

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

**Submission Title:** [Pre-proposals for IEEE802.15.8]

**Date Submitted:** [7 May 2012]

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**Re:** [.]

**Abstract:** [This document presents pre-proposals on the PHY and MAC system design for 802.15.8 (PAC)]

**Purpose:** [To discuss technical feasibility of proposed system design for 802.15.8 (PAC)]

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# Overview

## Peer Aware Communication

- Infrastructure or infrastructure-less communication among peers within proximity
- Peer-to-Peer Network (P2PNW) is formed for a desired service/application within proximity
- Many P2PNWs can coexist in proximity
- One peer can participate in multiple services or applications, i.e. multiple P2PNWs
- P2P communication: can be centralized or distributed within a P2PNW

## Context

- Services, applications, users, devices, proximity, security, etc.

## Context-aware

- All the peer-to-peer communications are formed for the **desired services /applications /users /devices** etc. in the proximity, i.e. **Context-aware Peer-to-Peer Communications** or **Context-aware P2PNWs**.

# Overview (cont.)

## **Virtual Leader (VL):**

A peer defined to represent, manage, and coordinate the P2P communications among a group of peers sharing the same context-based service/application, or intra-P2PNW communications. A VL may be dynamically determined and/or changed within P2PNW. One VL for one application; one application can have only one VL.

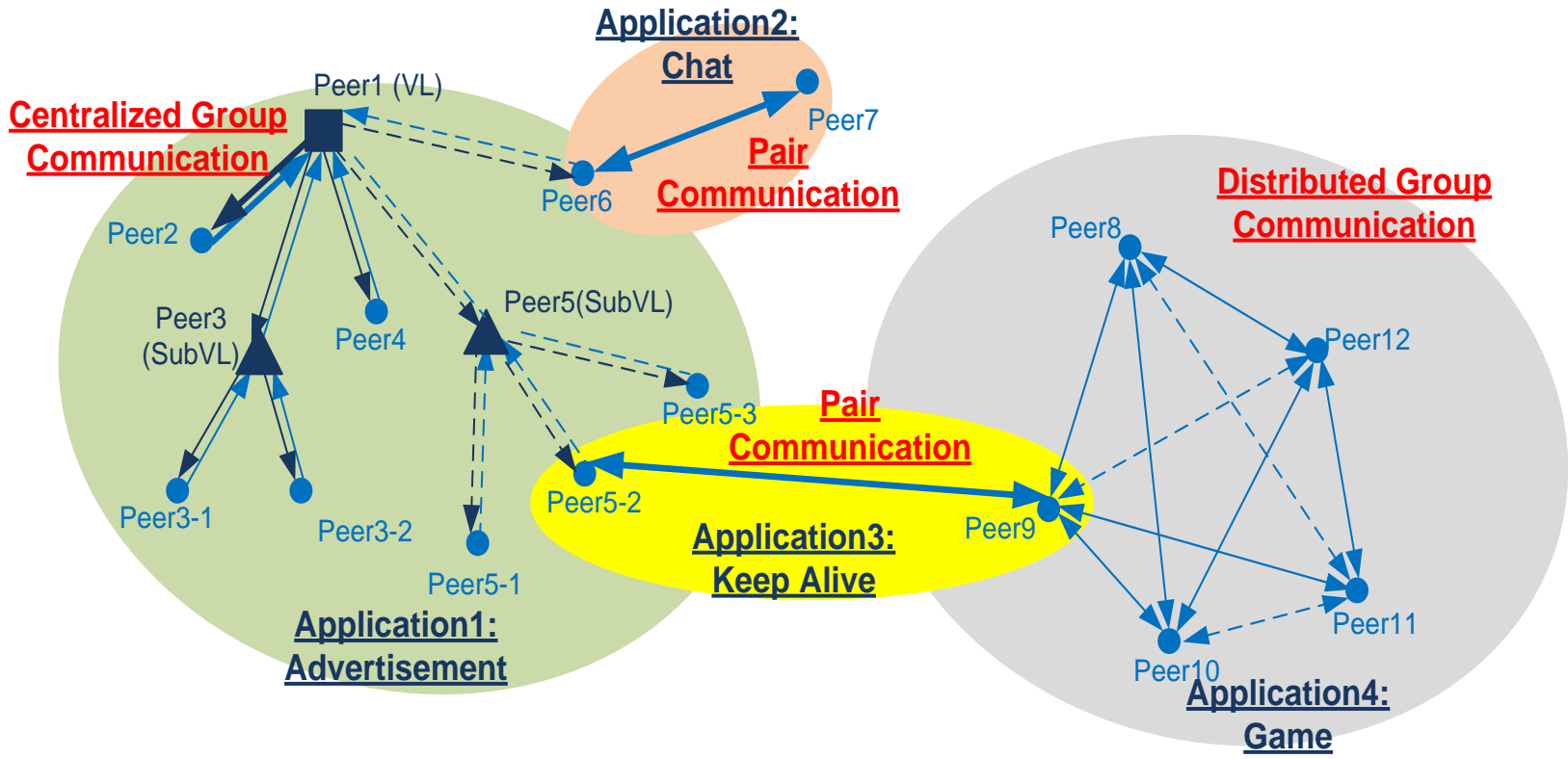
## **Super Virtual Leader (SuperVL):**

A peer defined to coordinate with all VLs, or inter-P2PNW communications. A super virtual leader may be dynamically determined and/or changed among the virtual leaders. The super virtual leader is the top leader of the VLs' hierarchical structure. Only one SuperVL in the proximity.

