks
 - Maintains uptime



Installation and Implementation



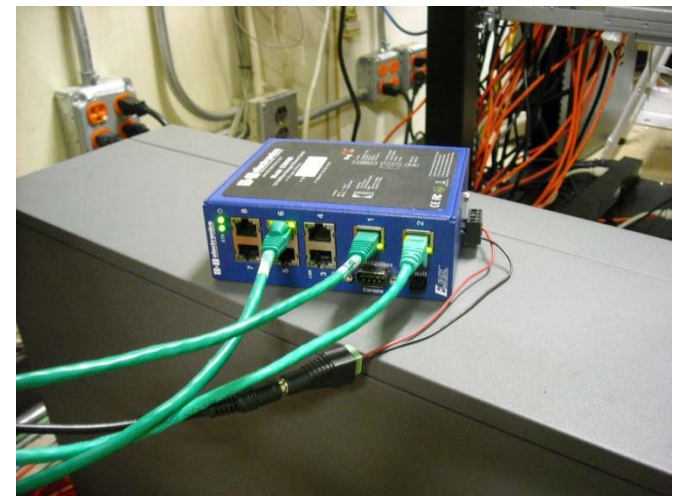
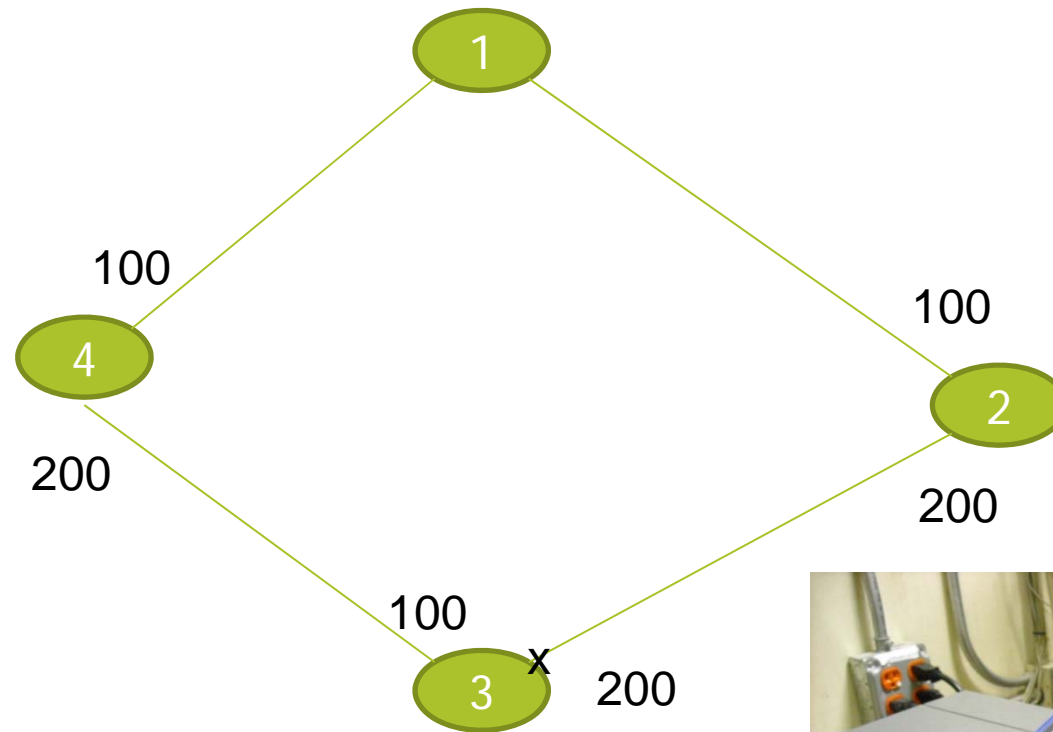
- **Radio link selected**
 - Non-licensed 5 GHz system
- **Switched based routing**
- **Recently completed reservoir upgrade**
 - Power, control, and telemetry installed
- **Antenna sites allowed for easy access and maintenance of radios**
- **Neighborhood concerns**



Technology Options



- Rapid Spanning Tree Protocol (RSTP)



