



Wireless Ethernet

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Westermo Data Communications

Industrial Ethernet - Requirement

- Must Be Reliable
- Industrial Ethernet Use Same IEEE Standards As Office
- Suitable For Hostile Environments
- Easy To Implement And Design
- Easy To Identify And Remedy Faults





What Is Your Perception Of The Term Wireless

Wi-Fi (2.4GHz) ?
Bluetooth ?
Radio ?

Industrial Ethernet - Requirement

- Wireless Solutions
 - GSM
 - GPRS
 - Bluetooth
 - WiFi
 - 802.11b
 - 802.11g
- Unlicensed ISM Bands



Industrial Ethernet - Requirement

- Must Be Reliable
 - Industrial Ethernet Use Same IEEE Standards As Office
 - **We Have Radio Standards That Can Be Implemented**
 - Suitable For Hostile Environments
 - **The Radio Hardware Can Be Designed For Harsh Environments**
 - Easy To Implement And Design
 - **Is This Possible – Copper And Fibre And Visible Medium – What About RF**
 - Copper and Fibre Solutions Connections - Simple To Operate
 - **As Above – What Can We Do To Simplify Radio Solutions**

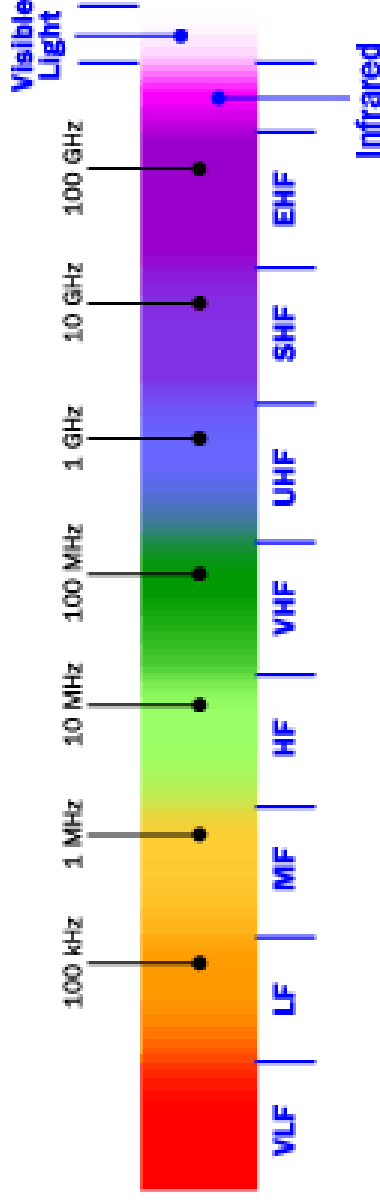


Wireless Solutions Use Radio Frequencies

- **Copper / Fibre Solution**
 - Visible Physical Medium
 - Either Can Be Implemented For Dedicated Solution
- **Radio (RF) Solution**
 - Invisible Solution
 - Radio Frequencies Open To Anyone



Wireless Solutions Use Radio Frequencies



AM Radio - 535 KHz > 1.7 MHz

Short Wave Radio - 5.9 MHz > 26.1 MHz

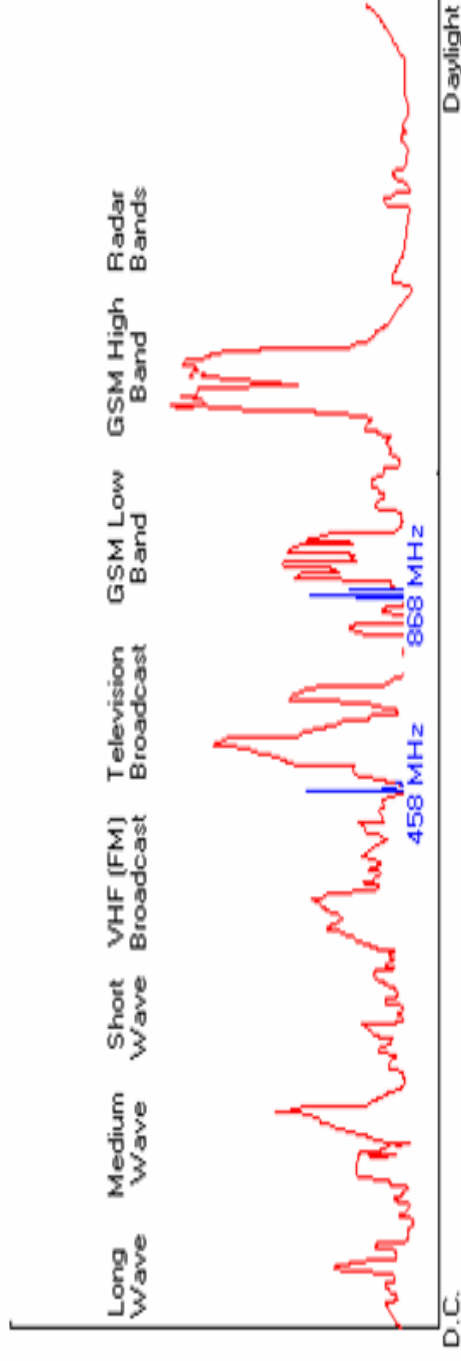
Citizens Band (CB) Radio - 26.96 MHz > 27.41 MHz

Television Stations - 54 > 88 MHz For Channels 2 Through 6

FM Radio - 88 MHz > 108 MHz

174 > 220 MHz For Channels 7 Through 13

Wireless Solutions Use Radio Frequencies



- Garage Door Openers : Around 40 MHz
- Baby Monitors: 49 MHz
- Radio Controlled Planes: Around 72 MHz
- Radio Controlled Cars: Around 75 MHz
- Wildlife Tracking Collars: Around 215MHz > 220 MHz
- MIR Space Station: 145 MHz > 437 MHz
- GSM Phones: Around 900 / 1800 MHz
- Air Traffic Control Radar: 960 MHz > 1,215 MHz
- Global Positioning System: 1,227 MHz & 1,575 MHz
- Deep Space Radio Communications: 2290 MHz > 2300 MHz

Radio Frequencies – Examples

- Very Low Frequency
 - Submarine Communications LF Or VLF (3 – 30 KHZ)
 - Very Long Transmission Distances
 - Lower Bandwidth
 - Little Effect From Common Obstructions
- Extremely High Frequency
 - Infra-Red Communications (300 GHz)
 - Very Short Transmission Distances
 - Higher Bandwidth
 - Easily Effected By Interference (Dust, Rain, Mist)



Radio Frequencies – Summary

- Low Frequency
 - Greater Powers Of Penetration
 - Travels Further In Free Space
 - Lower Frequency = Lower Data Rate
- High Frequency
 - Absorption More Readily In Most Materials – (Air, Walls)
 - Travel Less Distance In Free Space
 - Higher Frequency= Higher Data Rate.





