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

**Submission Title:** [Code Performance Comparison  for IEEE802.15.4k LECIM]
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**Source:** [Kyungsup Kwak, Jaedoo Huh*, M. Al Ameen, Yongnu Jin, Hong W. Liu]
**Company:** [Inha University, *ETRI]
Address [428 Hi-Tech, Inha University, 253 Yonghyun-dong, Nam-gu, Incheon, 402-751, Republic of Korea], [ETRI, 161 Gajeong-dong, Yuseong-gu, Daejeon, 305-700, Republic of Korea]*
Voice: [+82-32-860-7416], FAX: [+82-32-876-7349],
E-Mail: [kskwak@inha.ac.kr]
**Re:** []

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

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

# Contributors

| Name | E-mail | Affiliation |
|------|--------|-------------|
| Kyung Sup Kwak | kskwak@inha.ac.kr | Inha University |
| Jaedoo Huh | jdhuh@etri.re.kr | ETRI, Korea |
| M. Al Ameen | m.ameen@hotmail.com | Inha University |
| Yongnu Jin | jyn4941@163.com | Inha University |
| Hong W. Liu | hong.w.liu@hotmail.com | Inha University |

# Outline

❑ Cluster and CLON Topology

❑ Interference in LECIM network

❑ Performance comparison with two code Schemes

❑ Performance under MUI within the homogeneous system

❑ Performance under MUI with the heterogeneous systems

❑ Performance under Doppler effect

