

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

**Submission Title:** [Interference Mitigation for IEEE802.15.4k LECIM Networks]

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**Re:** []

**Abstract:** [A PHY Proposal for Low Energy Critical Infrastructure Networks Applications]

**Purpose:** [To be considered in IEEE 802.15.4k]

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# Interference Mitigation for IEEE802.15.4k LECIM Networks

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# Outline

- Frequency Bands
- Available Methods for PHY
- CLON & Cluster Topology
- Interference Mitigation Methods

## Frequency Bands

- The frequency bands under considerations are:

| Frequency Band (MHz) | Symbol Rate (ksps) | Channel bandwidth (kHz) | Modulation |
|----------------------|--------------------|-------------------------|------------|
| 863-870              | -                  | -                       | -          |
| 902-928              | -                  | -                       | -          |
| 950-958              | -                  | -                       | -          |
| 2360-2400            | -                  | -                       | -          |
| 2400-2483.5          | -                  | -                       | -          |

# Frequency Bands

- The list of other IEEE 802 standards that share the 2400-2483.5 GHz

| Standard | PHY specification |
|----------|-------------------|
| 802.11b  | DSSS – CCK        |
| 802.11g  | OFDM – QAM        |
| 802.11n  | MIMO OFDM – QAM   |
| 802.15.1 | FHSS – GFSK       |
| 802.15.4 | DSSS – O-QPSK     |
| 802.15.6 | D-MPSK            |

- The list of other IEEE 802 standards that share the 863-870 MHz, 902-928 MHz and 950-958 MHz bands

| Standard | PHY specification                          |
|----------|--|
| 802.15.4 | DSSS – BPSK<br>DSSS – O-QPSK<br>PSSS – ASK |
| 802.15.6 | D-MPSK                                     |

# Available Methods for PHY

- Time Division Multiplexing (TDM) is used in one CLON for different end points
- CLONs can use different frequency bands (channels) with different center frequencies
- Frequency Division Multiplexing (FDM) based orthogonality is thus utilized among CLONs
- Code Division Multiplexing (CDM) based orthogonality can be further adopted for multiple clusters of CLONs. (e.g., short PN codes for multi-cluster identification)

# Interferences

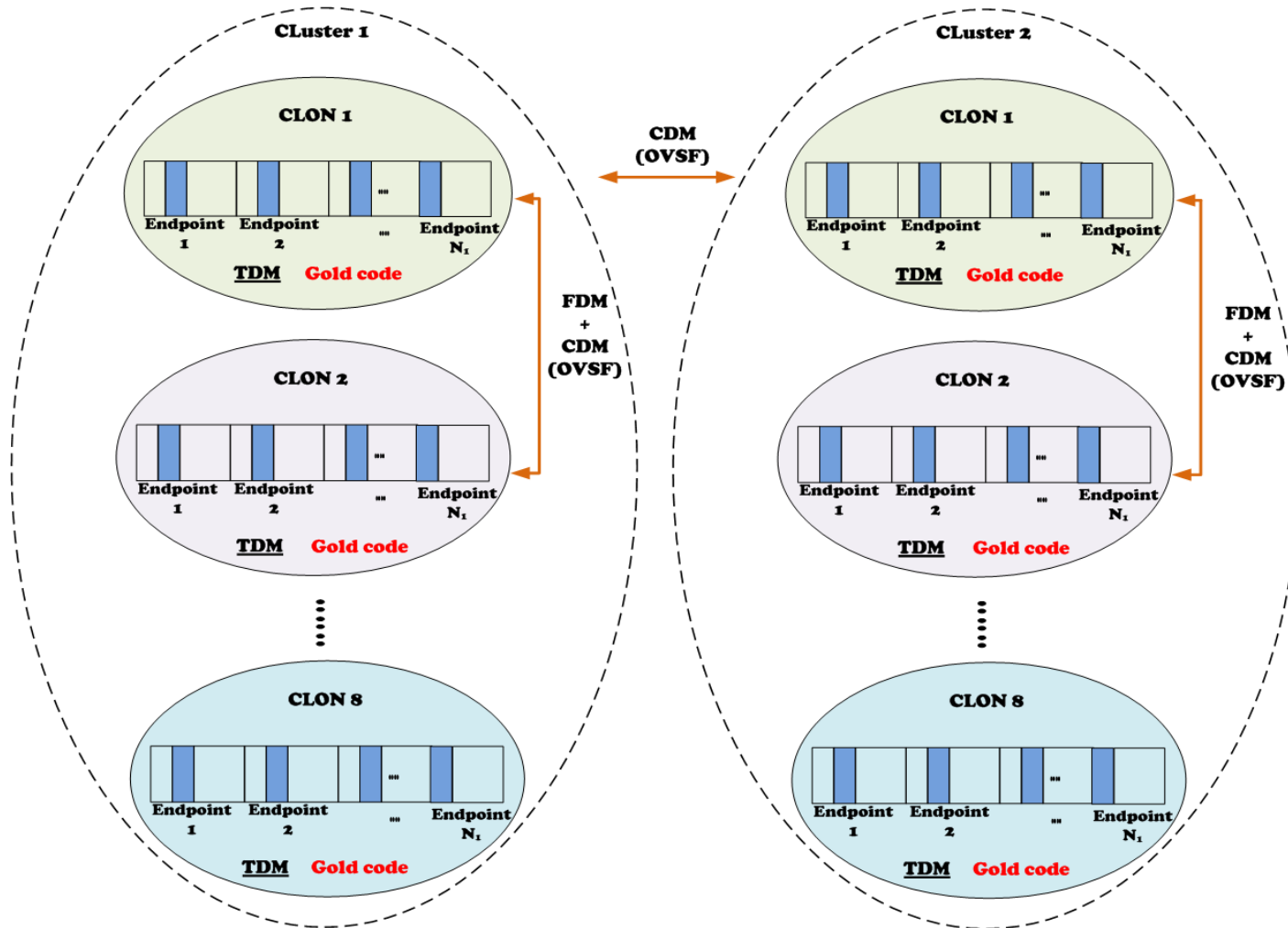
- The major interference occurs at three levels.
  - Intra CLON
  - Inter CLON
  - Inter CLUSTER
  