## **Sub-Virtual Leader (SubVL):**

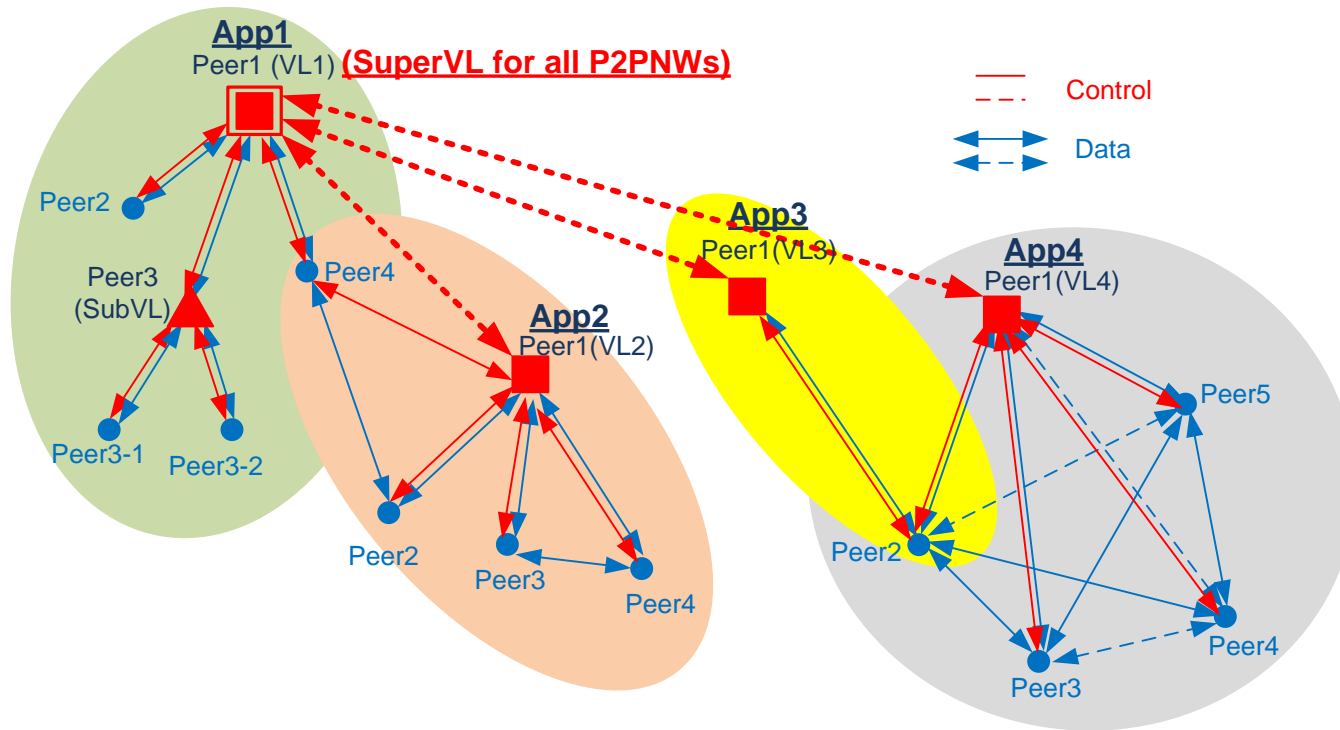
A peer defined to extend coverage through multi-hop. A SubVL is a VL for the subgroup peers under; a peer under the VL or a SubVL. The SubVL may have a subset of VL's function.