Wireless Solutions – Radio Frequency Information

Wireless Ethernet – Two RF Choices

869 MHz
2.4 GHz

Two Choices – Two Characteristics

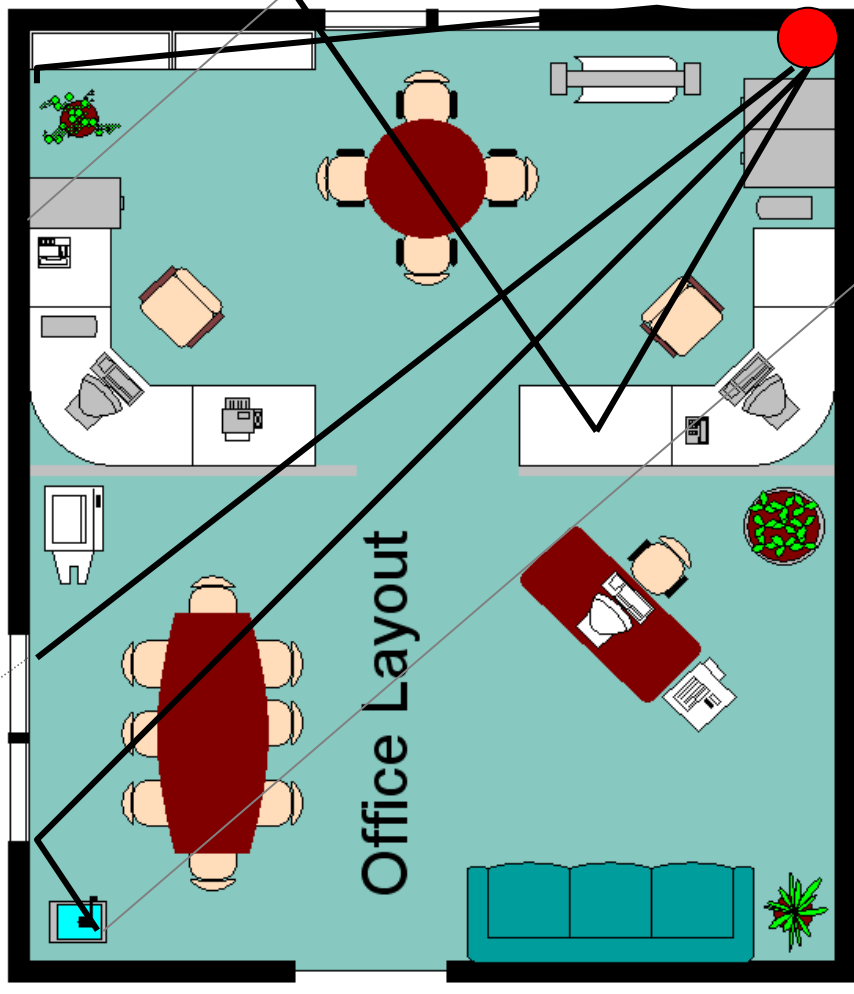
Wireless Solutions – Radio Frequency Information

Choice One – 2.4 GHz

- **Two Standards**
 - **802.11 b**
 - **Data Rate Of 11Mb/s**
 - **Maximum Distance In Factory 100 Meters**
 - **Can Be Stopped By Walls**
 - **802.11 g**
 - **Data Rate Of 54 Mb/s**
 - **Maximum Distance In Factory 30 Metres**
 - **Will Be Stopped By Walls**