# 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)
    - with Orthogonal Variable Spreading Factor (OVSF) code + Gold code
- Gold code is used as primary for Spreading/Multiple Access operation inside a CLON
- OVSF code provides protection from external interference
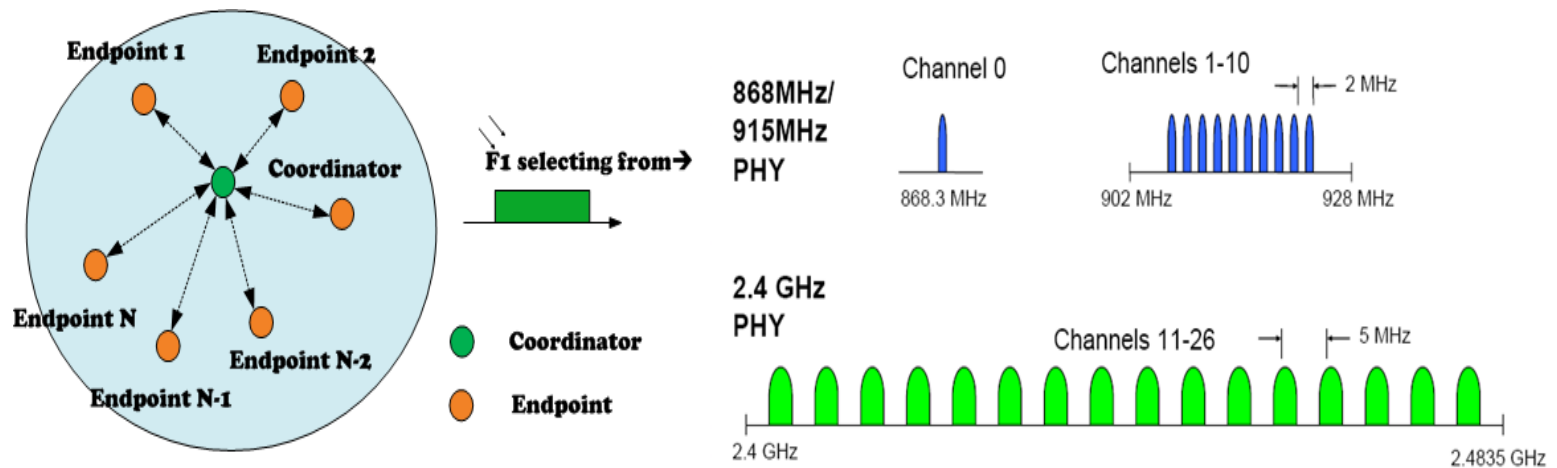
# CLON & Cluster Topology
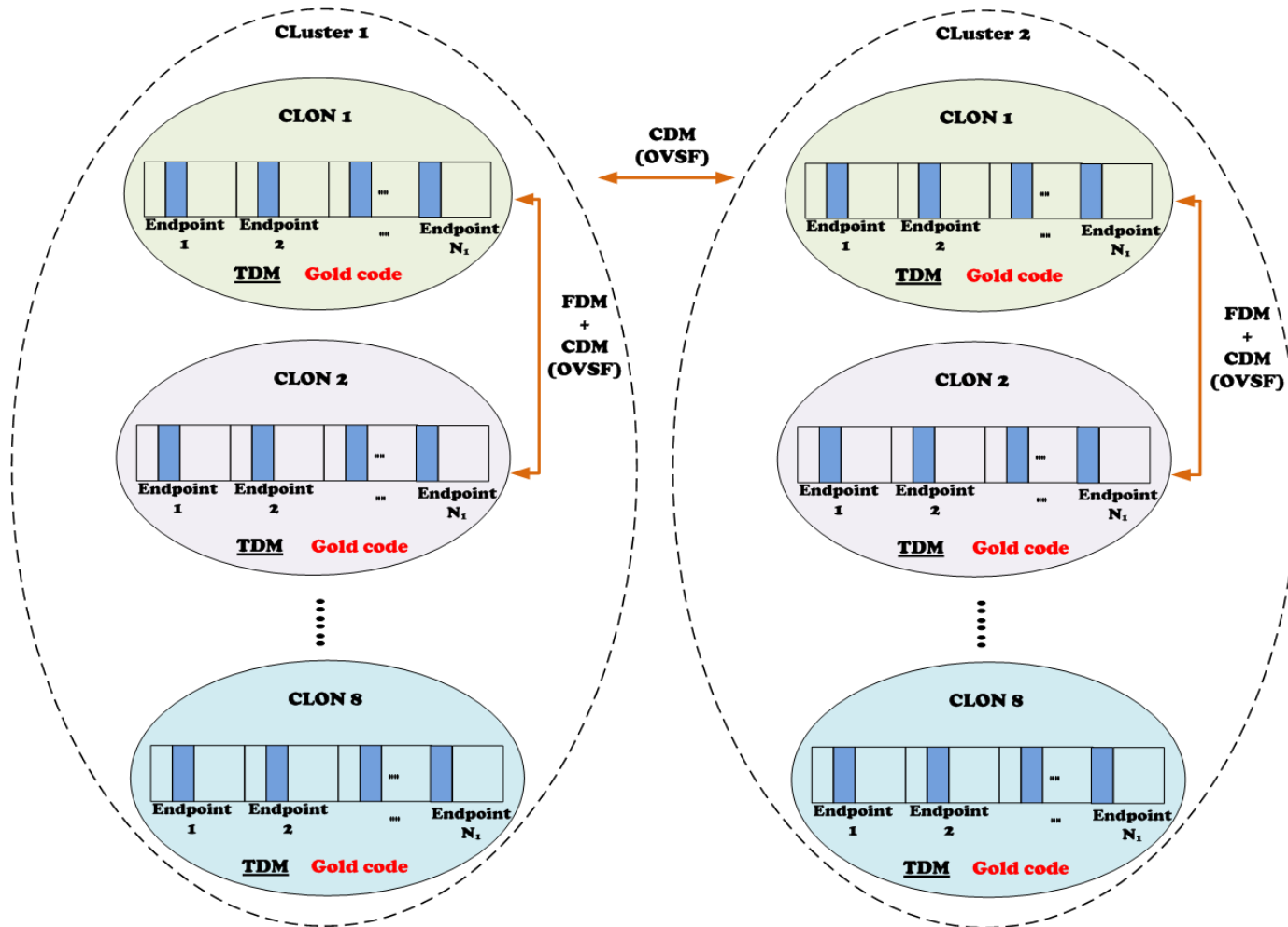
# Interference models in LECIM (1)

- 8 CLONS are used in LECIM which forms one cluster
- The major interference occurs at three levels
  - Intra CLON
  - Inter CLON
  - Inter CLUSTER
  - From other systems (networks): WiFi, Zigbee, WBAN, SUN
- **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.

# Interference Models in LECIM (2)

- **Inter CLON**
  - There are eight CLONs in a cluster. Interference is caused by one CLON to another CLON in the network.
  - A FDM technique with CDM (OVSF) is to be used for communication <span style="color:red">among CLONs and to mitigate the interferences from other networks</span>
  - There are also other networks (LAN, PAN, RAN etc) present in the same area.
- **Inter CLUSTER**
  - Interference can be caused by external networks. In an area there can be several clusters.
  - They will cause interference to the LECIM network.
  - A CDM technique employing OVSF code is used to mitigate external interference.