Equipment Configuration



Redundancy Settings

Redundancy Setting :

Bridge Priority:	<input type="text" value="32768"/>
Hello Time:	<input type="text" value="2"/> Sec (Range 1~10)
Forwarding Delay:	<input type="text" value="15"/> Sec (Range 4~30)
Max Age Time:	<input type="text" value="20"/> Sec (Range 6~40)
Advanced Settings:	<input type="button" value="Port Configure"/> <input type="button" value="RSTP Information"/>

Equipment Configuration



Port Configuration	Port	Port Cost	Priority	Admin P2P	Admin Edge	Admin Non Stp
	1	50000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	2	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	3	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	4	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	5	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	6	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	7	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼
	8	200000	128 ▼	AUTO ▼	TRUE ▼	FALSE ▼

Equipment Options



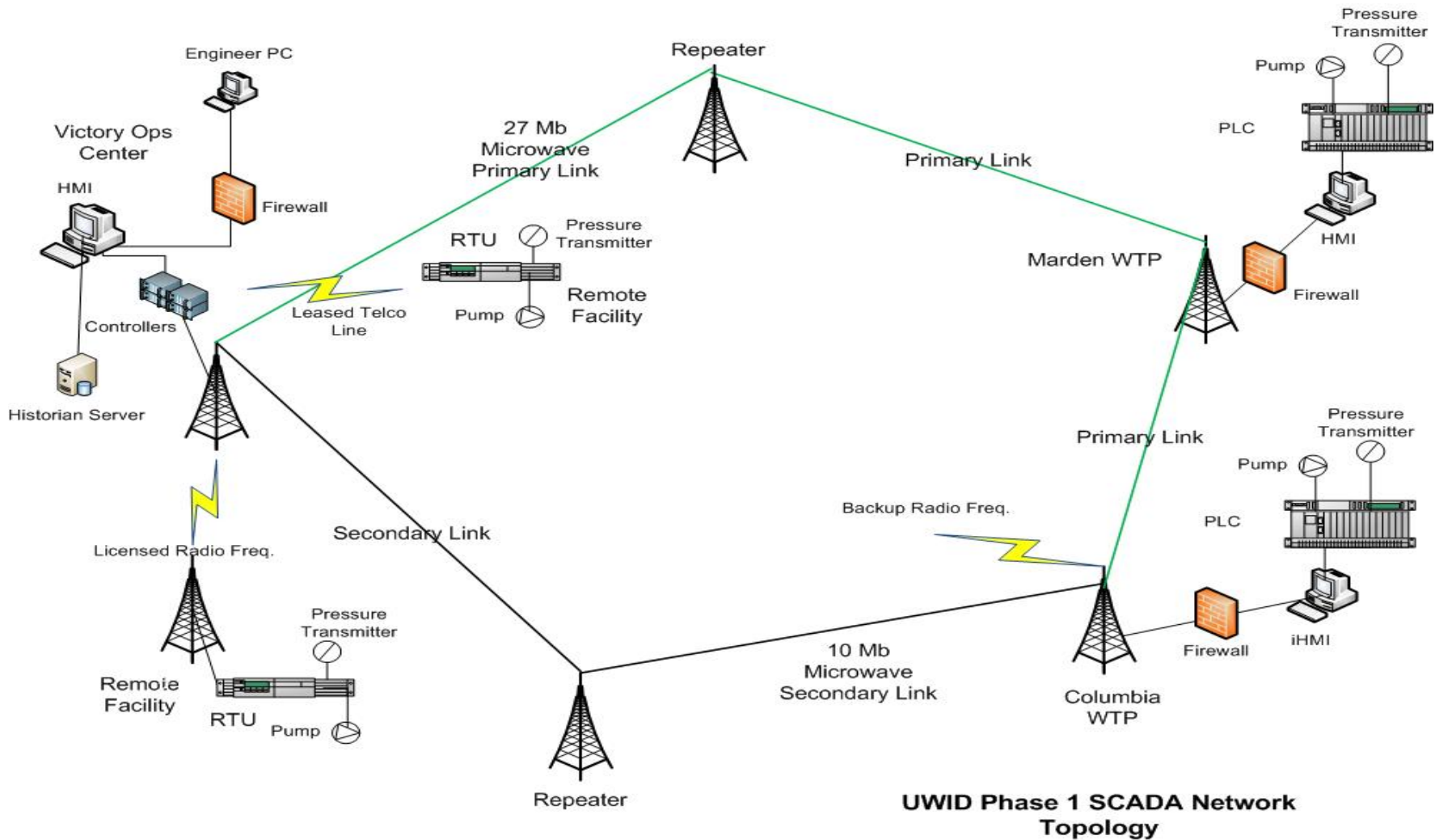
Root Bridge Information :

