

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

**Submission Title: [DEV sync frame transmission for adjacent piconet coexistence]**

**Date Submitted: [8 March 2009]**

**Source: [Z. Lan, Junyi Wang, C.S. Sum, Tuncer Baykas, R. Funada, M.A . Rahman, C.W Pyo, F. Kojima, H. Harada, S. Kato]**

**Company [NICT]**

**Address [3-4, Hikarino-oka, Yokosuka, 239-0847, Japan]**

**Voice: [], FAX: [+81-46-847-5440], E-Mail: [lan@nict.go.jp]**

**Re: []**

**Abstract: [DEV sync frame transmission for adjacent piconet coexistence]**

**Purpose: [This document provides a solution for intersystem coexistence]**

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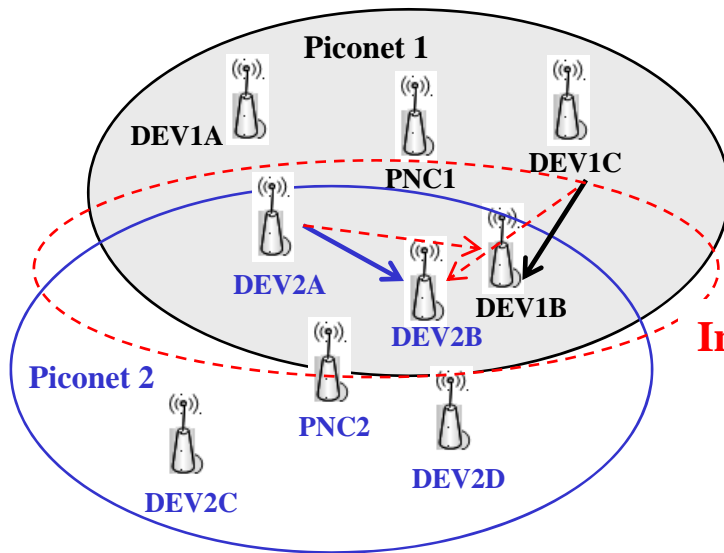
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# Summary

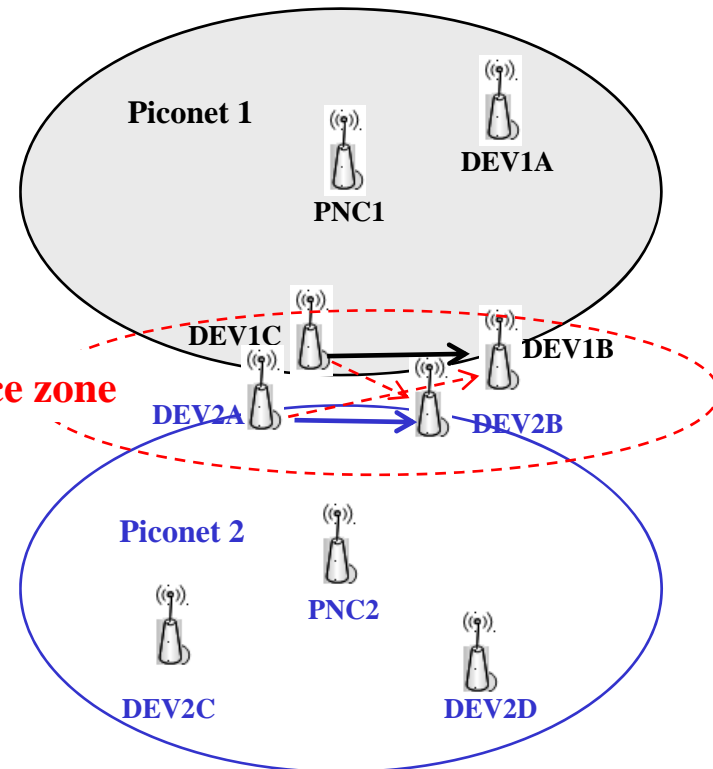
- This document describes the piconet coexistence enhancement using DEV sync frame transmission specified in the TG 3c system
- The outline of this document
  - Problem statement of interference between adjacent piconets
  - Definition of sync frame and DEV sync frame transmission
  - Corresponding operation procedure
- The sync frame concept could be potentially extended for inter-system coexistence between TG 3c and TG ad systems