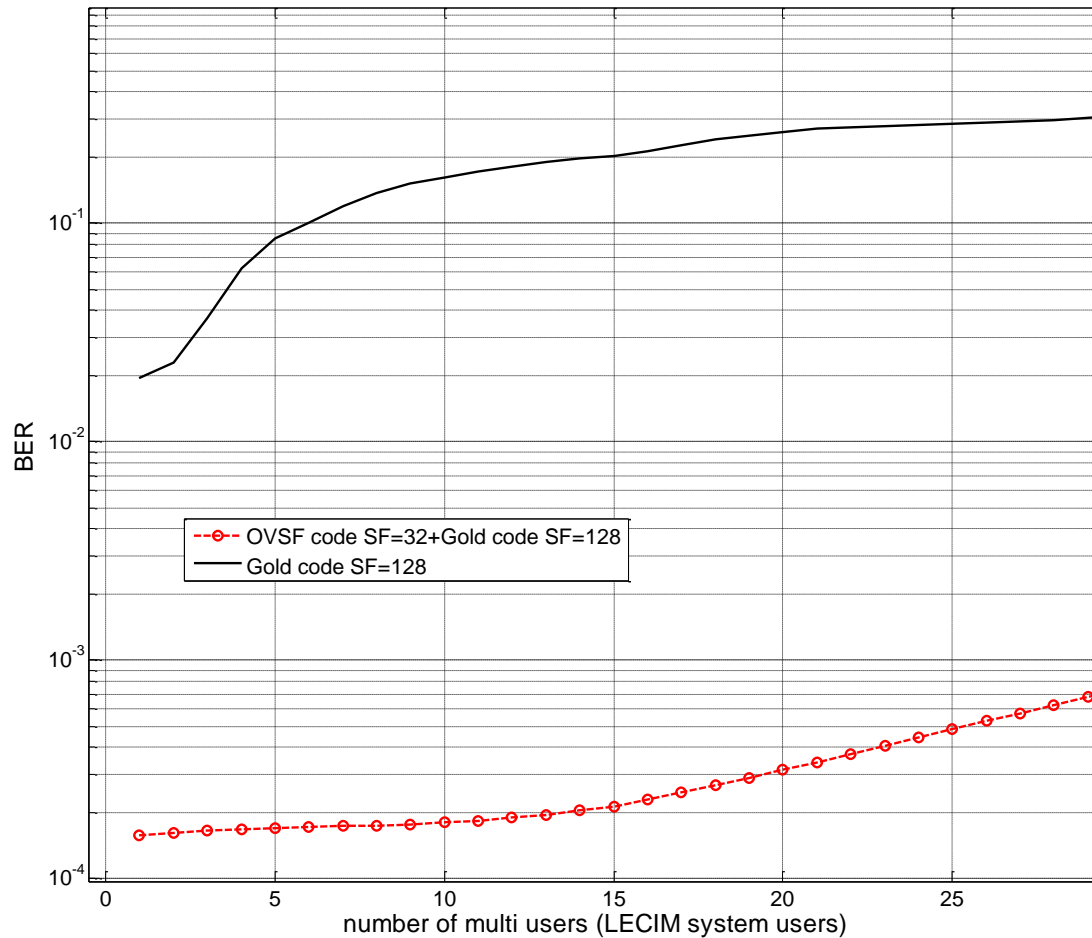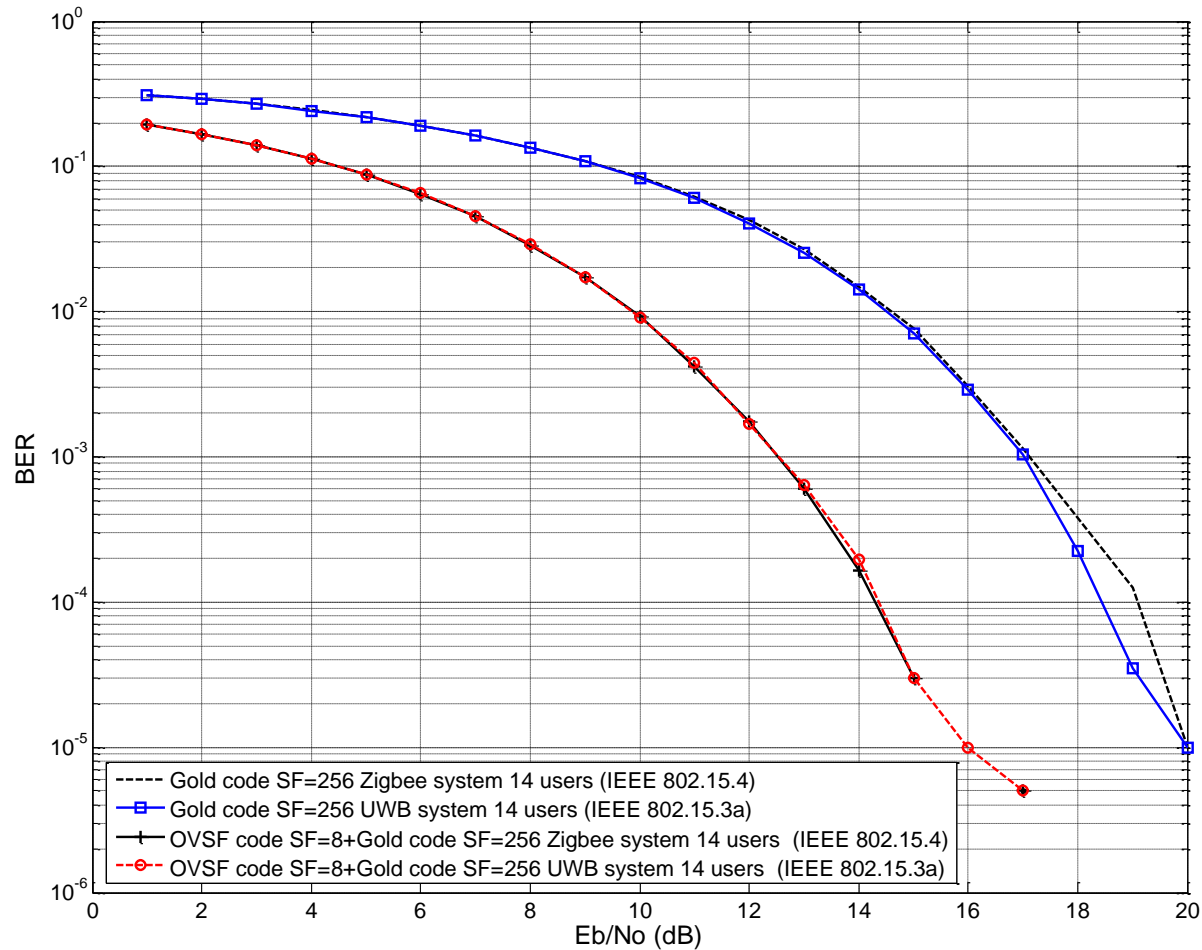# Models