# PAC Networks in Proximity



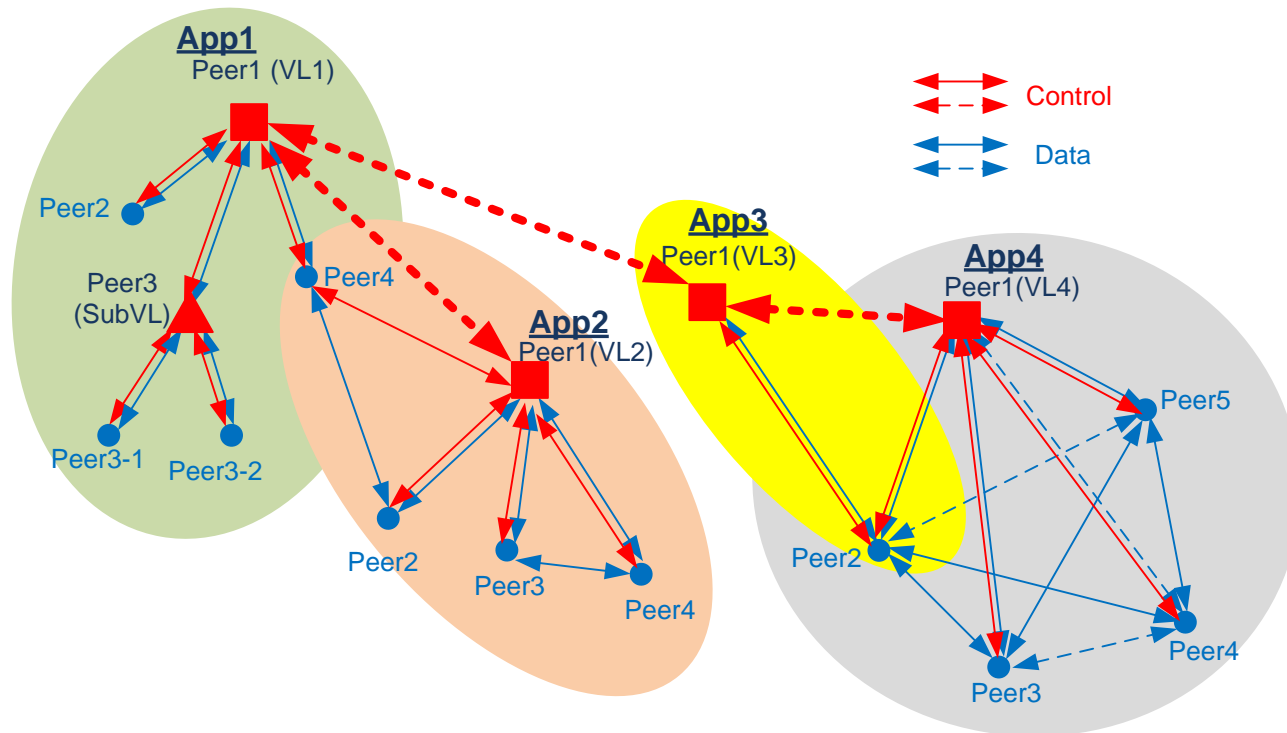
**→ Context-Aware Peer-to-Peer Communications**

# Centralized Inter-P2PNW Control Scenario



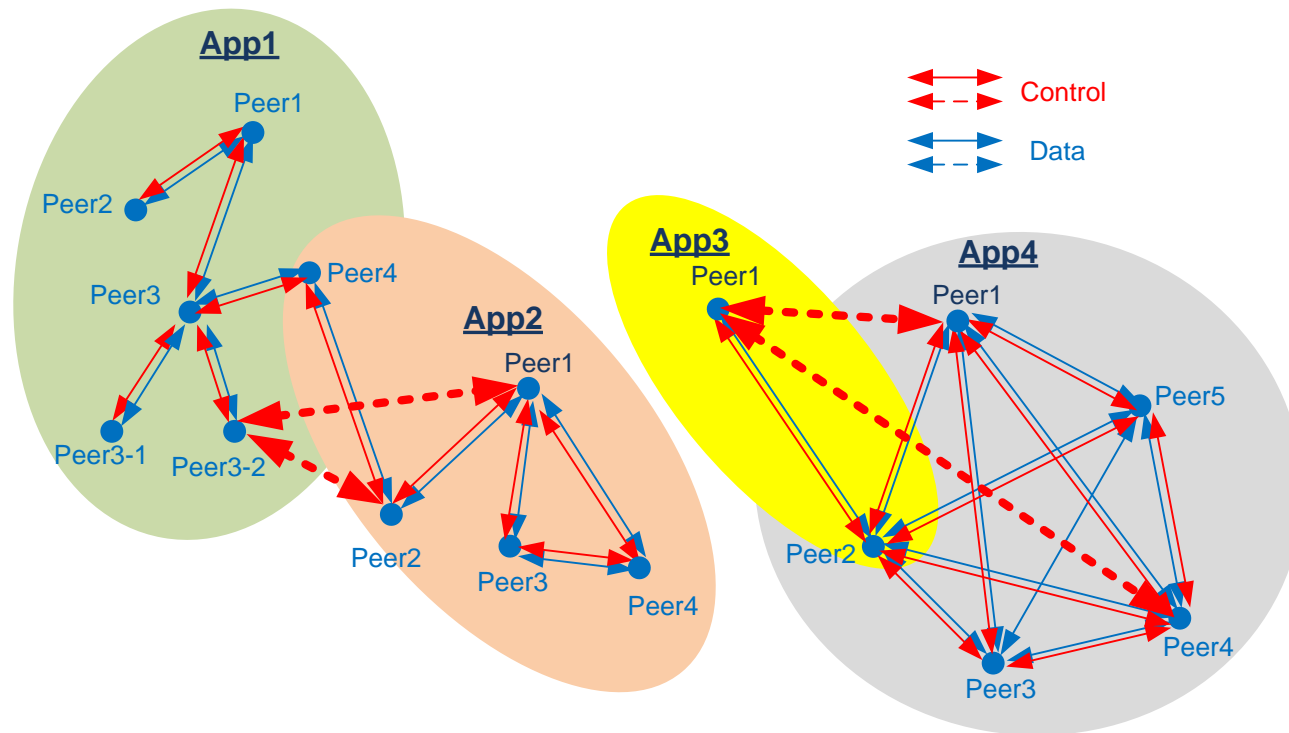
- Inter-P2PNWs: virtually centralized control by SuperVL
- Intra-P2PNW: virtually centralized control by VL