# Interference between adjacent piconets

Two piconets have overlapping area



Two piconets don't have overlapping area

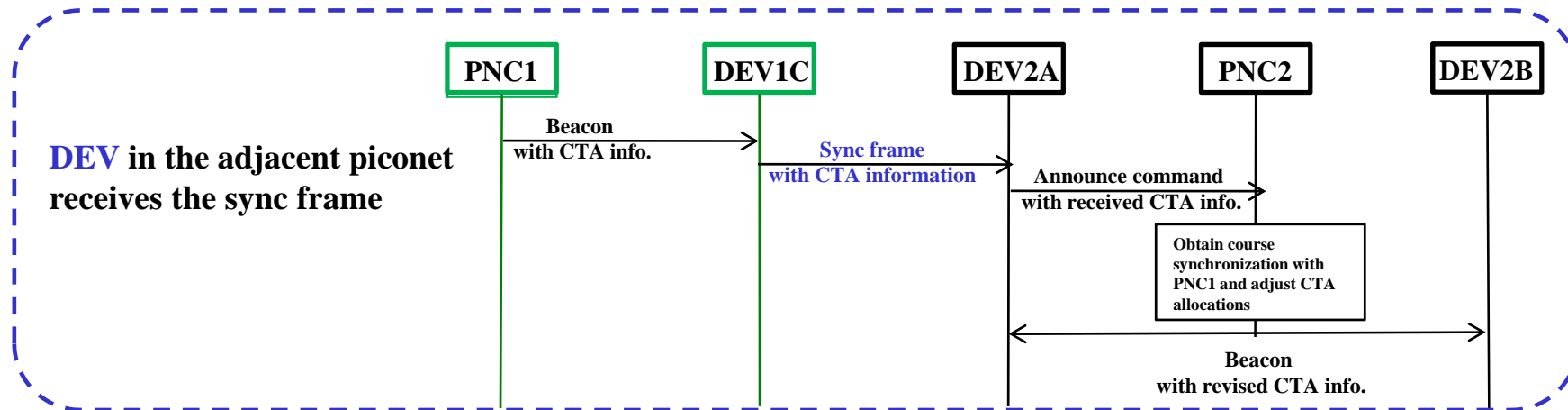
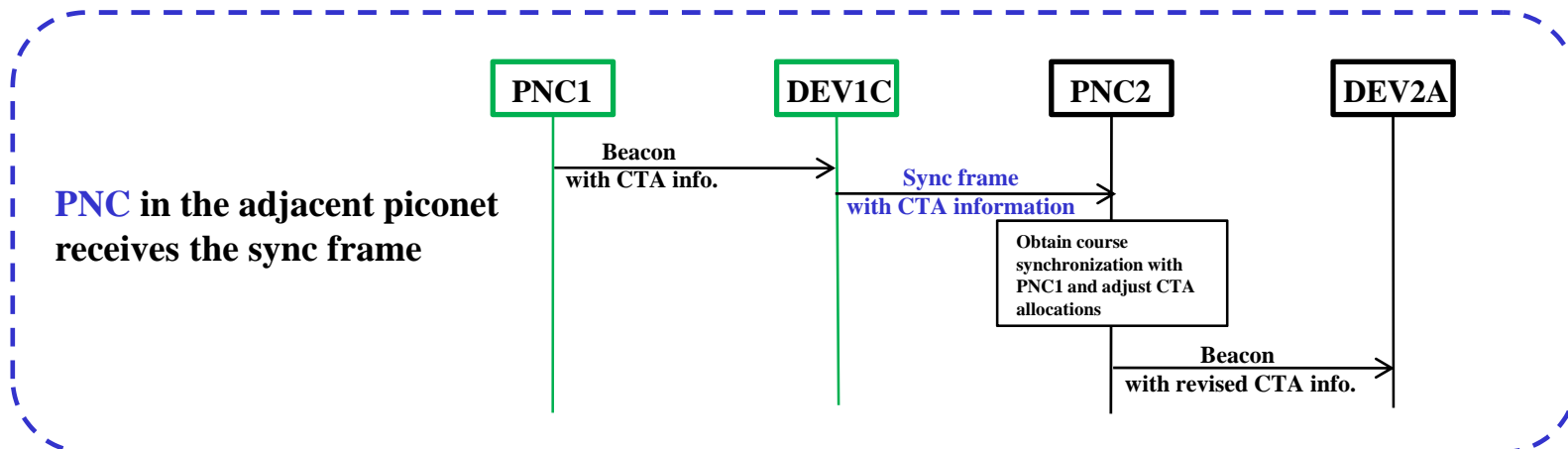