Bridge ID	8000-001016183146
Root Bridge ID	8000-001016183136
Root Port	1
Root Path Cost	250000
Max Age Time	20
Hello Time	2
Forward Delay Time	15

Port Information:

Port	Priority	PathCost	P2P	Edge	Partner	Role	State
1	128	50000	Y	N	Rapid	Root	Forwarding
2	128	200000	Y	N	Rapid	Alternate	Discarding
3	128	200000	Y	Y	Rapid	Unknown	Disabled
4	128	200000	Y	Y	Rapid	Unknown	Disabled
5	128	200000	Y	Y	Rapid	Unknown	Disabled
6	128	200000	Y	Y	Rapid	Designated	Forwarding
7	128	200000	Y	Y	Rapid	Unknown	Disabled
8	128	200000	Y	Y	Rapid	Unknown	Disabled

Communications Configuration



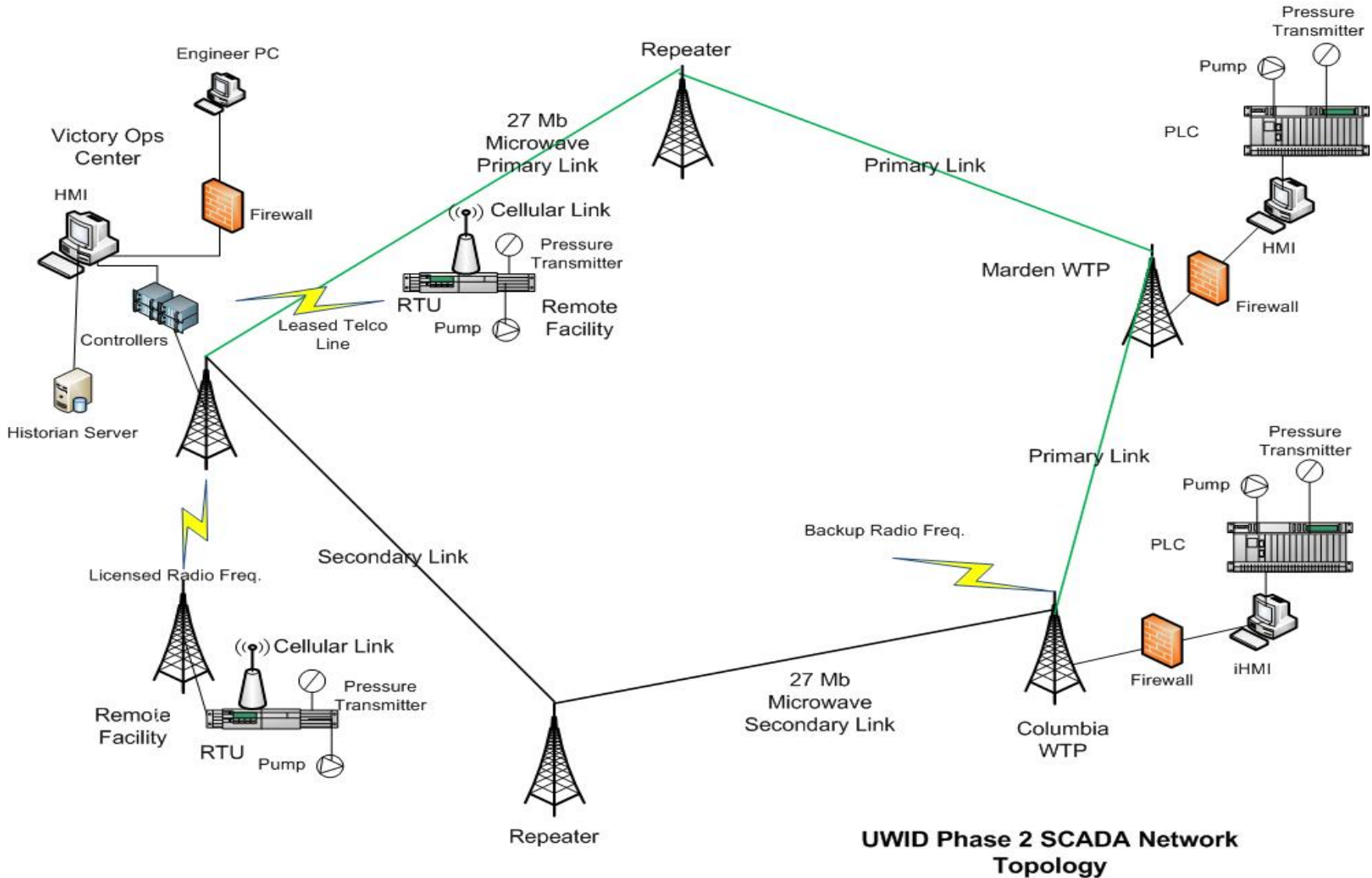
UWID Phase 1 SCADA Network Topology

Next Steps