# Hybrid Inter-P2PNW Control Scenario



- Inter-P2PNWs: distributed control
- Intra-P2PNW: virtually centralized control by VL

# Distributed Inter-P2PNW Control Scenario



- Inter-P2PNWs: distributed control
- Intra-P2PNW: distributed control



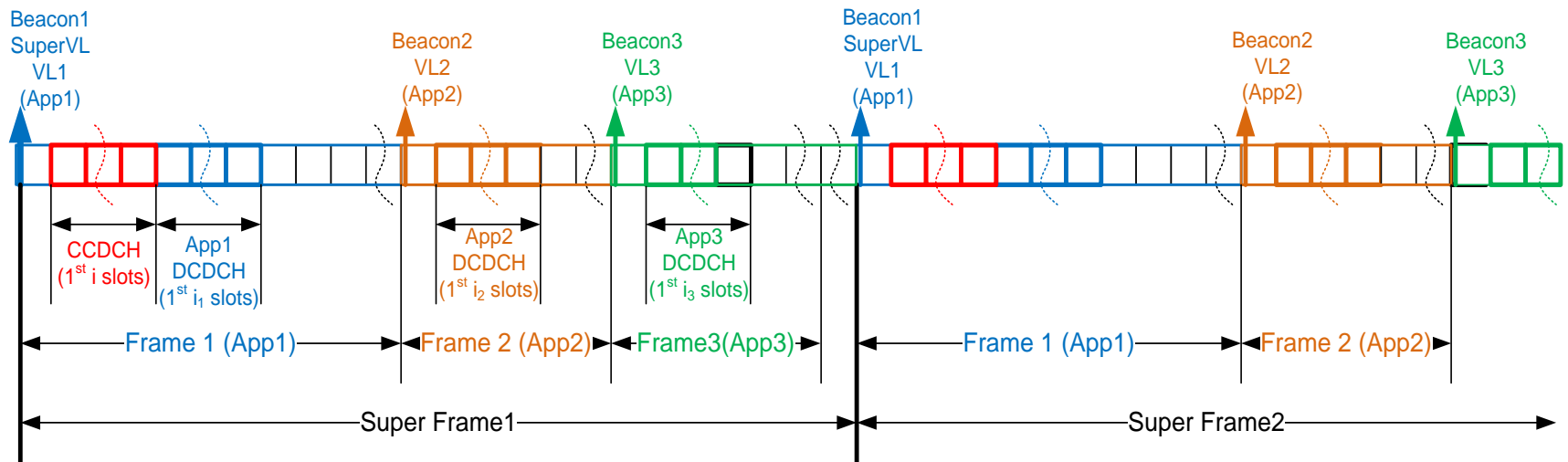
# System Architecture

- Block diagram of system architecture
- Call flow of system procedures
- Flowchart of system operations
- Interfaces of system logic functions

# Frame Structure

- Super frame structure
- PHY & MAC frame structure
- Multiplex schemes:
  - TDMA
  - CDMA/DSS
  - OFDMA