-  Data transmission in Piconet 1
-  Data transmission in Piconet 2
-  Interference

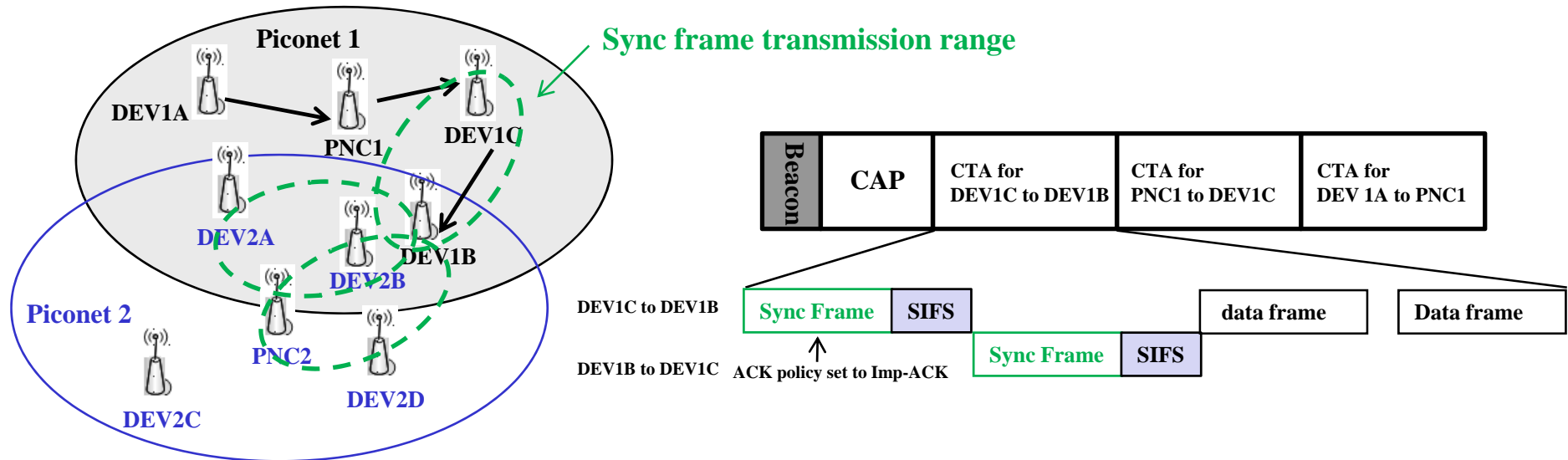
# What is DEV sync frame transmission

- Sync frame transmitted in CMS contains occupied CTA information with relative to the already-active superframe timing helpful for adjacent piconet to mitigate interference
- Sync frame transmission is an optional function that specifies the protocol of sync frame transmission targeting co-channel interference mitigation from hidden PNC node and enhancement of coexistence of adjacent piconets
- It also provides a method to obtain coarse synchronization among adjacent independent piconets for better CTA scheduling