Wireless Solutions – 2.4 GHz



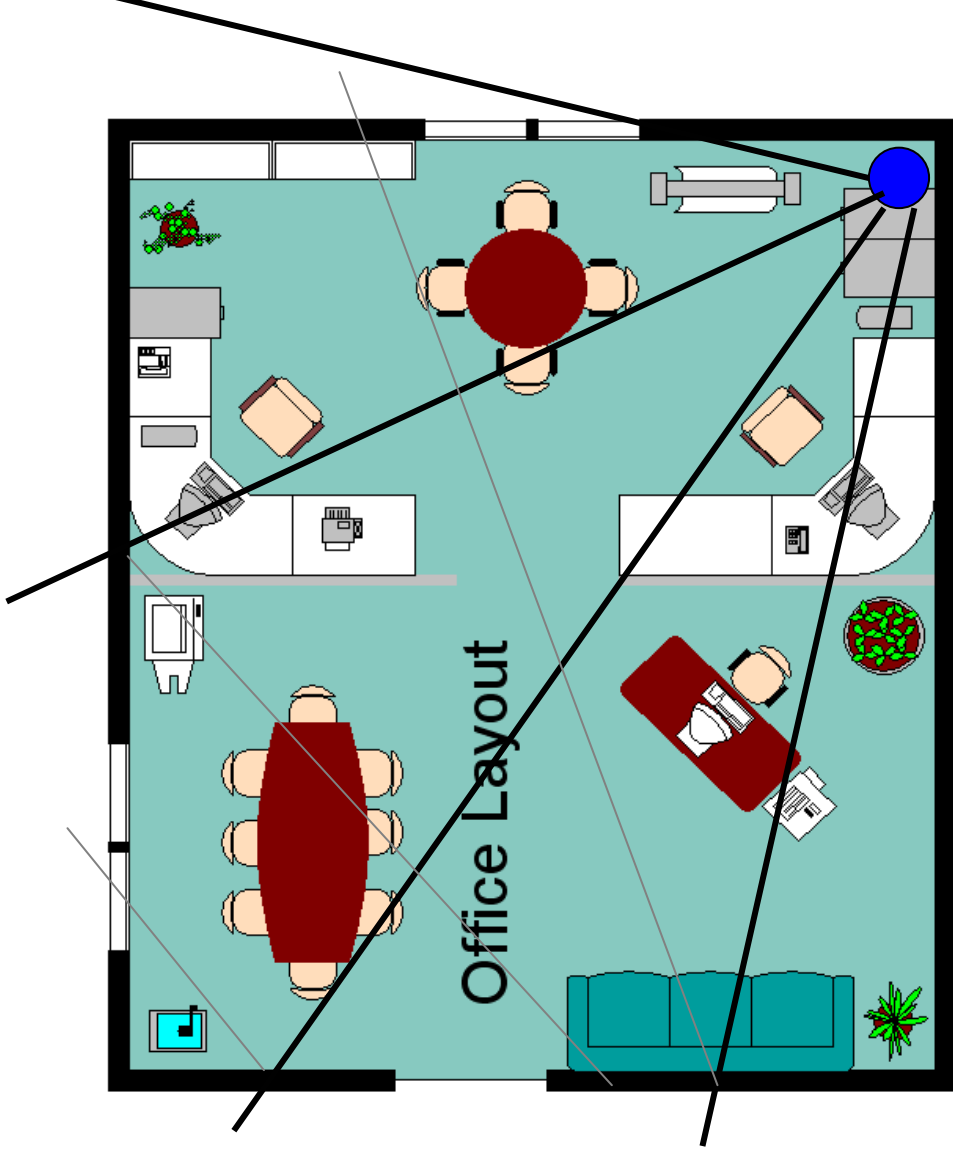


Wireless Solutions – Radio Frequency Information

Choice Two – 869 MHz

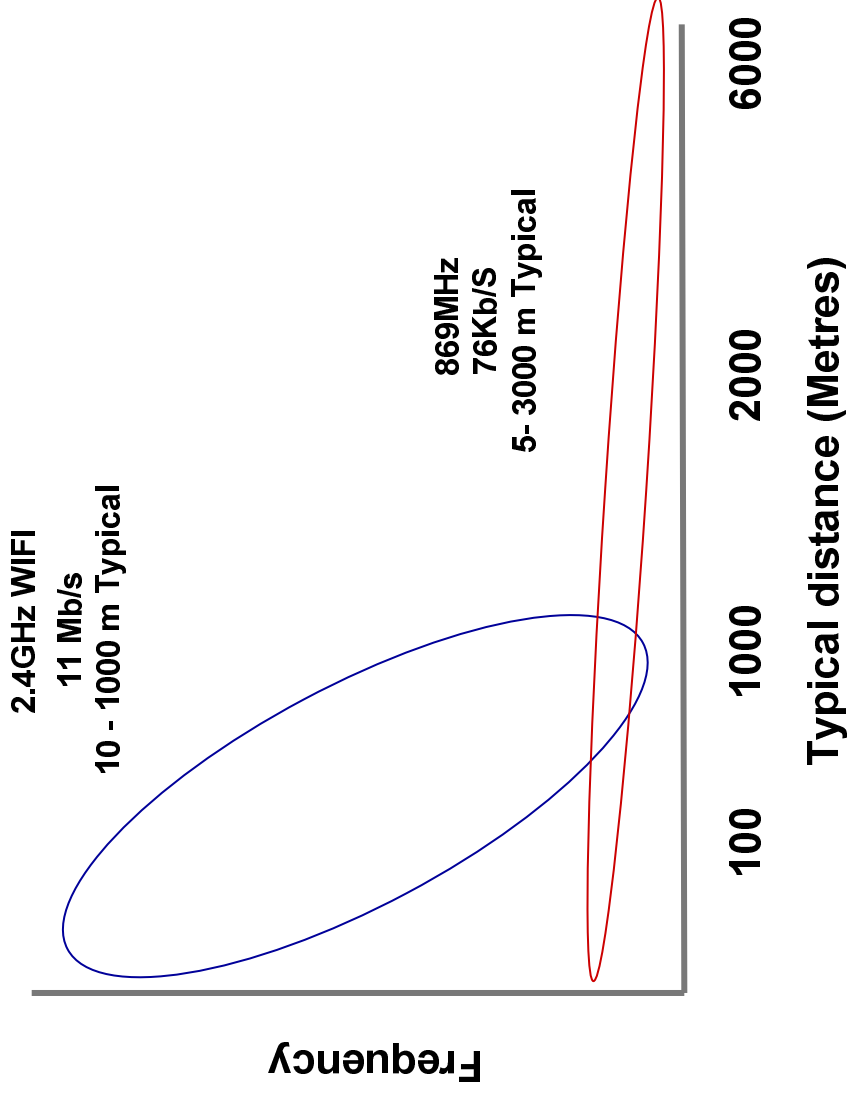
- **869 MHz**
- **Data Rate Of 76 KBits/s**
- **Maximum Distance In Factory 6 KM**
- **Can Be Pass Through Walls**

Wireless Solutions – 869 MHz





Wireless Solutions – Radio Frequency Information



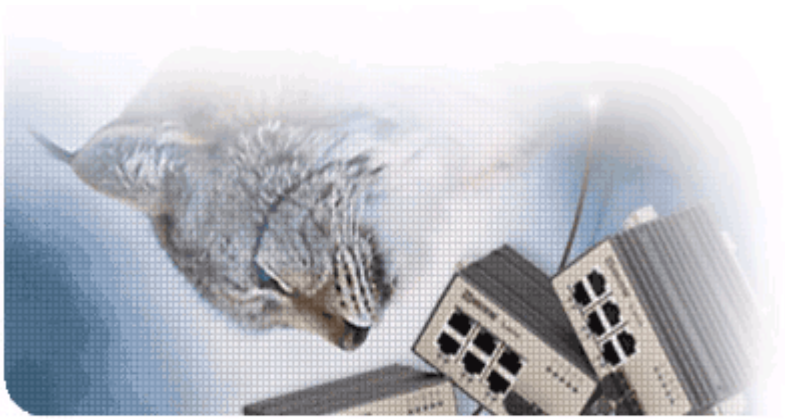
Wireless Ethernet Frequencies

- 869 MHz
 - Very Reliable Operational Frequency
 - Easy To Deploy
 - Excellent Range
 - Limited Bandwidth (76 KBits/s)
-
- 2.4 GHz
 - 802.11b or 802.11g Ensures Compatibility
 - High Data Rate 11 MBits/s or 54 MBit/s
 - Limited Range