# Super Frame Structure



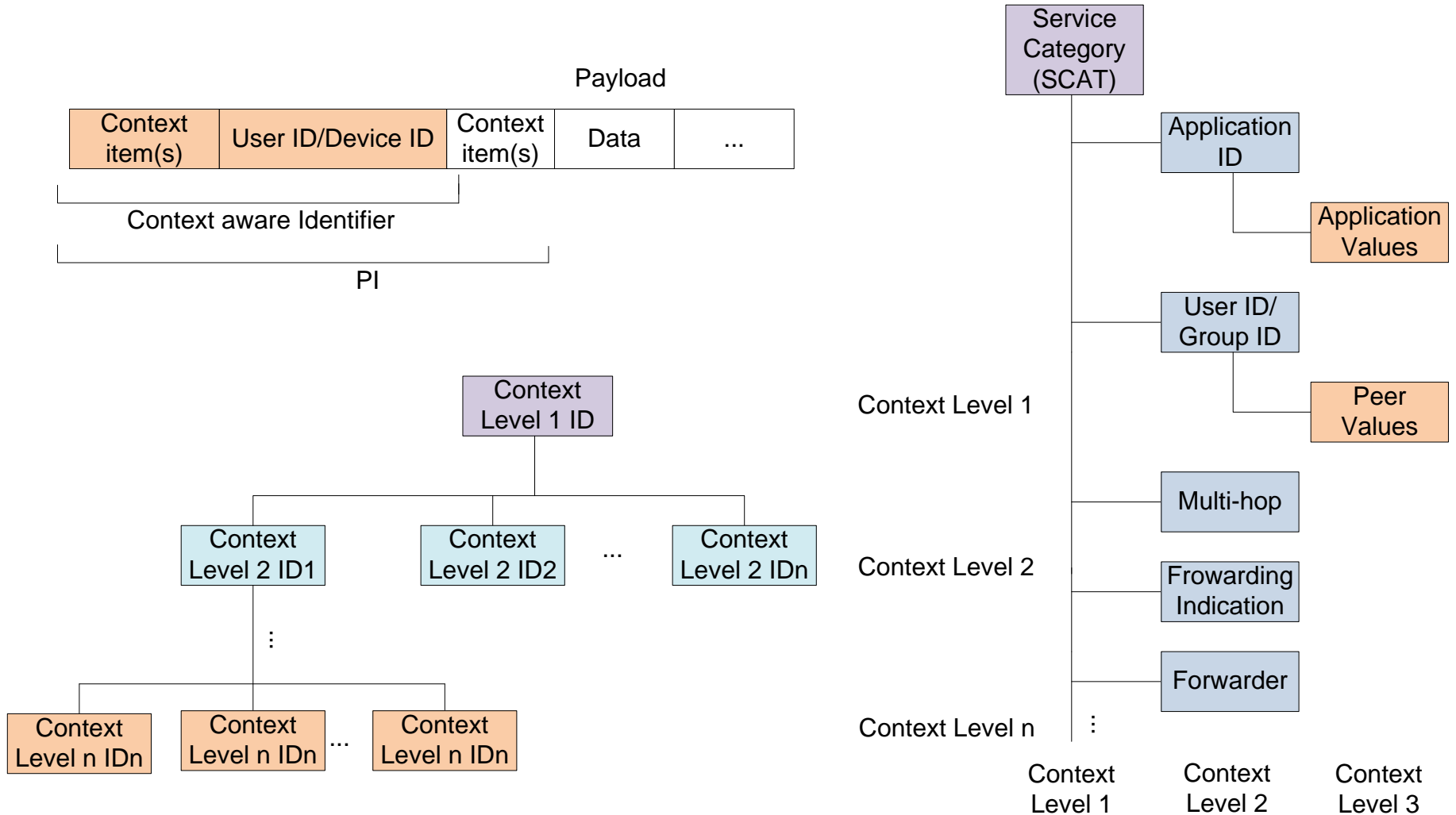
**CCDCH** is defined for **inter-P2PNWs** communications and shared by SuperVL, VLs, SubVL(s) or Peers of all services or applications or P2PNWs in proximity.

**DCDCH** is defined for **intra-P2PNW** communications and shared by the VL, SubVLs and peers within a P2PNW.

The CCDCH and/or DCDCH may be used for but not limited to the following,

- common control messages to **inter-P2PNWs** in proximity or within the **intra-P2PNW**
- paging or broadcast messages to **inter-P2PNWs** in proximity or within the **intra-P2PNW**
- short high priority data transmissions to **inter-P2PNWs** in proximity or within **intra-P2PNW**

# Context Information and Context-aware ID



# General Scan Procedures

- General Procedures
  
- Schemes
  - Centralized control
  - Hybrid control
  - Distributed control

# Context-aware Discovery Procedures

- General context-aware discovery procedure
- Fast peer discovery scan procedure
- 1-to-N discovery procedure
- Multi-hop discovery procedure

# General Context-aware Discovery Procedure

# Fast Peer Discovery Scan Using Context-aware ID

Service Based				
<i>Context-aware Category (CACat)</i>	<i>Service ID (SID)</i>	<i>User ID (UID)</i>	<i>AP Parameters (APParam)</i>	<i>Others</i>
Emergency	War Fire Medical ...	Homeland Security Police Patient ...	Region, broadcast/multi-cast... Location, severity, help center... Hospital, doctor, privacy level... ...	
High Priority	Flood watch ...	Weather forecast center ...	Region, time, severity, help center...	
Connection	Facebook ...	Facebook User ID	Chat, status update...	
Advertisement	Service x Product y ...	Agent or store Manufacture or store ...	Price, discount, forward credit... Price, club coupon, expiring date... ...	
User Centric Activities	Content exchange	User ID	Content name, size, privacy...	
Smart Environment	Device Sync	User ID	Device list, items to synchronize...	
Smart Transportation	Traffic	Traffic controller	Location, time, status...	
Network of Network	Network name	Network ID	Context, load, parent network...	
User Based				
<i>Context-aware Category (CACat)</i>	<i>User ID (UID)</i>		<i>User Parameters (UParam)</i>	<i>Others</i>
Gamer	User ID or virtual User ID		Games, game skill level...	
Multi-hopper	User ID		Level of hops, number of peers behind...	
Device Based				
<i>Context-aware Category (CACat)</i>	<i>Device ID (DID)</i>		<i>Device Parameters (DParam)</i>	<i>Others</i>
Tablet	Device ID		Manufacturer, operating system...	
Monitoring System	Device ID		Manufacturer, model...	