of two Code schemes with OVSF code and Gold code
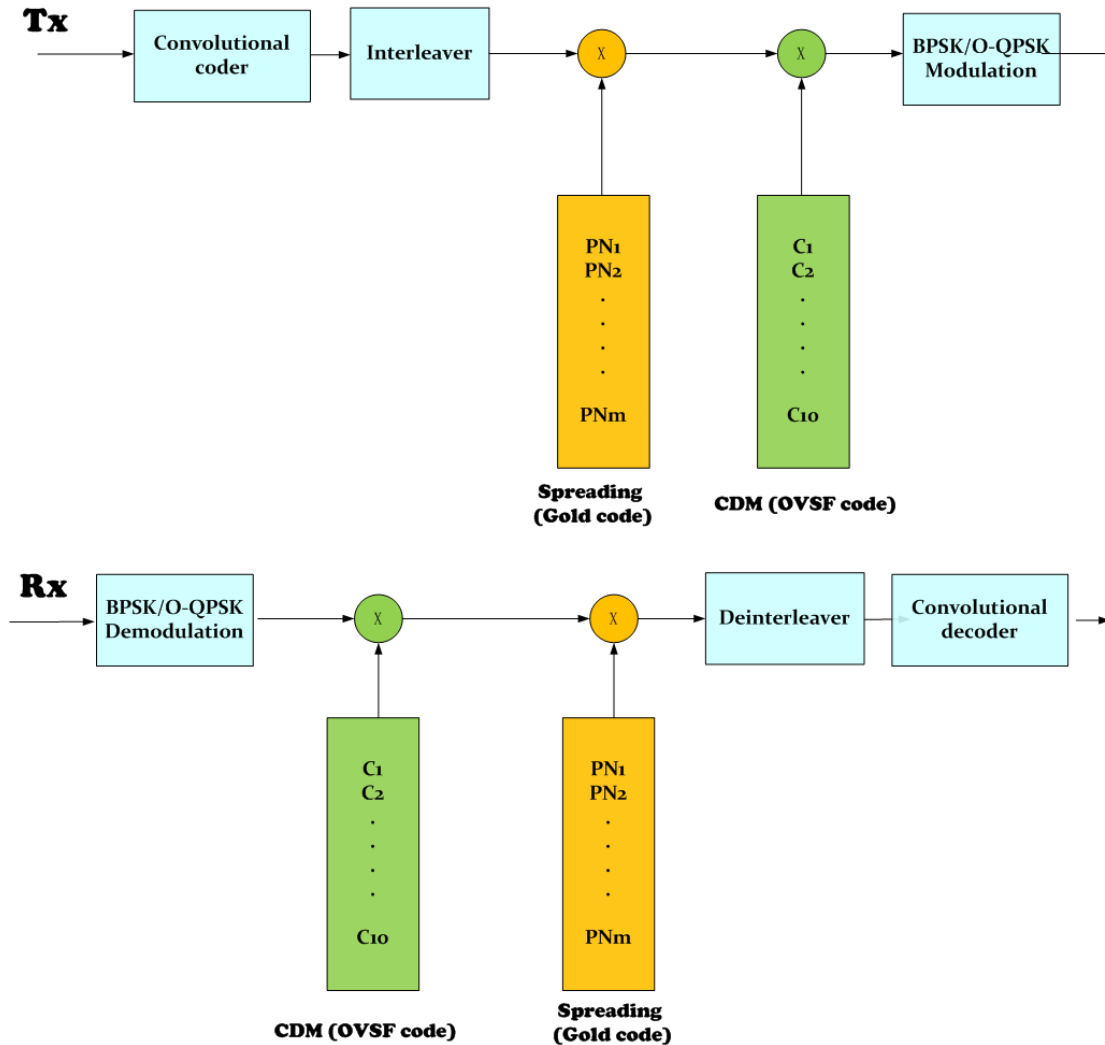