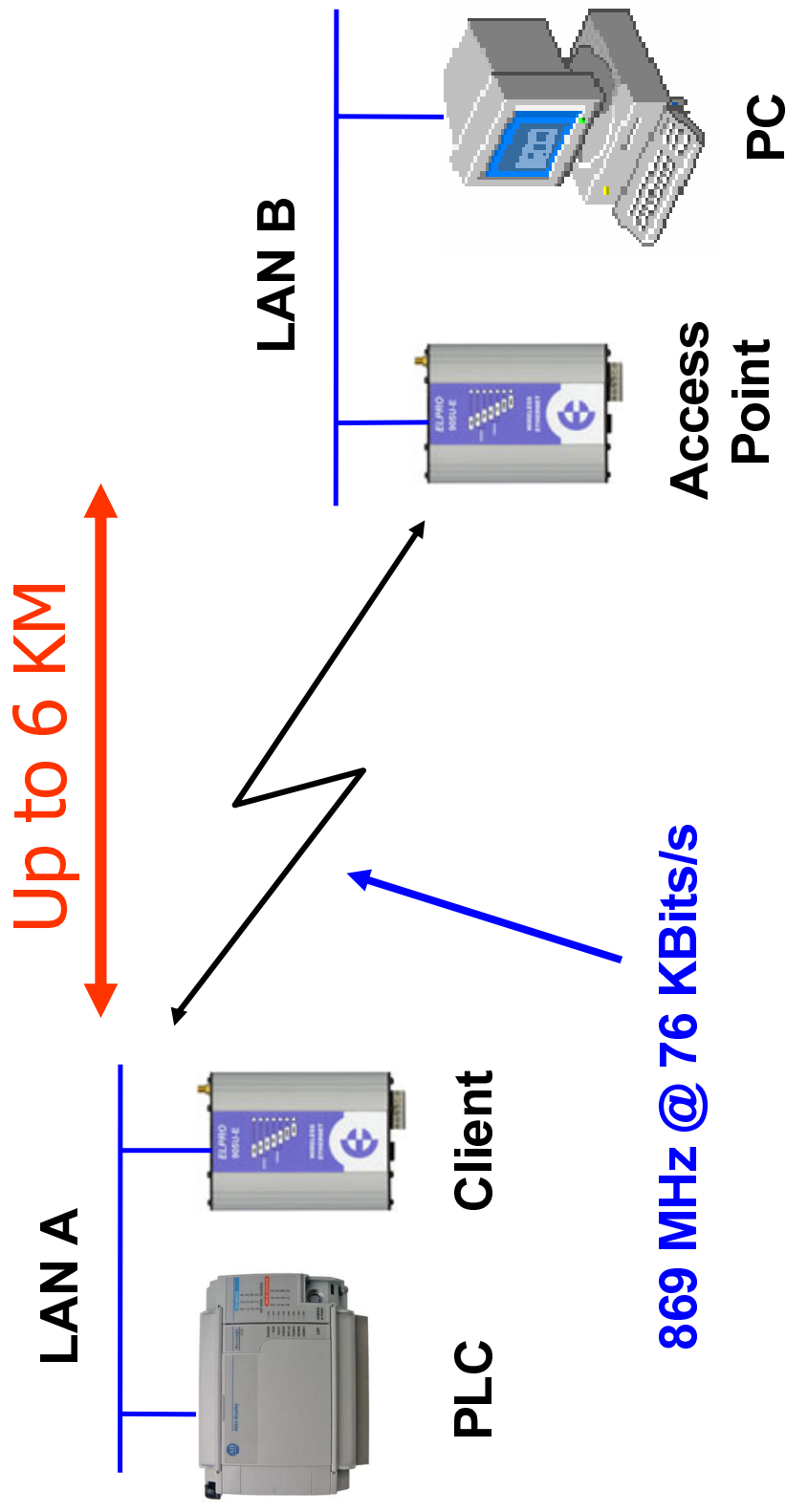
Wireless Solutions



Building A Network

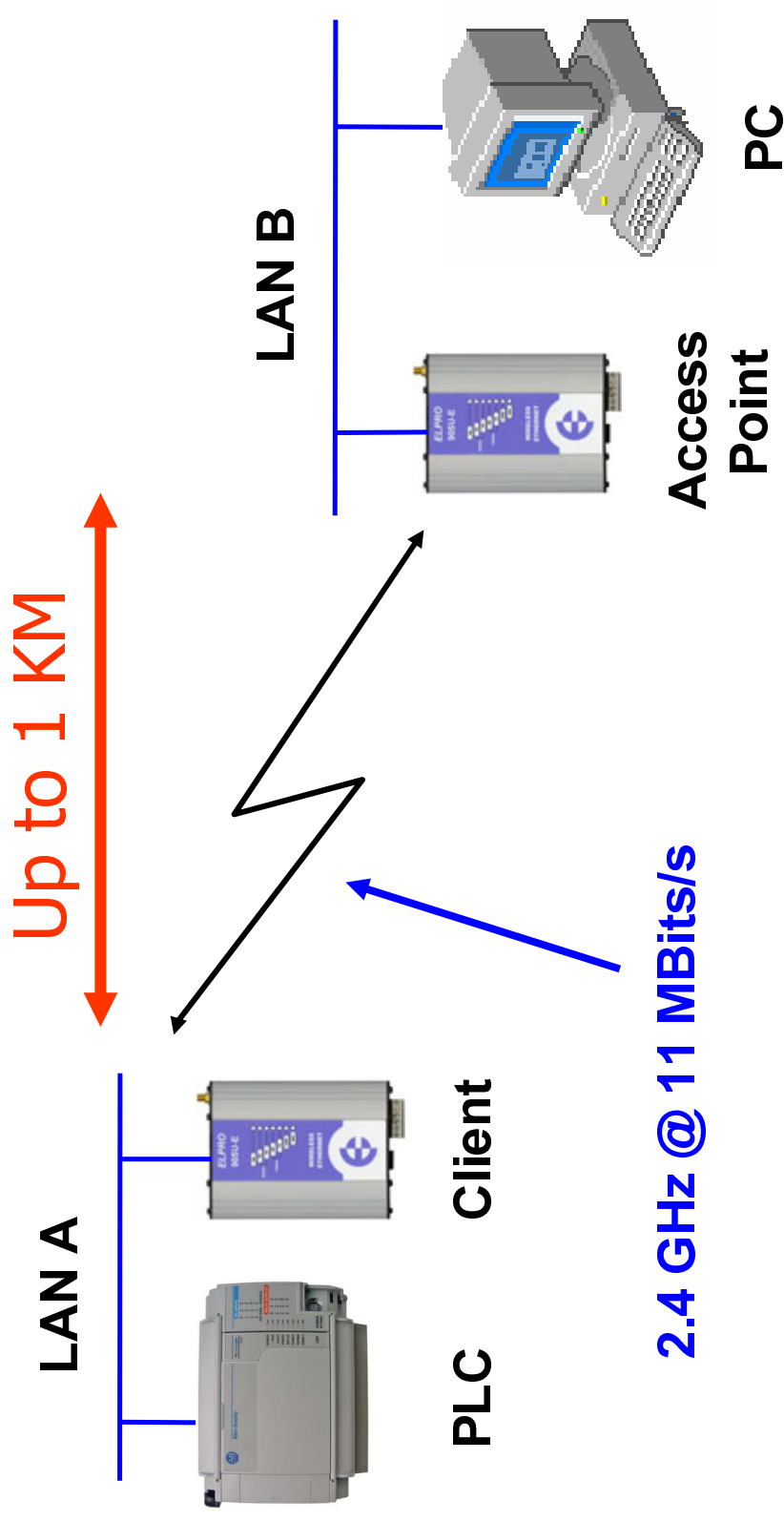


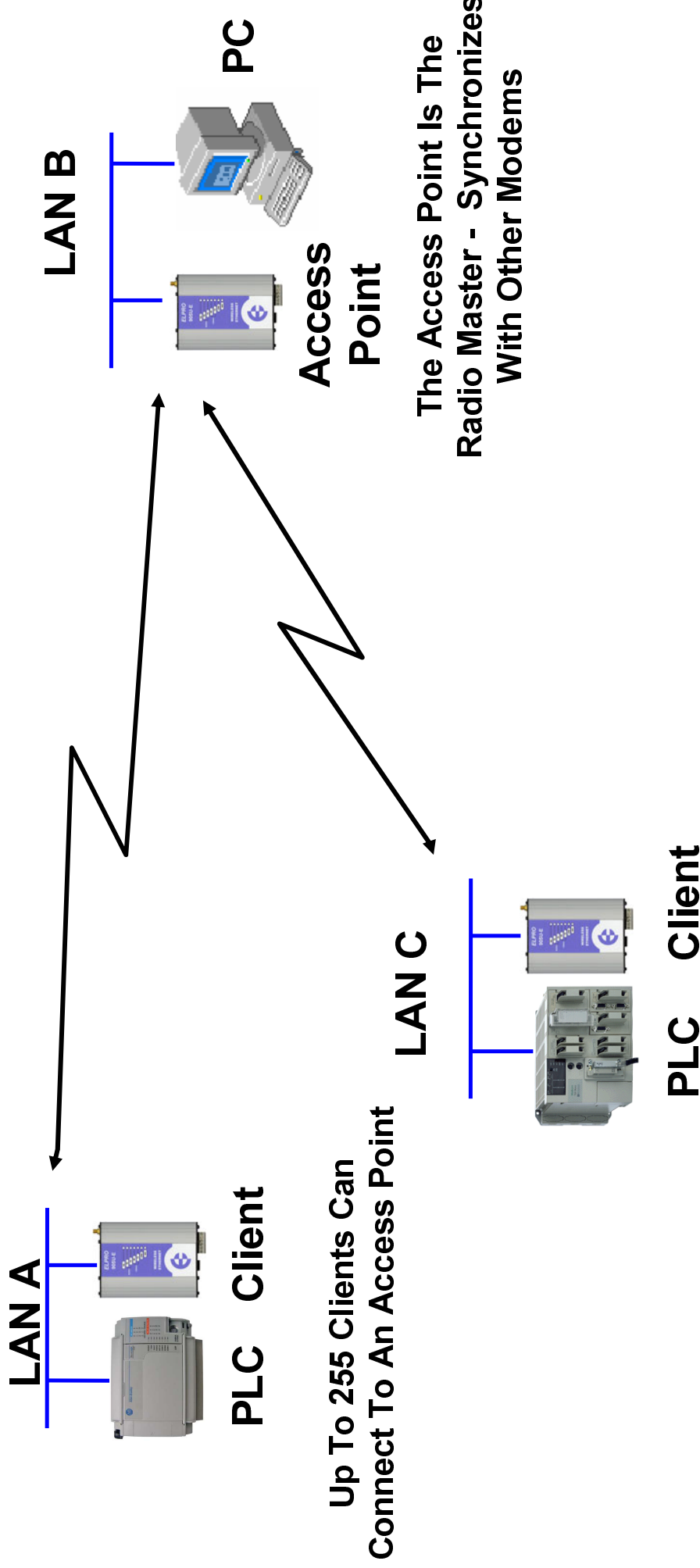
Wireless Solutions – Building A Network



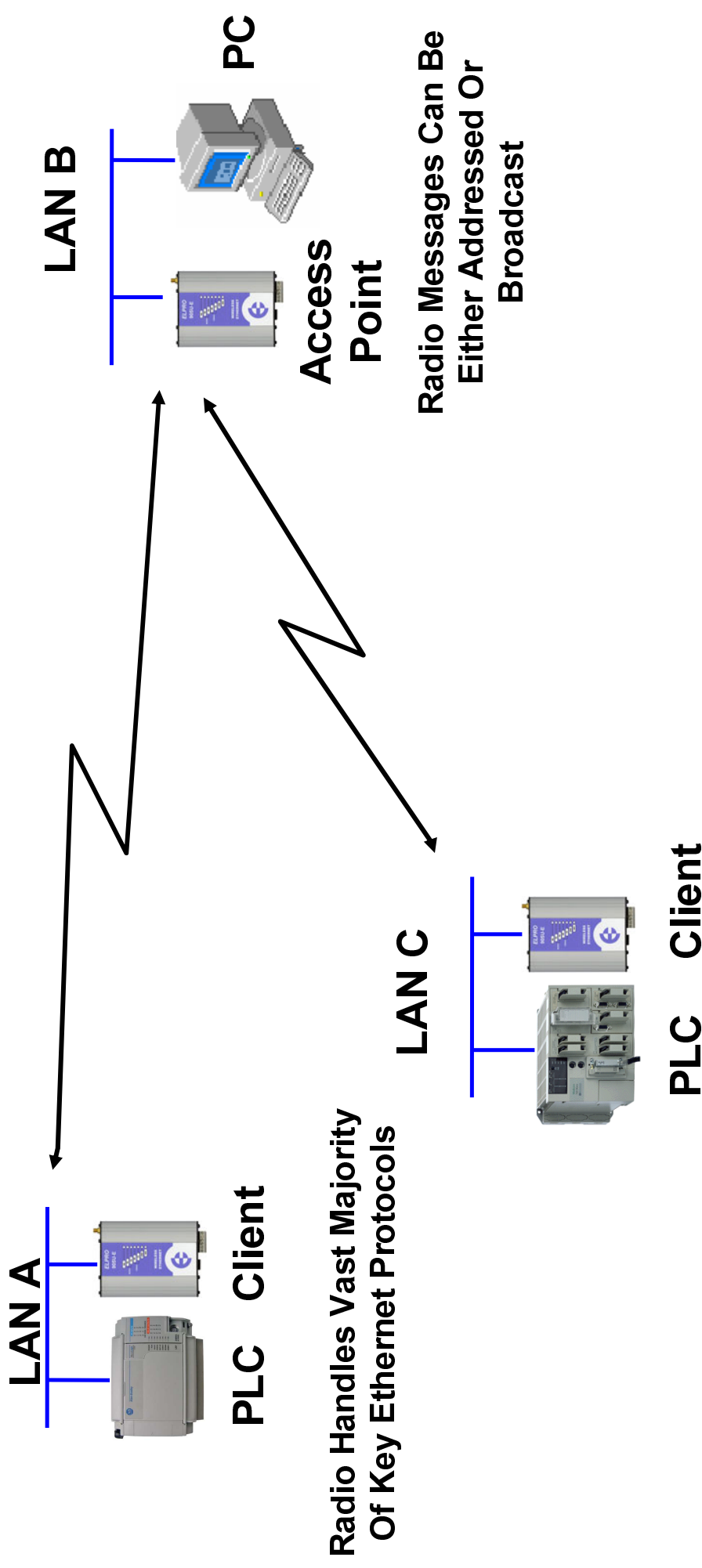


Wireless Solutions – Building A Network

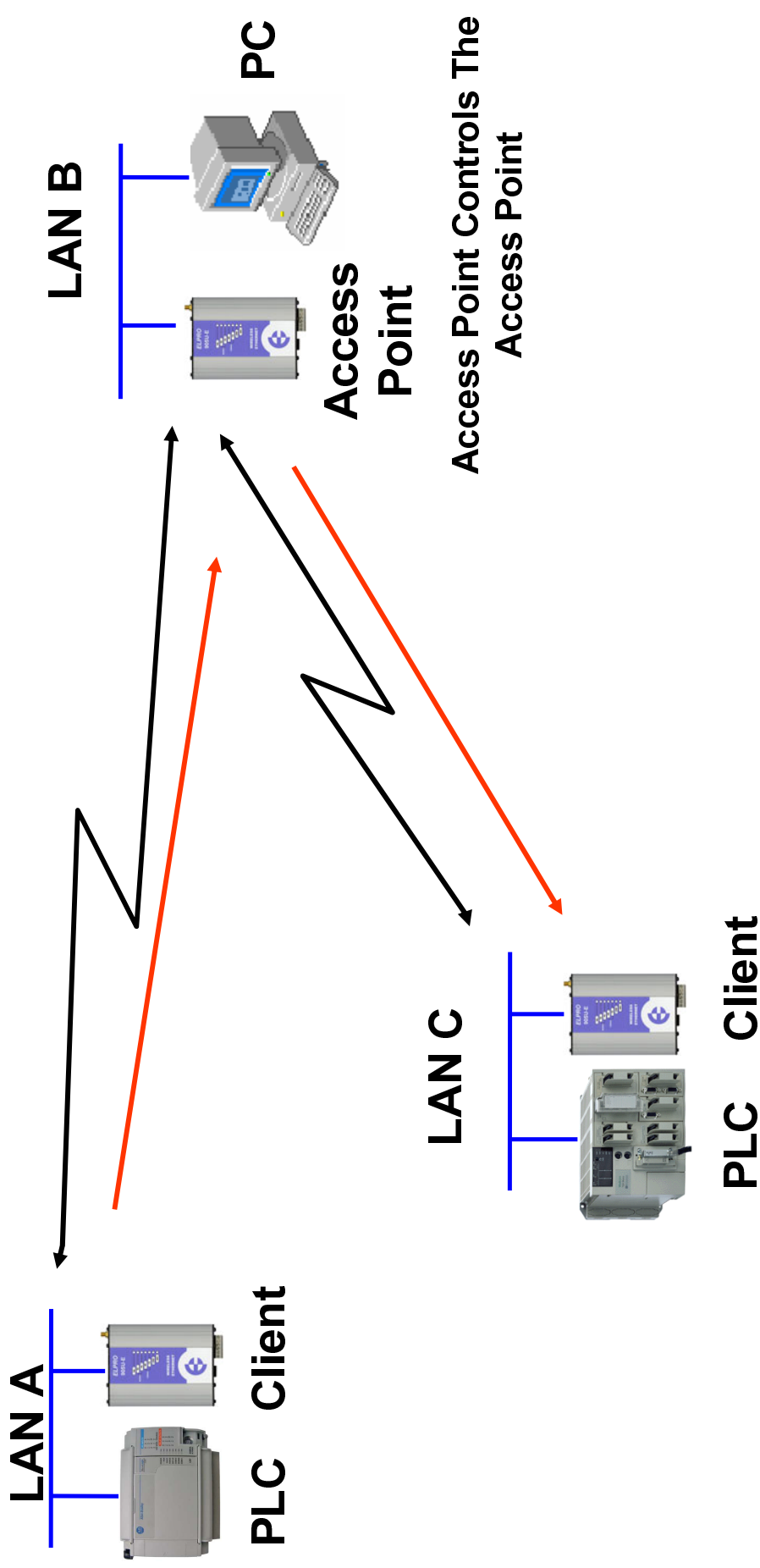


Wireless Solutions – Multipoint Network

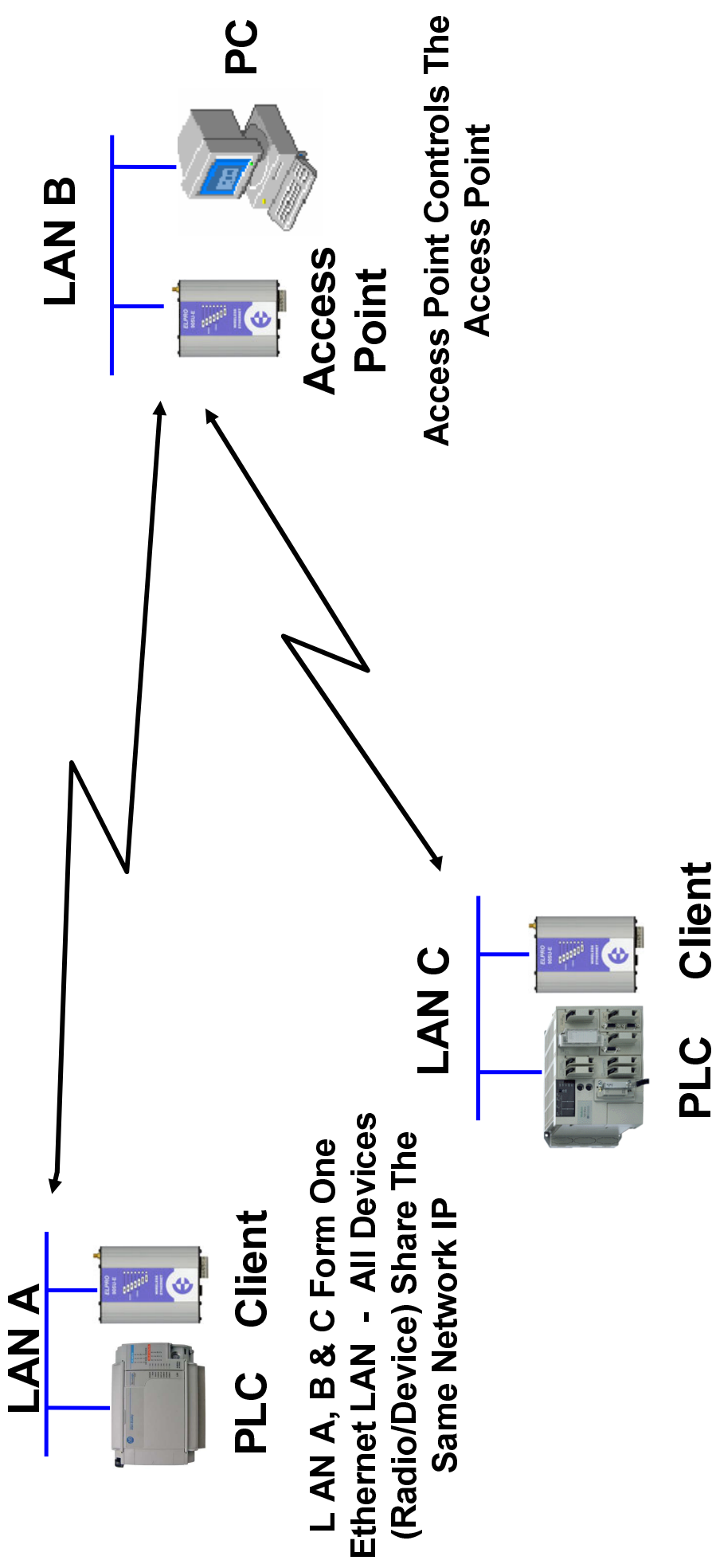