# Fast Peer Discovery Scan Procedure

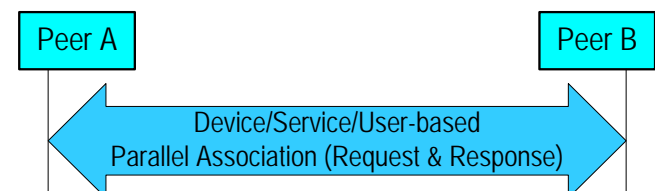
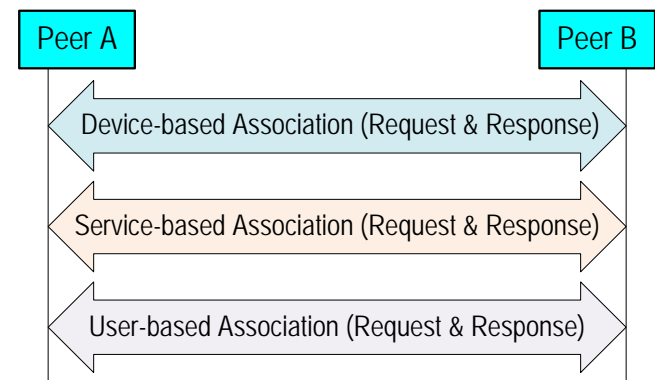
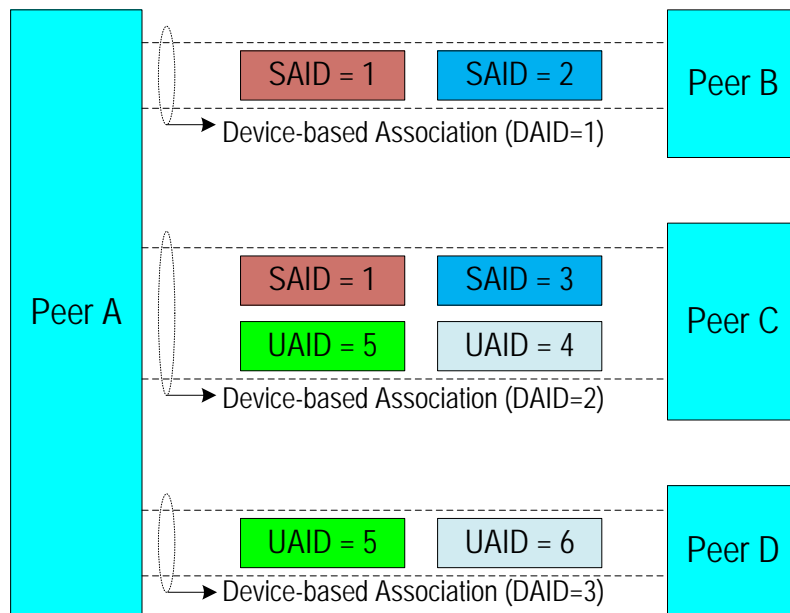
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# Peer Association / Disassociation / Re-association Procedures

- Association Context
  - Device/user/service-based
- Unified Association Procedure
  - Includes: distributed association, disassociation, re-association
- Context-aware Peer and Virtual Leader Selection
- Context-aware Distributed Association
  - Mutual, group-based, multi-hop
  - Interactive association with discovery
  - Association with channel switching
- Context-aware Association Update
  - Mutual, group-based, multi-hop
- Context-aware Disassociation
  - Mutual, group-based, multi-hop
- Context-aware Re-association
  - Mutual, group-based, multi-hop
- Context-aware Hierarchical Association
  - Association update
- When association is triggered, what to do?
  - Which association procedure should be applied?
  - When / why / how?
- Add block diagram?

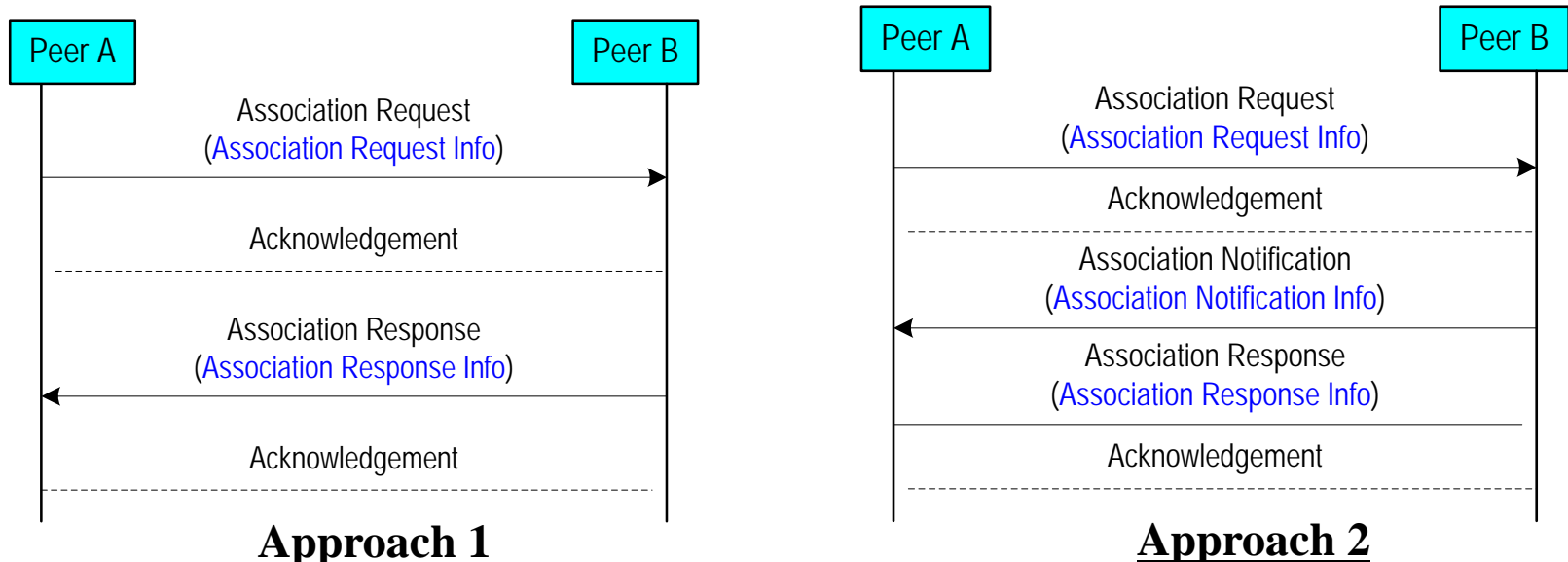
# Association Identifier and Association Context Information