# Coexistence between adjacent piconets with DEV sync frame transmission

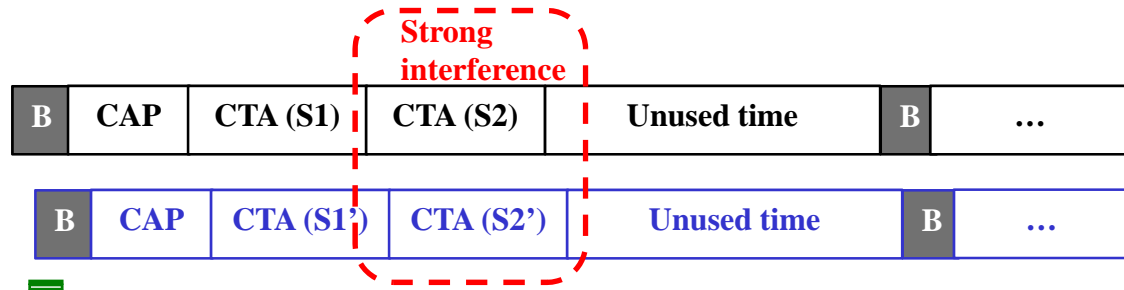
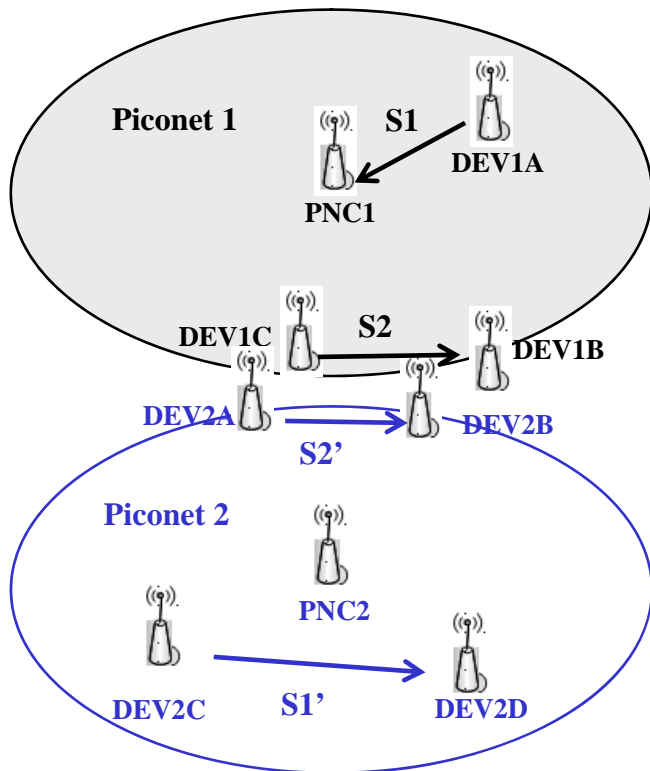


# An example of sync frame exchange

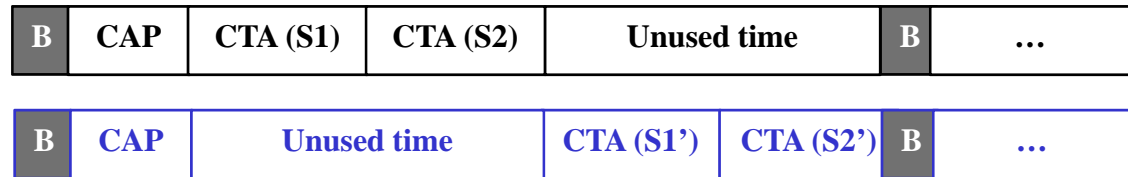


- DEV1C sends sync frame with ACK policy set to implied ACK (Imp-ACK) at the start of its **CTA**
- After SIFS of receiving sync frame from DEV1C, DEV1B sends sync frame to further **extend the transmission range of sync frame**
- The transmission of sync frame may be performed in either omni-directional or directional mode
- The transmission of sync frame may also be performed in **CAP** for flexibility and easy configuration