- **Intra CLON**
  - The interference here occurs due to communication between end devices in a CLON network. A TDM technique with Gold code is to be used between end device communications.

# Interferences

- **Inter CLON**
  - There are eight CLONs in a cluster. Interference is caused by one CLON to another CLON in the network. FDM technique with CDM (OVSF) is to be used for communication between two CLONs.
- **3 Inter CLUSTER**
  - Interference can be caused by external networks. In an area there can be several clusters.
  - There are also other networks (LAN, PAN, RAN etc) present in the same area.
  - They will cause interference to the LECIM network. A CDM technique employing OVSF code is used to mitigate external interference.

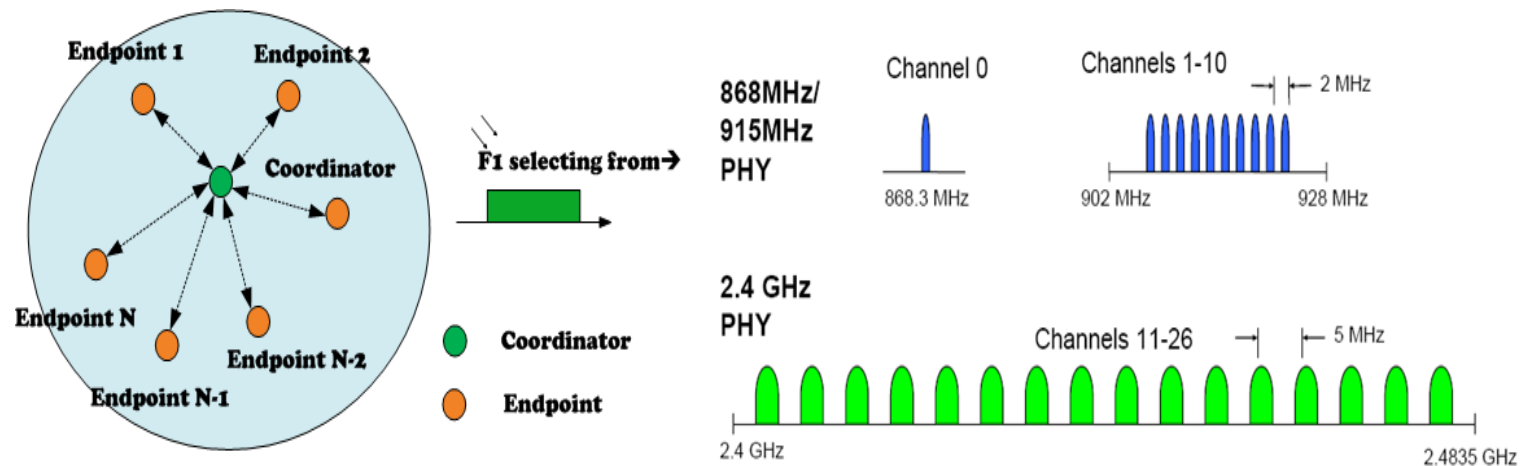