- Upgrade to 40 MB radios
 - \$10,000 per segment
- Link/Load balancing hardware
- Incorporate cell modem with radio communications at remote sites
- Migrate existing radios to digital/IP radios
- Retire telephone circuits

Next Steps

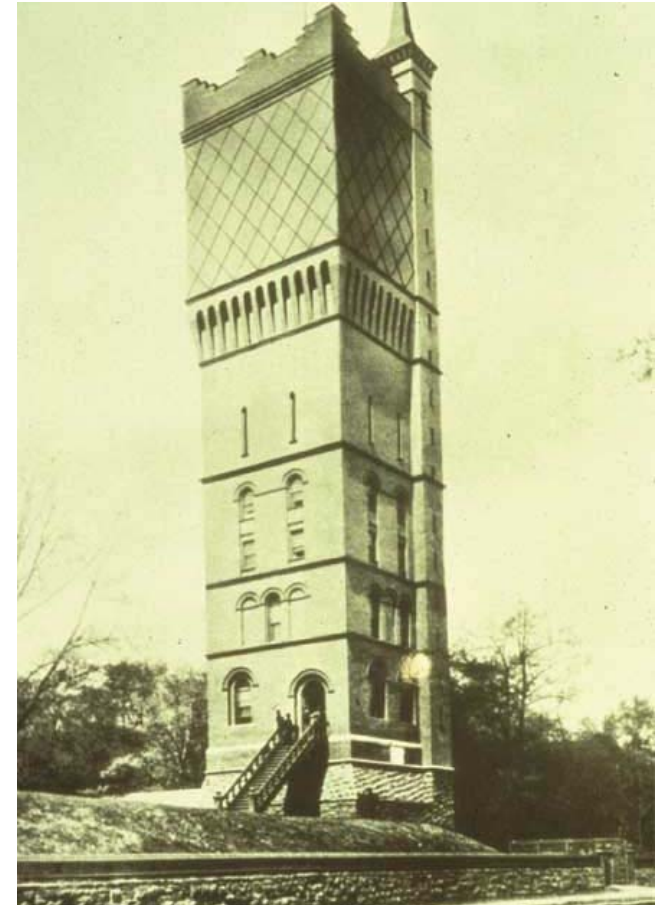


UWID Phase 2 SCADA Network Topology

Things to Consider



- **Do you have technical staff to maintain system or do you need to contract out**
- **Alternative routing could change the way you react to a communications failure**
- **VPNs & firewalls**
 - Dynamic or multipoint VPN
- **Backup power**
 - Generator or UPS
- **Diagnostic tools**
- **Ease of configuration**



Questions?