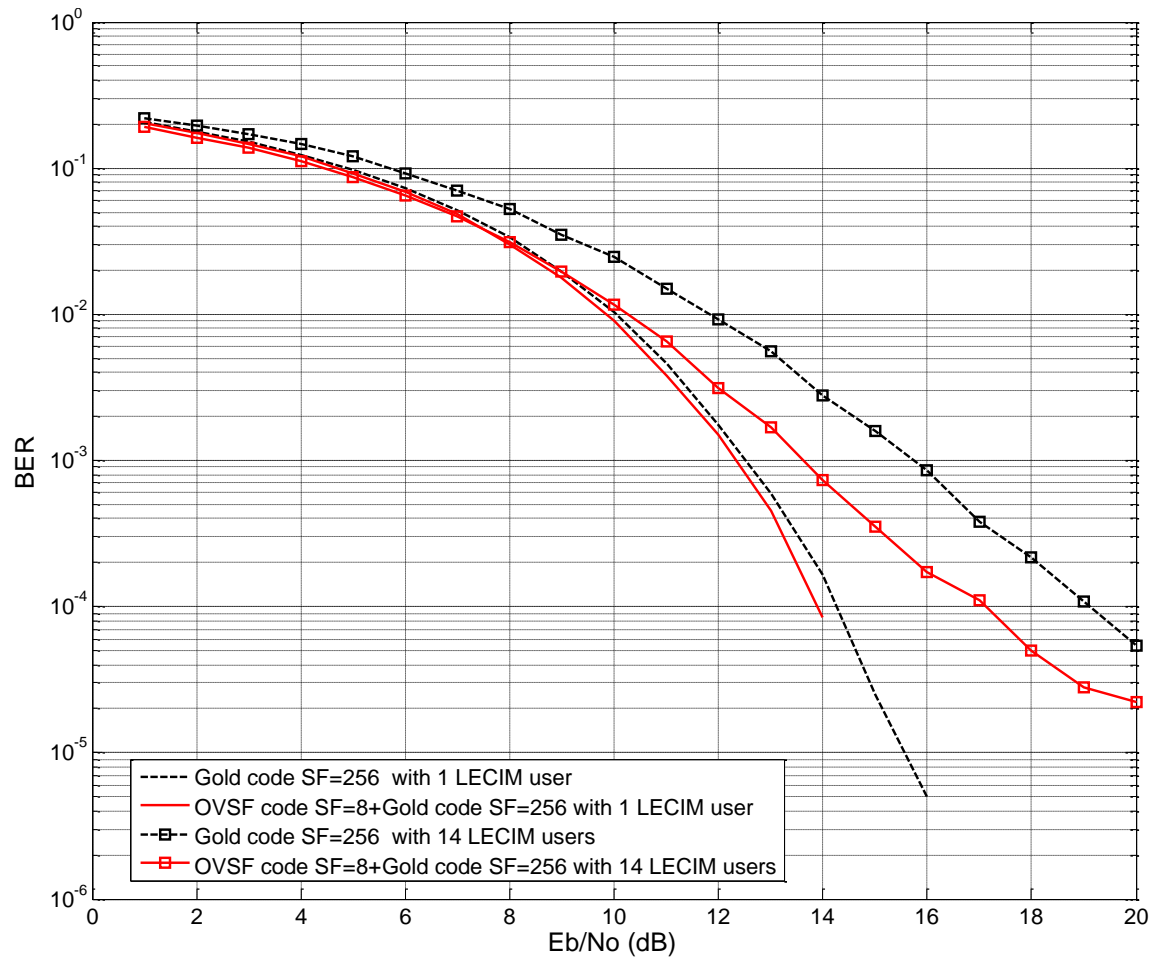# Performance comparison under 802.15.3a Channel