Wireless Solutions – Network Protocols



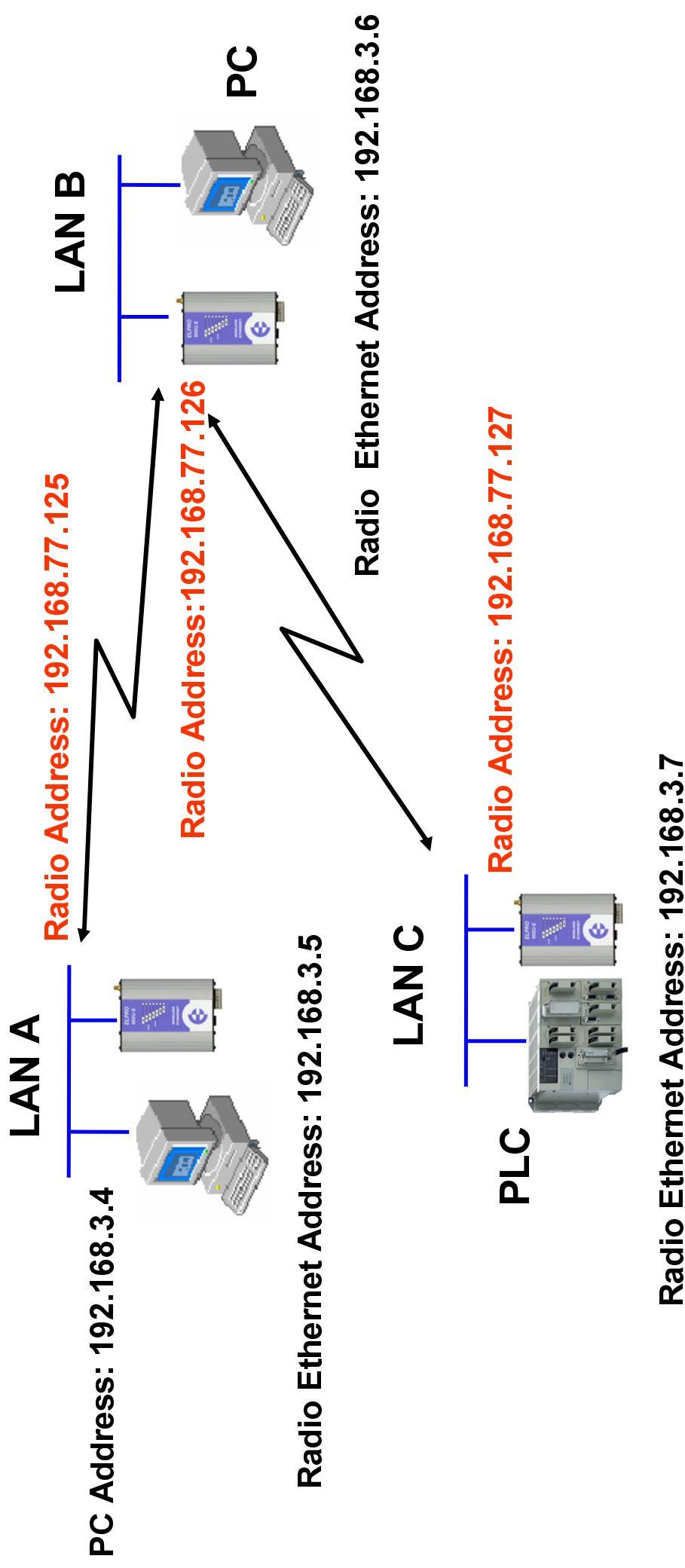
Wireless Solutions – Network Repeater



Wireless Solutions – Network Bridge



Wireless Solutions – Network Routing



Wireless Ethernet – Key Points

- ✓ Highlighted Different Types Of RF Frequencies
 - ✓ 2.4 GHz
 - ✓ 869 MHz
 - ✓ Lower Frequencies – Greater RF Reliability / Lower Bandwidth
 - ✓ Higher Frequencies - Reduced RF Reliability / Higher Bandwidth
