

Wireless Systems – An Overview



What are wireless technologies

- Mobile Phones
- Radios, Analogue, Digital
- TV
- Wi-Fi
- Car key fobs
- E-mail
- Live Streaming
- Data Modems



Wireless Technology is 'Everywhere'



- **If Wireless technology is everywhere! Why have we struggled to solve the problem with using it in our industry.**

- Market size
- Variety of offering required
- Power requirements
- System Design



Market Size - We are a Small Market



- Our market size is too small and varied for it to be addressed by the larger telecoms companies or for us to address it properly ourselves, so we rely on modules and sub assemblies from the manufacturers.
- The focus commercially is on 2.4Ghz and GPRS which does not address our need's. The cost to CE compliance test for R & TTE of a finished transmitting product is £35000-£40000!
- We have too many different scenarios for single product solution
 - Types of Sensor, Location, Output
- As the quantities are low and the offering varied. Inevitably the costs of wireless systems are high whether upfront or as maintenance

Variety - Sensor Inputs



- **Voltage/Current/Resistance**
 - Easy to accommodate
 - Cable replacement systems available
 - Multiplexors required for more than 5 channels usually
- **RS485**
 - No need for local interface
 - Multiple units into one node for no extra cost.
- **Vibrating Wire**
 - Must have local excitation Module for the sensor
 - Multiplexing required to get more than two sensors

Variety - More Sensor Inputs



- Pulsed
- Frequency (Without Excitation)
- Modbus
- SDI12
- RS232
- RS422

With all these variations it is difficult to make an offering that is a cover all solution.

Variety - Wireless Technology Signals



There are many wireless data transfer methods we can use not just GPRS and 2.4 GHz

GPRS Phones, Modems



Blue tooth Phones, Laptops



5.8GHz Security Cameras

2.4 GHz Wi-Fi, laptops, data modems

900 MHz Radios

450 MHz Car key fobs

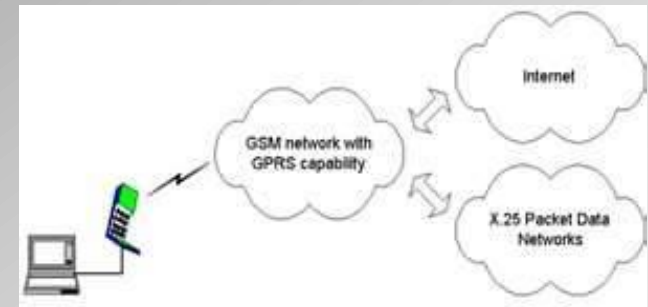


Signal Type



- **GPRS**

- Very stable
- Not effected to easily by line of sight
- High data transfer capacity
- Not guaranteed Signal Coverage
- Not suitable in deep basements and tunnels



- **GSM**

- Can transfer good amounts of data
- Reliable signal coverage
- Not effected to easily by line of sight
- Not suitable in deep basements and tunnels
- Difficult to obtain correct sim cards for data

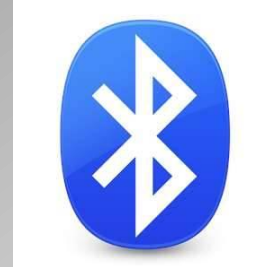


Signal Type



- **Bluetooth**

- Can transfer data quickly
- License free
- Readily available components and modules
- Short wave length reduces range to power ratio.
- Easily blocked by obstacles



- **2.4 GHz**

- License free
- Readily available components and sub components.
- Capable of transferring data quickly
- Short wave length reduces range to power ratio.
- Easily blocked by obstacles

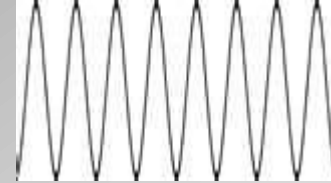


Signal Type



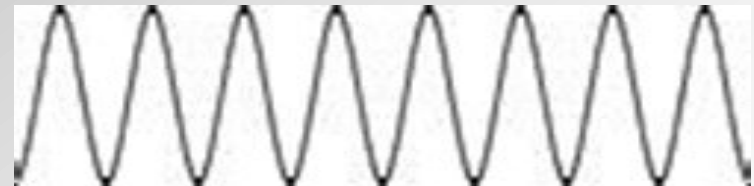
- **900 MHz**

- Many license free bands
- Medium wave length
- Mid range to power ratio
- Offers Resistance to obstacles
- Data Transfer rate Mid range



- **450 Hz**

- License free
- Long wave length
- Good range to power ratio
- Not easily blocked by obstacles
- Slower data transfer



Variety - What is required of the system!