CM1 with 7 multiple users
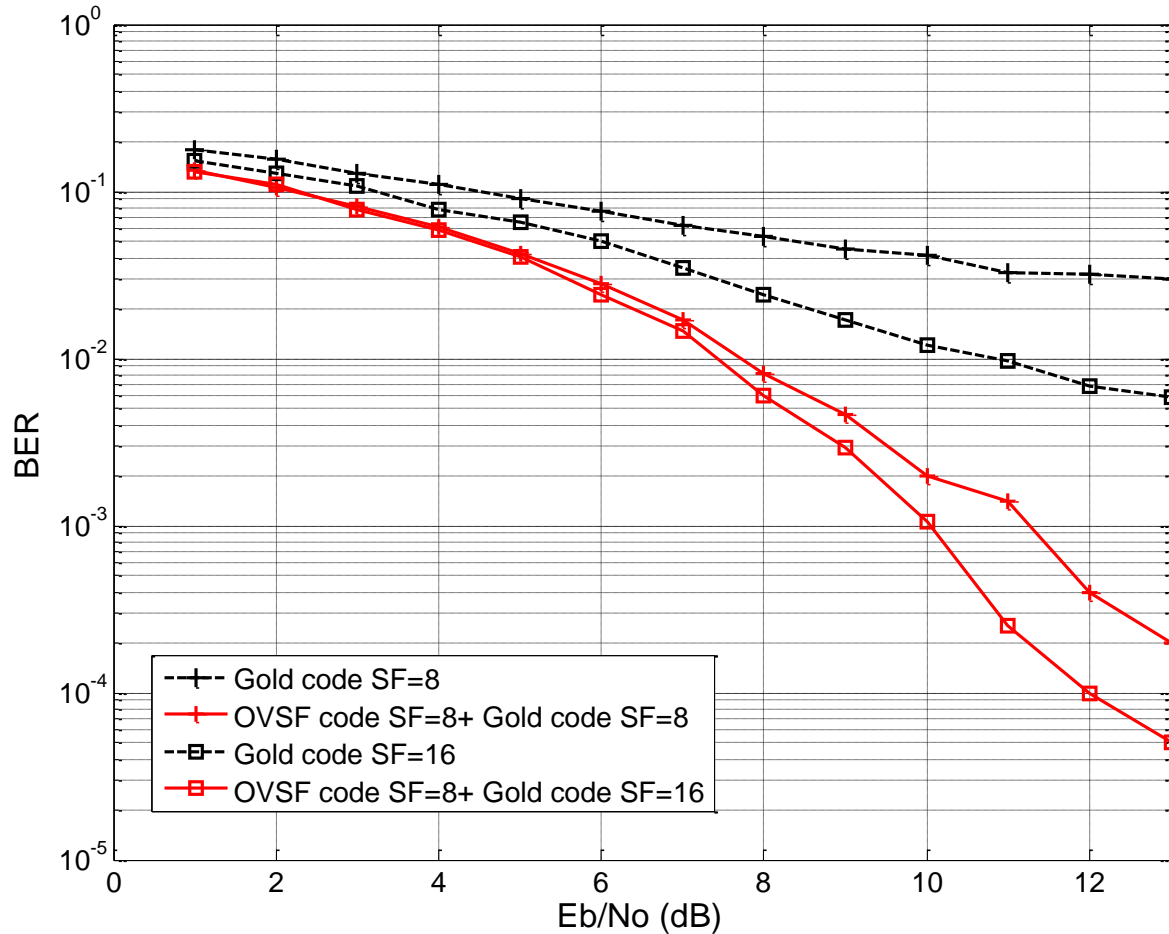
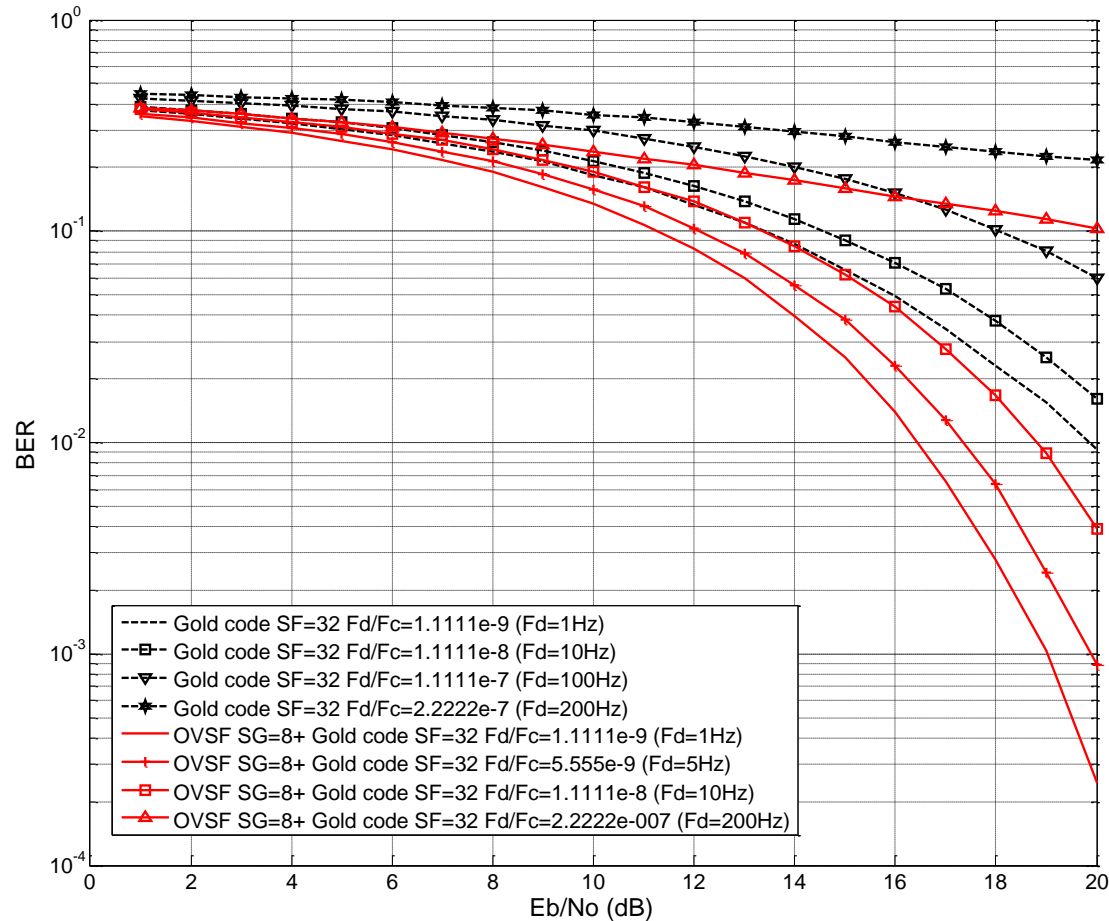# Performance comparison under Rician fading Channel model  with SNR=14dB