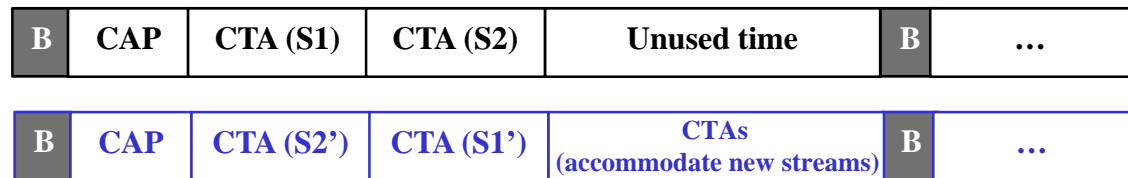
# Sync frame assisted CTA scheduling



↓  
**Piconet2** schedules the CTAs in the unoccupied time of the piconet 1 to avoid interference

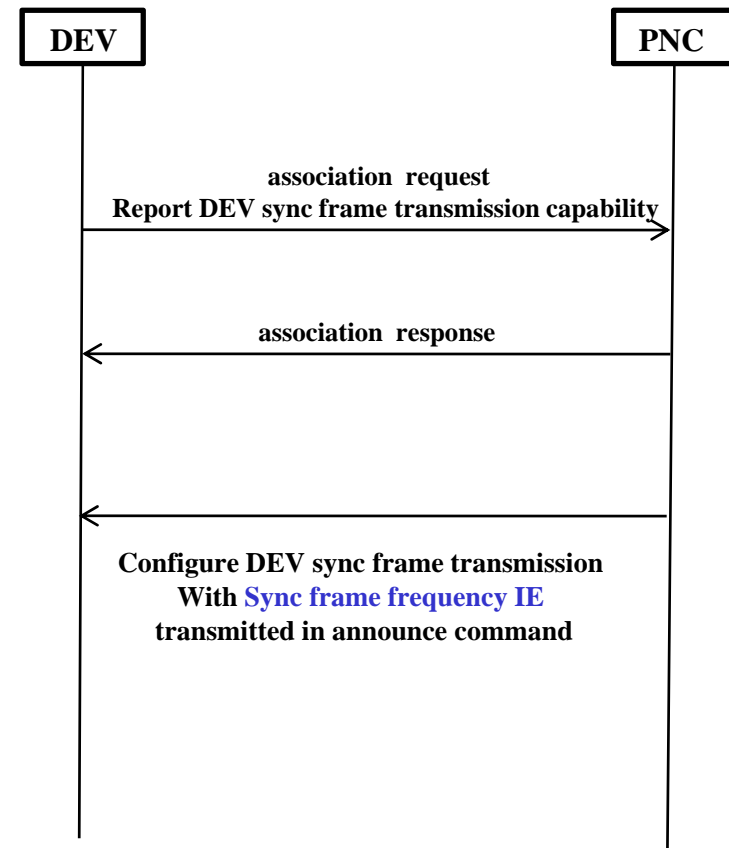


- Piconet2 schedules the CTAs according to the interference level from piconet 1 measured by sync frame
- Same period of time is spatial reused if the interference constrain is not violated
- The significant path loss of 60GHz environment offers good spatial reuse capability



# Configuration procedure

- DEV reports sync frame transmit capability during association
- If a DEV is capable of sync frame transmission, the PNC controls its sync frame transmission frequency by sending Announce command to the DEV
- The number of superframes between two sync frames is specified in Sync\_frame\_frequency IE contained in the Announce command
- If requested by the PNC, a DEV sends a sync frame at the first time of obtaining a CTA, then every pre-defined number of superframes as indicated in Sync\_frame\_frequency IE
- If the DEV is operating on directional transmission mode, all the supported directions will be handled in a round robin fashion