- How often does it need to record data?
- How often does it need to transmit data?
- Is there room for Solar power?
- Is the site urban/rural?
- Single instruments or Clusters?
- Will the logging interval need to be adjusted
- Will line of sight change

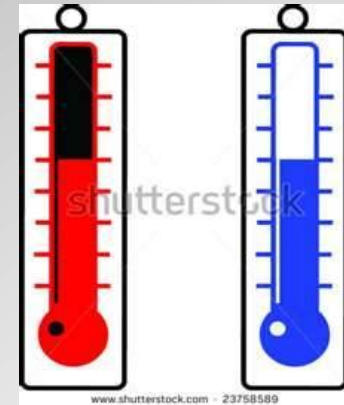
Variety - Range



The ranges we need to transmit over vary from 100m to 10km. Range is dependent on too many variables to be constant . Range in most cases is not meaningful as a specification.

- **Weather**

- Humidity
- Temperature



- **Line Of Sight**

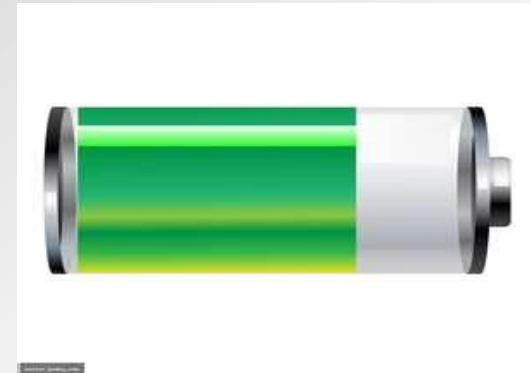
- Trees
- Buildings
- Traffic

- **Power**

- Battery Voltage

- **Aerial**

- Type
- Position
- Gain



Variety - Aerials



The type and position of an aerial is of critical importance to how a wireless system performs

- **Type**
 - Board Mounted
 - Stub
 - Flexible
 - Correct length Aerial for Emissions
- **Position**
 - Board Mount
 - Cabinet Mount
 - Outside of the box
 - Height
- **Gain**
 - Standard
 - High Gain



Power - Management



Why is power management important

- Air is a poor conductor and transferring data through it takes much more energy than along a cable
- Wireless systems are very power hungry when turned in receive or transmit mode
- Batteries don't last forever but are getting better
 - Lead Acid – Typical 6 D-cells in series.
 - Alkaline Batteries
 - Lithium Ion

Terminology



Wireless systems are made up of the following components

- **Transmitters**
 - Transmit Data, Radio Masts, TV Masts
- **Receivers**
 - Receive Data, TV, Radio
- **Transceivers**
 - Transmit and receive, Mobile Phones, Laptops
- **The main transmitting function normally mains powered and constantly functioning.**
 - Radio towers
 - Wi-Fi (Home Hubs)
 - Mobile Phone masts

Power - Great for Convenience bad for power consumption.



- When you ask the Wi-Fi for information it is already awake and gives it to you.
- When you turn the TV on the signal is there and you can watch
- When you dial a number the mast receives and you can talk

We require our low power draw components to be transmitters which makes it difficult to get a good range, battery life, flexibility mix

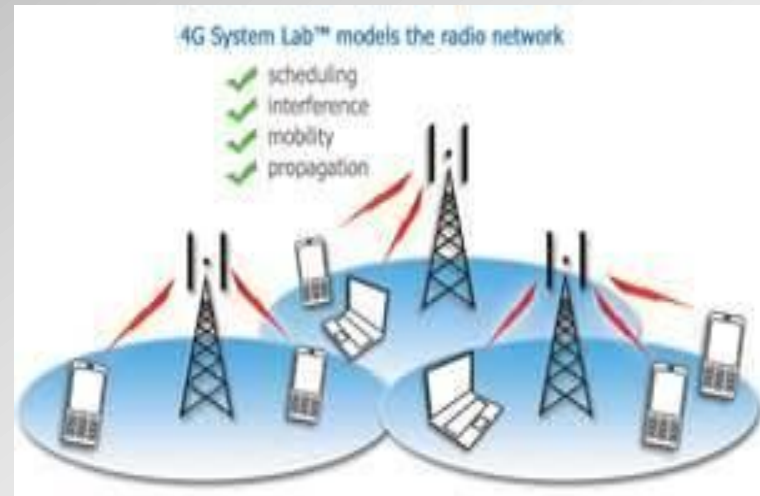
Power can be managed much more effectively with a good system design which we will now explore.