- Association Identifier (AID)
  - DAID: Device-based Association Identifier
  - SAID: Service-based Association Identifier
  - UAID: User-based Association Identifier
- Association Context Information (ACI)
  - An ACI contains properties and related information of an established association
    - AID, Association Type, Creation Time, Association Duration, Association Priority, Current Status, etc



# Context-Aware Peer Association

- Association Request: Requesting association (Approach 1 & 2)
  - Association Request Info: device profile, service profile, user profile, association requirement, etc
- Association Notification: Requesting mutual association (Approach 2)
  - Association Notification Info: device profile, service profile, user profile, communication configuration, etc
- Association Response: Responding association requests (Approach 1 &2)
  - Association Response Info: device profile, service profile, user profile, communication configuration, etc



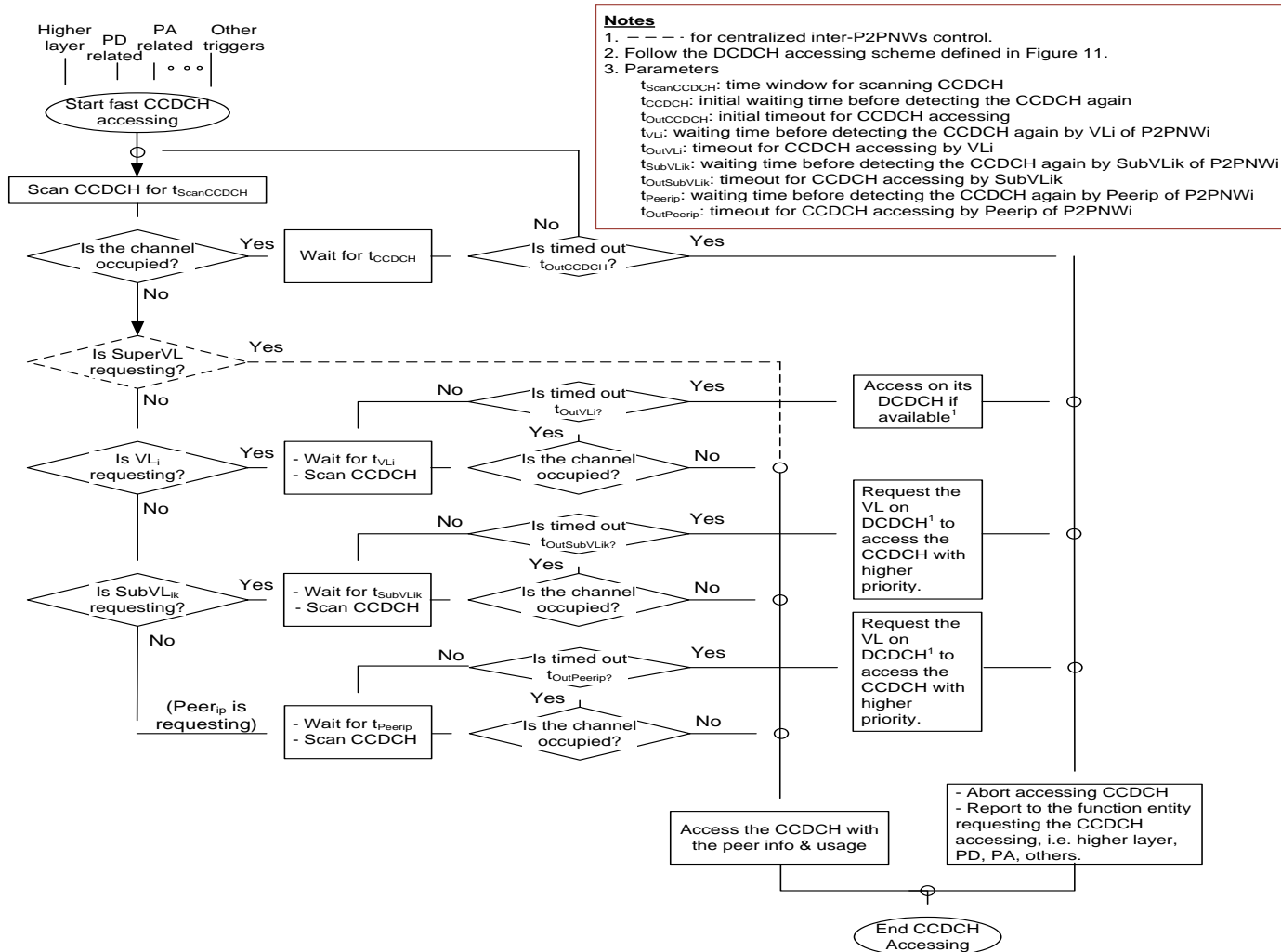
# Synchronization Procedures

- General assumptions for the synchronization
- Pair synchronization for single and multi-application
- Multi-hop synchronization for single and multi-applications
- Distributed group based synchronization for single and multi-applications