- ✓ Transmission Distances
 - ✓ 869 MHz – 6 > 8 KM
 - ✓ 2.4 GHz – 100 M
- ✓ Ability To Route / Bridge Networks



Wireless Solutions – Redundant Network Solutions



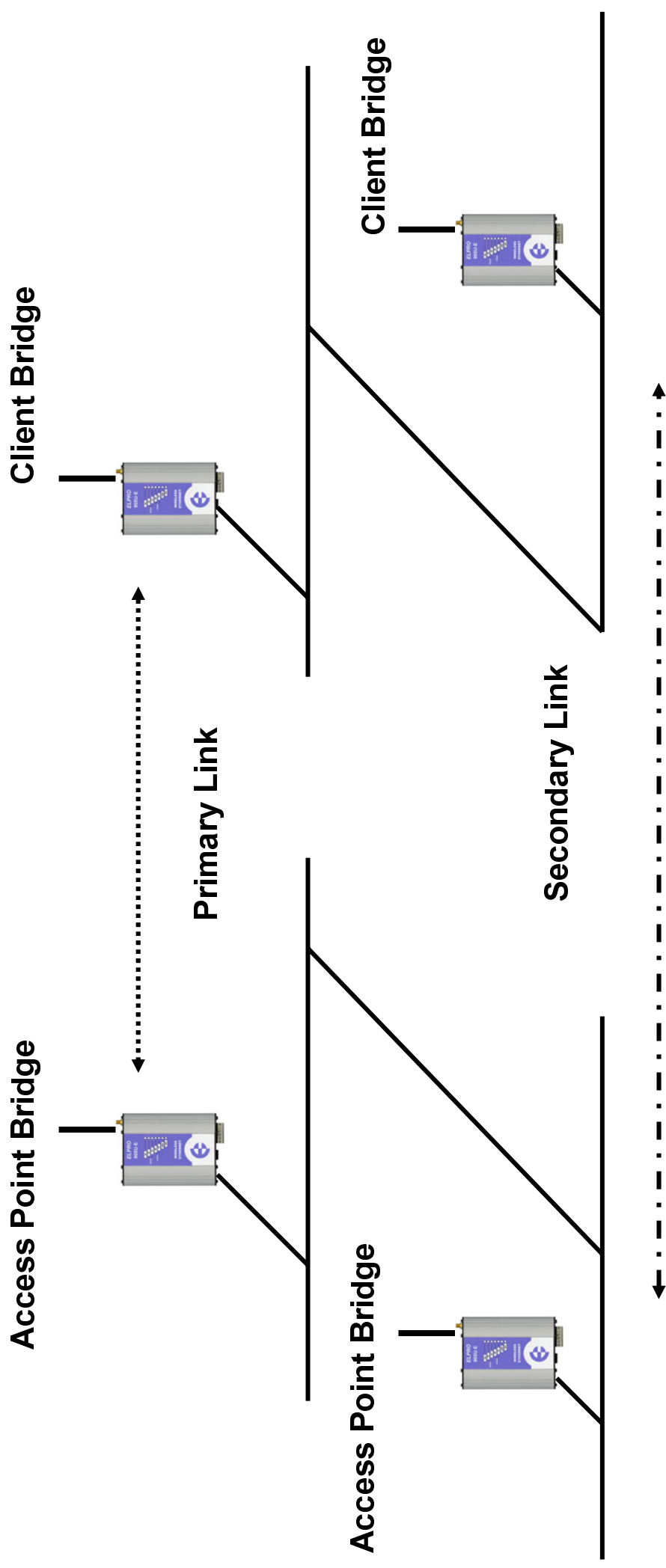
- Industrial Ethernet
 - Redundancy From ‘Redundant Ring Protocols’
 - Spanning Tree Protocol (STP)
- Wireless Ethernet Solutions
 - Spanning Tree Protocol Available
- Spanning Protocol Available On All Frequencies
 - 2.4 GHz
 - 869 MHz

Wireless Solutions – Redundant Network Solutions

- STP (Spanning Tree Protocol)
 - Designed To Handle Network Loops / Redundant Paths
 - Redundant Paths ‘Blocked’ Until Required
- Each Device On The Network Given Priority
 - The Lowest Number Is Root Node And Will Direct Traffic
 - Traffic Directed Across Network
- Care Needs To Be Taken As STP Consumes Network Traffic

