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Strategic Implementation of Wireless Technologies

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Why Wireless?

- Offers adopters significant strategic advantage in terms of:
  - Cost Savings
    - Engineering
    - Installation
    - Logistics
  - Dramatic improvement in the frequency and reliability of data

Key Drivers

- Installation Savings
- Better Information
- Economies of Scale
- Operational Savings
- Safety

Wireless Evaluation Criteria

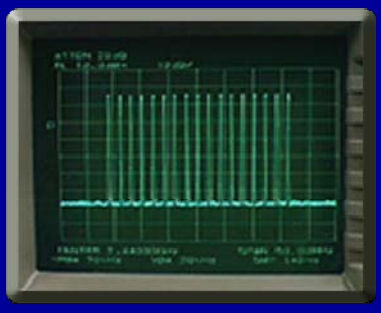
- RF Technology
- Security
- Interference Rejection
- Sensitivity
- Power Management
- Legacy System Integration
- Backwards Compatibility

RF Technologies

- Unlicensed vs. Licensed
  - Unlicensed
    - In 1985, the FCC permitted use in the ISM Bands
    - (902-928MHz, 2.4-2.4835 GHz, 5.725-5.85 GHz)
    - Power levels up to 1 Watt
  - Licensed
    - VHF/UHF
    - Only operate within Licensed area

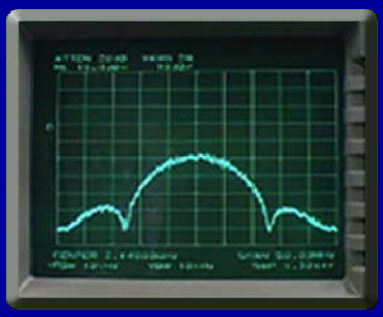
Unlicensed Spread Spectrum

- Frequency Hopping Spread Spectrum (FHSS)



Unlicensed Spread Spectrum

- Direct Sequence Spread Spectrum (DSSS)

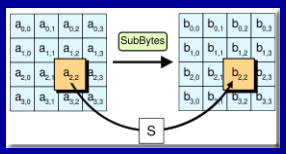


Spread Spectrum Advantages

- No License Required
  - Not limited to a single geographic location nor has a defined term for use.
- Interference Rejection
  - Quickly hops pseudo-randomly through multiple channels, allocating a specific time slot and frequency for its transmission providing inherent immunity to interference.

FHSS Characteristics

- Security
  - Communication frequency changes rapidly
    - FHSS appears to be short duration impulse noise to an untended receivers.
  - Advanced Encryption Standard (AES)
    - 128 & 256 bit Encryption Keys



FHSS Characteristics

- Data Integrity
  - Error Checking

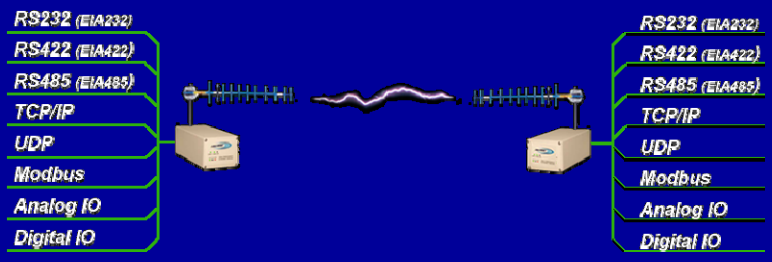
    - Uses Cyclic Redundancy Check, giving each packet a unique digital signature guaranteeing what is received is identical to what was sent
    - As width of the CRC increases, so does the probability of error detection.
      - » 8 Bit CRC – 99.6094%
      - » 16 Bit CRC – 99.9985%
      - » 32 Bit CRC – 99.9999%

FHSS Characteristics

- Sensitivity
  - Very Important as the more sensitive the receiver is, the weaker the transmitted signal can be
  - Sensitivity is expressed in terms of dB
    - *Example:* a receive sensitivity of -110 dBm is better than a receive sensitivity of -107 dBm by 3 dB, or a factor of two. In other words, at a specified data rate, a receiver with a -110 dBm sensitivity can hear signals that are half as strong as a receiver with a -107 dBm receive sensitivity.

FHSS Characteristics

- Flexibility
  - Operation of different protocols over the same communications layer

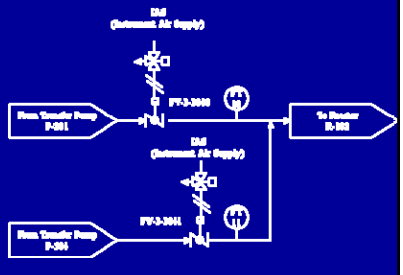


FHSS Characteristics

- **Temperature Range**
  - **Reliable Operation within industrial temperature ranges (i.e. -40° to +75° C).**
- **Operation in Hazardous Environments**
  - **UL certification for Class 1, Division 2 environments permitting radio operation in the presence of flammable or explosive gases, fluids or vapors.**

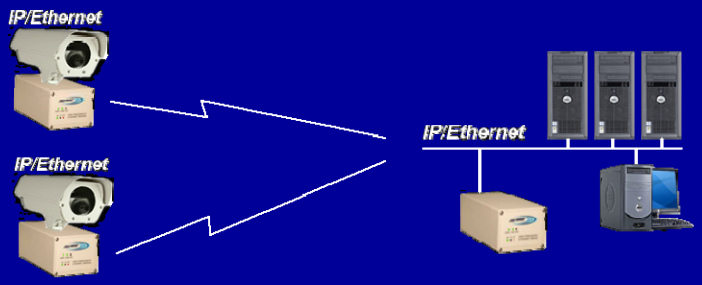
Applications

- **Wireless I/O**
  - **Conduit & Wire Replacement**
    - **Analog & Digital IO**
      - Turn Pumps On/Off
      - Actuation of Valves
      - Remote transmitters



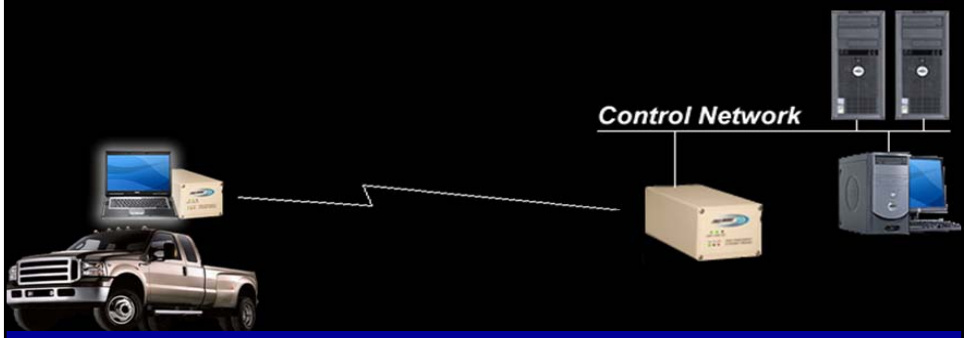
Applications

- **Security**
  - **Detect intrusions, control access, or perform video surveillance within facility.**



Applications

- **Workforce Mobility**
  - **Allows mobile workers to access applications and perform jobs where they work.**



Applications

- Mobile Asset and Material Tracking
  - Tracking asset location allows for better use of assets as well as regulatory compliance for the use, storage and transport of hazardous chemicals.

Applications

- Integration of Technologies
  - Integrate Wireless Sensor Networks with other technologies providing greater potential for widespread applications.

Closing

- **Information is Power.**
- **The ability to gather time-critical information, digest it and react to it is the key to continuously adapting to change with increasing reliability and profitability.**