System Design



One of the most important aspects of system design is deciding which parts of the system you want to be clever and have Intelligence?

- What is intelligence?
 - Can it turn itself on and off
 - Can it capture data
 - Can it process data
- Where is it?
 - Sensor
 - Wireless Node
 - Receiver
 - Software



Intelligence in sensor



Pros

- Data security
- Localised Calibration Data
- Remote programming
- Flexible



Cons

- Expensive as every sensor has processing
- More complex and more likely to go wrong
- Power hungry

Intelligence in Wireless Node



Pros

- Useful for power management
 - Sleep function
 - Shuts down if no signal
- Self healing networks
- Remote Programming
- Cost reduction over intelligence in sensor

Cons

- Cost increase over a dumb cable replacement modem

Intelligence only in Main Station/Software



Pros

- Cheapest Hardware Option
- Flexible Data Obtainment

Cons

- Very power hungry



Wireless Network types

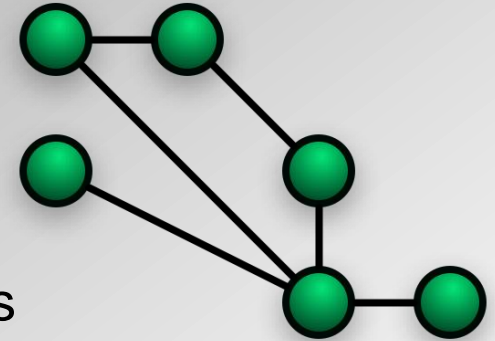


Mesh Network

No central node all nodes are able to communicate to each other.

- Self healing capability, the path of data transfer is not fixed
- System is stable
- Fault finding within the system is difficult
- Many extra nodes needed if range is large
- Draws more power than a star

Good for sites where traffic and line of site may vary as the complex algorithm allows other paths to be found through the nodes back to the gateway.



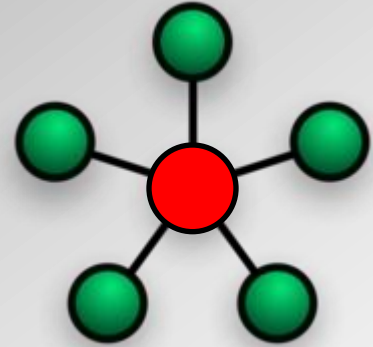
Wireless Network types



Star Network

Gateway to which all the other nodes communicate

- More efficient on power as data packets cannot be passed around multiple routes.
- Faulty nodes do not effect the rest of the network
- Easy to detect faults and replace units without effecting other links
- Heavily reliant on central node if it goes down so does the system



Very good on sites that are large and open such as open cast mining

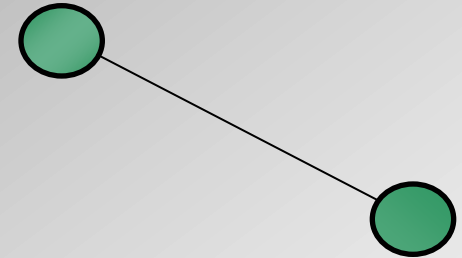
Wireless Network types

Point to point

This is the most basic network available and involve one node talking to another node with no other network.

- Basic and easy to use
- Simplest form of network
- Not very Flexible
- Only suitable for simple jobs

Very good for monitoring large areas where the points are sparsely spread. Environmental monitoring over large areas.



Moving Forwards

- **More custom designed systems**
- **Migration away from 2.4 GHz**
 - (No need to use a hammer to crack an egg)
- **Mesh networks with 450mhz**
- **New Battery Technologies**
 - Mobile phone and laptop battery technology migration into the less commercial fields.
- **Energy Harvesting**
 - Vibration
 - Solar
 - Thermal

END

THANK YOU



13:15 – 14:15

Executive Buffet Lunch

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