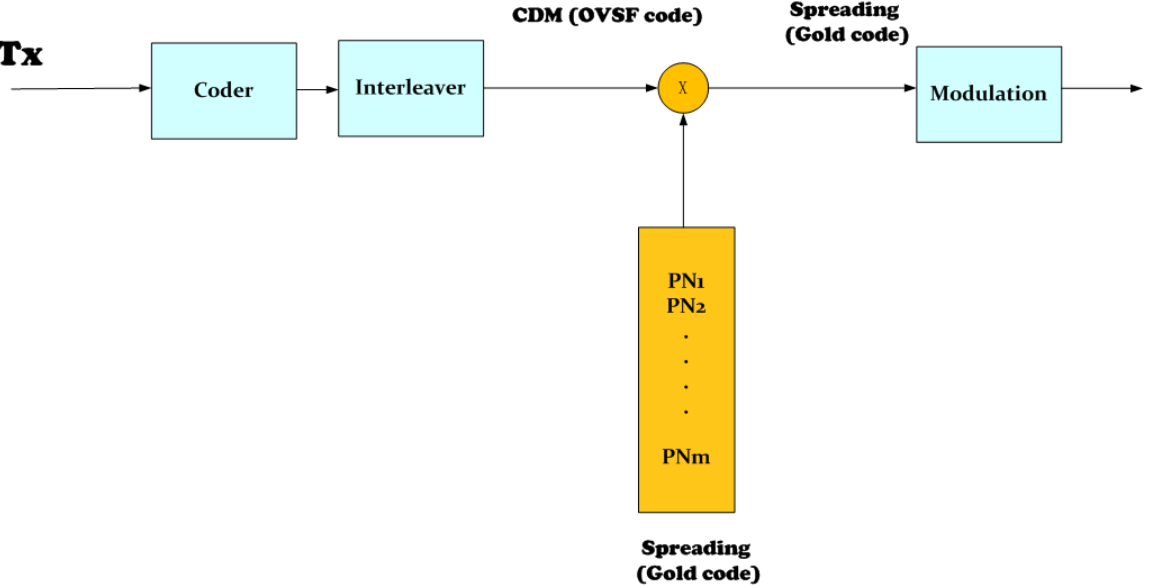
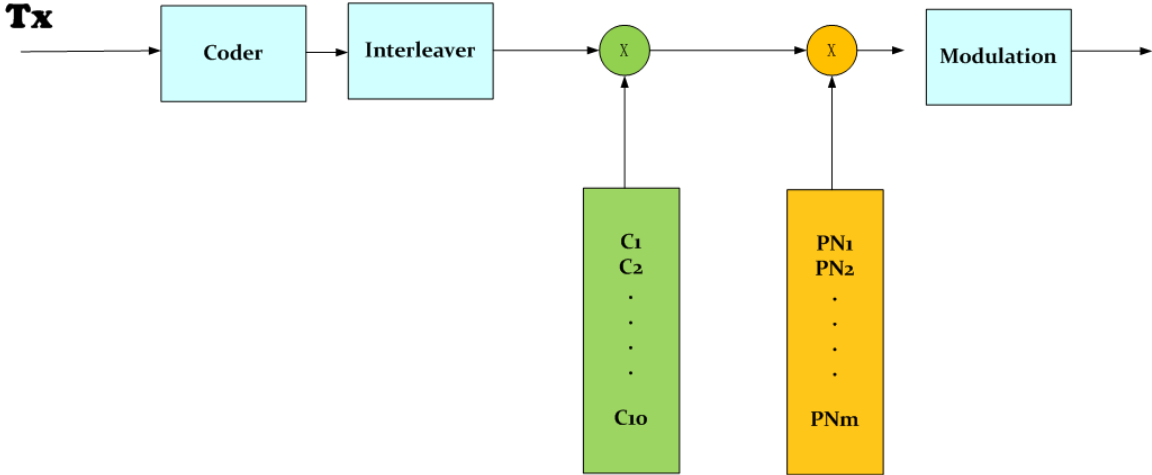
# CLON & Cluster Topology



## CLON & Cluster Topology

- The major approach to mitigate interference for both internal and external interference is to use TDM, FDM and CDM with Gold code (PN sequence) and Orthogonal Variable Spreading Factor (OVSF) code.
- Gold code is to be used as primary for operation inside a CLON. OVSF code is to provide double protection from external interference.





# Interference Mitigation Methods

- Clear Channel Assessment (CCA)
  - Energy detection and/or carrier sense
- Dynamic channel selection
  - Channel switching
- Low Duty cycle
- Passive scanning
- LQI and RSSI
- Transmit power control
  - Limited transmission power
- Slow channel hopping at MAC layer

The End

Thank You