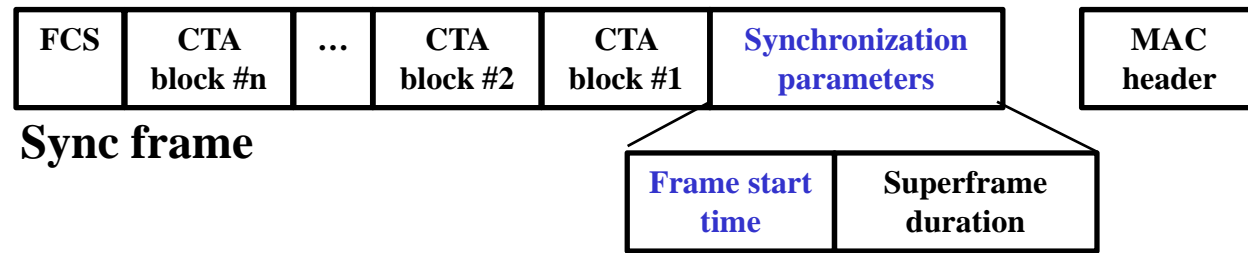
## Potential enhancement for inter-system coexistence between TG 3c and TG ad systems

- Sync frame transmission can be utilized for coexistence with other systems operating on 60GHz band
- If the TG ad system is capable of understanding the contents of sync frame (support the sync frame format), it can use the time slots allocation information contained in sync frame to smartly schedule the transmission even on the same channel to avoid interference

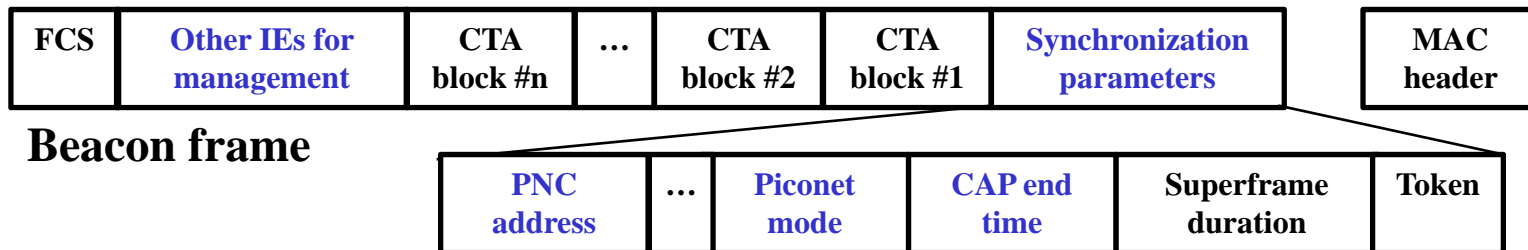
# Conclusion

- DEV Sync frame transmission is an effective mechanism to mitigate interference and enhance the coexistence of adjacent piconets
- The concept can be extended to provide inter-system coexistence of TG 3c and TG ad systems

# Annex 1 :Sync frame format



↑  
Indicate the time offset of a sync frame relative to the start of the superframe



## Annex 2 : Related IE

- Capability\_IE (Section 7.4.11)
  - Add a new bit assignment in DEV capabilities field
    - Bit 36: Sync\_frame\_capable
- Sync\_frame\_frequency\_IE
  - Add Section 7.4.36 “Sync Frame Frequency IE”

Octets:1			1	1
Reserved (2 bits)	Sync frame direction	Sync frame frequency (5 bits)	Length	Element ID

- Sync frame frequency field indicates the number of superframes between two Sync frame transmission requested by PNC
- Sync frame direction bit indicates if the Sync frame transmission is omni or directional
  - If directional, sync frame direction is round robin of DEV available directions