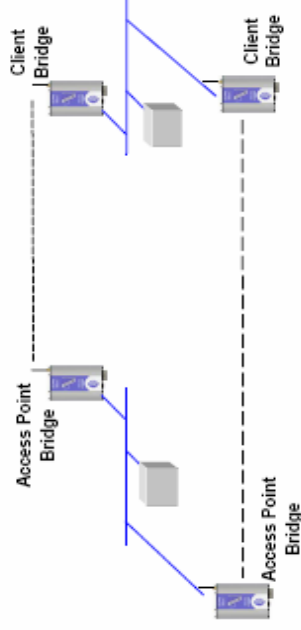


Wireless Solutions – Network Routing



Wireless Solutions – Wireless Connections

- How Are Connections Established?
 - Access Point
 - On Start Up – Radio Send Out ‘Beacons’ Or Link Requests
 - Beacon Period – Manual / Automatic Configuration
 - Client
 - Scan For Messages From Access Point
 - Attempts To Connect To Strongest Beacon Signal
 - Client Link
 - Authentication Check
 - Request Link
 - Link Established
 - Access Point
 - Link Established
 - Master – Takes Full Control Of Messages



Wireless Ethernet – Key Points

- ✓ Highlighted Different Types Of RF Frequencies
 - ✓ Effective Bandwidths
- ✓ Transmission Distances
 - ✓ 869 MHz – 6 > 8 KM
 - ✓ 2.4 GHz – 100 M
- ✓ Ability To Route / Bridge Networks
- ✓ Network Redundancy Solutions





Wireless Solutions



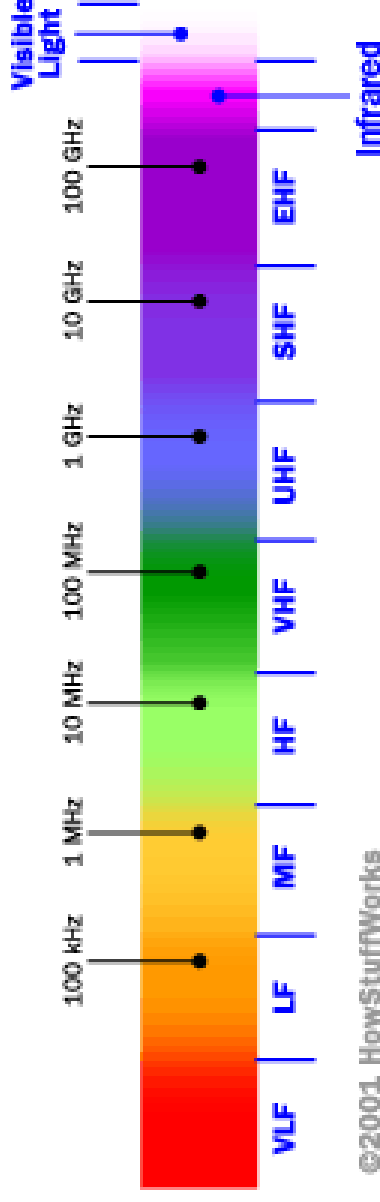
Network Security

Network Security

- **Different Protocols / Security Methods**
 - **Password Protection**
 - **MAC Address Filtering**
 - **White List (Enables Only Listed Devices)**
 - **Black List (Denies Listed Devices)**
 - **WEP Encryption**
 - **WPA 1**
 - **WPA 2**
 - **AES / Military Encryption**
 - **Proprietary Encryption**



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Network Security – Physical Limitations

- 2.4 GHz
 - Easy To Find (Simple To Use PC To Connect To)
 - Easy To Sniff / Examine Data
- 869 MHz
 - Difficult To Find (PC Not Able To Connect To Frequency)
 - Difficult To Examine Data



Network Security

- **MAC Address**
 - **Manually Build Table Of 'Allowed' Devices 'Whitelist'**
 - **Manual Build Table Of 'Denied' Devices 'Blacklist'**
- **Software Tools Readily Available That Can Emulate MAC Addresses**
- **This Known As Spoofing**



Network Security

- WEP
 - Wired Equivalency Protocol
 - Suitable For Home / Small Office Applications
 - 64 or 128 Bit Keys Available
 - Full Of Known Flaws
- Very Easily Cracked
 - 5 / 10 Million Sniffed Packets Required To Break The Key
 - Cracking Tool – Makes No Difference With Key Length
 - 30 Minutes Average Crack Time!





Network Security (2.4 GHz)

- **WPA**
 - **WiFi Protected Access**
 - **PSK**
 - **Pre Shared Key**
 - **Common In Homes And Small Businesses**
 - **Passwords Are Used To Enter The Network**
- **AES**
 - **Advanced Encryption Standard / System**



Network Security (2.4 GHz)


- **WPA 2**
- **As WPA – Stronger Algorithm – Not Backwards Compatible**
- **Military Grade Encryption / AES**
- **Set Up Passwords / Authorization Through Server**



Network Security (869 MHz)

- **869 MHz Frequency Difficult To Eavesdrop**
- **WEP / WPA Encryption Available**
- **Proprietary Encryption Also Available**
- **Unlike WEP / WPA Above Encryption Not Ready Available**

Wireless Ethernet – Key Points

- 
- ✓ Highlighted Different Types Of RF Frequencies
 - ✓ Effective Bandwidths
 - ✓ Transmission Distances
 - ✓ 869 MHz – 6 > 8 KM
 - ✓ 2.4 GHz – 100 M
 - ✓ Ability To Route / Bridge Networks
 - ✓ Network Redundancy Solutions
 - ✓ Security

Implementing A Network

- Site Surveys
 - 869 MHz
 - Open 'Unlicensed' Frequency
 - Governed And Controlled By OFCOM
 - Sites That Consume Complete Bandwidth – Breaks The Law
 - OFCOM Can And Will Close Down Systems That Break The Law
 - Site Surveys Possible With Radios / Scanners / Antenna Selection
 - Worst Case Tests First - Lowest Antenna Height / Low Gain Antenna
 - BERT (Bit Error Rate Test)
 - GPS Positioning Of Antenna (For Future Reference)
 - Location and Orientation Of Antenna
 - Final Antenna / Cable Selection






Implementing A Network

- **Site Surveys**
 - **2.4 GHz**
 - **Totally Open Frequency**
 - **No Control Of Frequency Allocation**
 - **BERT – Checks**
 - **GPS Positioning Of Antenna**
 - **Location And Orientation Of Antenna**
 - **Antenna / Cable Selection**

Wireless Ethernet – Key Points

- ✓ Highlighted Different Types Of RF Frequencies
 - ✓ Effective Bandwidths
- ✓ Transmission Distances
 - ✓ 869 MHz – 6 > 8 KM
 - ✓ 2.4 GHz – 100 M
- ✓ Ability To Route / Bridge Networks
- ✓ Network Redundancy Solutions
- ✓ Security
- ✓ Site Surveys



- 
- ✓ **Understand The Frequencies**
 - ✓ **Ensure The Application and Frequencies Are Combatale**
 - ✓ **Transmission Distances**
 - ✓ **Understand The Limitations Of Transmission Distances**
 - ✓ **Ability To Route / Bridge Networks**
 - ✓ **Routing / Bridging & Repeating Enable Multiple Solutions**
 - ✓ **Network Redundancy Solutions**
 - ✓ **Enable Reliable and Resilient Networks**
 - ✓ **Security**
 - ✓ **Various Levels Of Security Ensure Secure Network**
 - ✓ **Site Surveys**
 - ✓ **Carrying Out A Site Survey Ensure Solution Will Work In Exact Environment**



Technology In Action

Stand D109