# Performance comparison under Rician fading Channel model with other system users

# Performance comparison under Cost 207 Hilly Channel model  with multi-users

# Performance comparison under Cost 207 Bad Urban Channel model with Doppler effect (center frequency Fc=900MHz)

# Performance comparison under GSM/EDGE channel model typical case for hilly terrain with Doppler effect (center frequency Fc=900MHz)
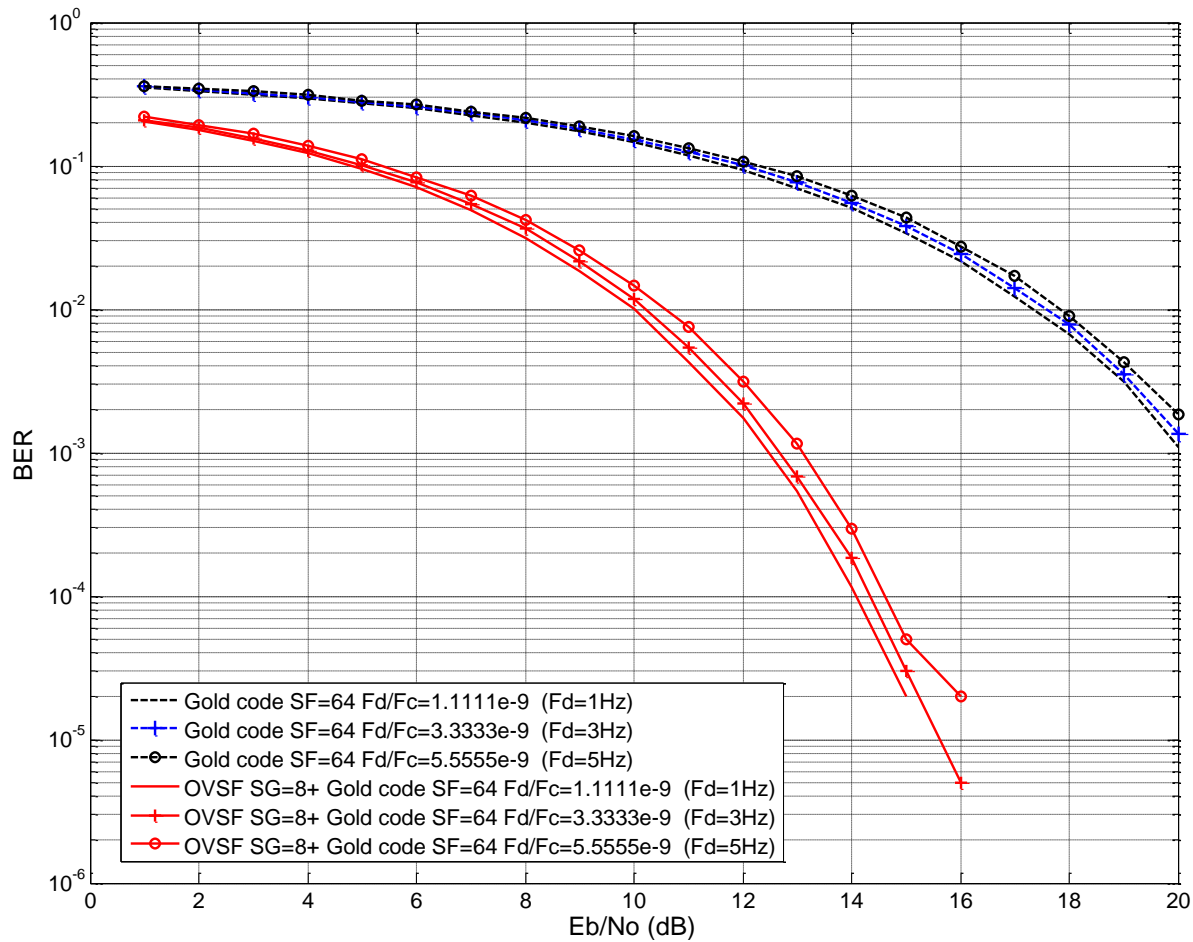
# Conclusion

- **In a CLON, Time-Division multiple access is used to share a Resource (Channel)**

- **To cover the high path loss or interference, we need Spreading Code (PN)**

- **Among CLONs, FDM and CDM are used to mitigate the interference**

- **According to the code performance comparison above, <span style="color:red">OVSF code</span> with Gold code has better orthogonality even under imperfect synchronization conditions**

- **The OVSF code scheme with Gold code scheme shows considerable performance improvement against the interference under various multi users environments and the Doppler effect**

- **OVSF code can be successfully utilized to realize the interference mitigation in CDM scheme**

# The End

# Thank You