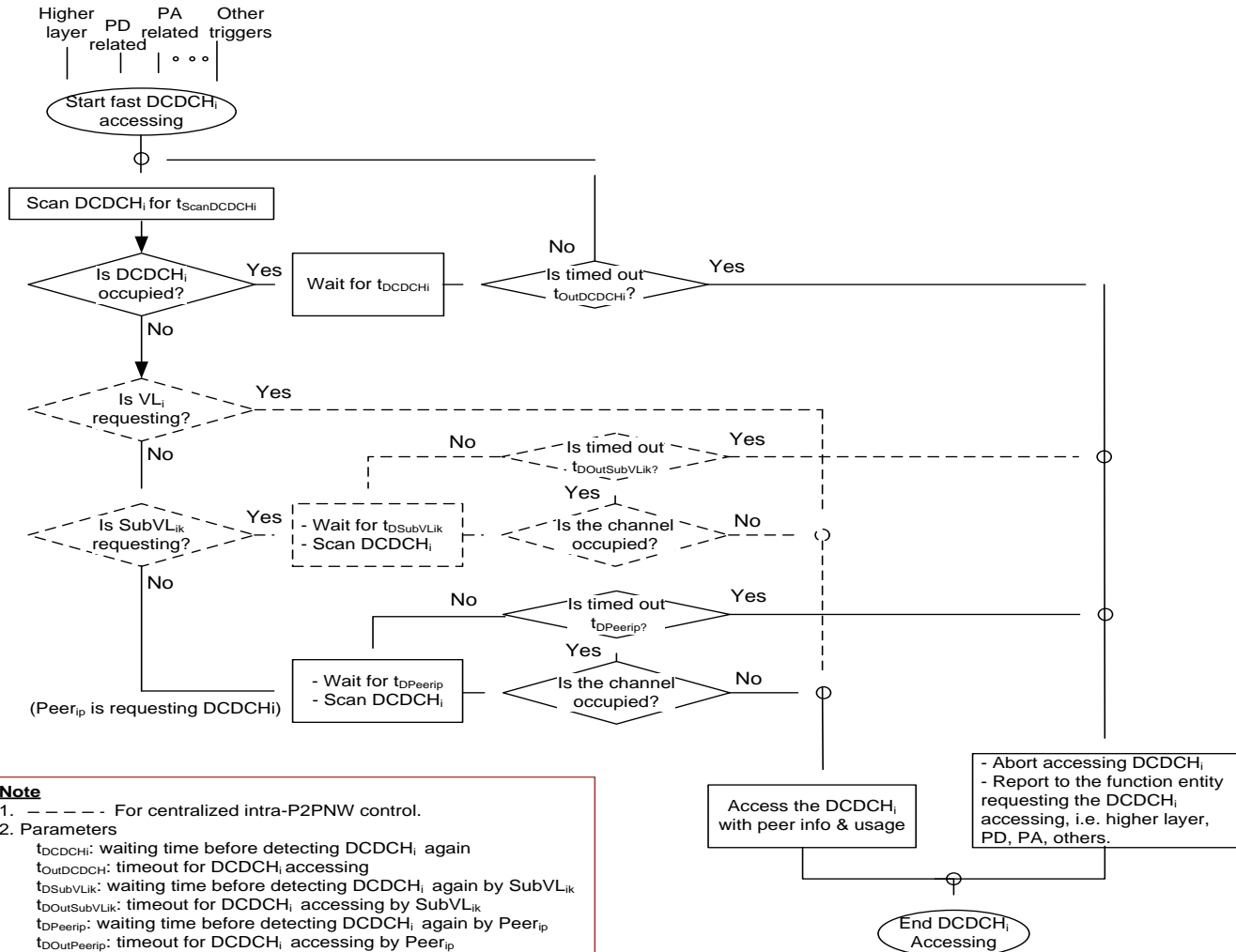
# Channel Management Procedures

- Fast Inter-P2PNW Channel Accessing Procedure
- Fast Intra-P2PNW Channel Accessing Procedure
- Inter-P2PNWs Channel Allocation with P2PNW detection
  - for centralized control
  - for distributed control
  - for hybrid control
- Inter-P2PNWs Channel Allocation with P2PNW cooperation.
  - for centralized control
  - for distributed control
  - for hybrid control
- Intra-P2PNW Channel Allocation/Accessing with peer detection
  - for centralized control
  - for distributed control
- Intra-P2PNW Channel Allocation/Accessing with peer cooperation
  - for centralized control
  - for distributed control

# Fast Inter-P2PNW Channel Accessing Procedure



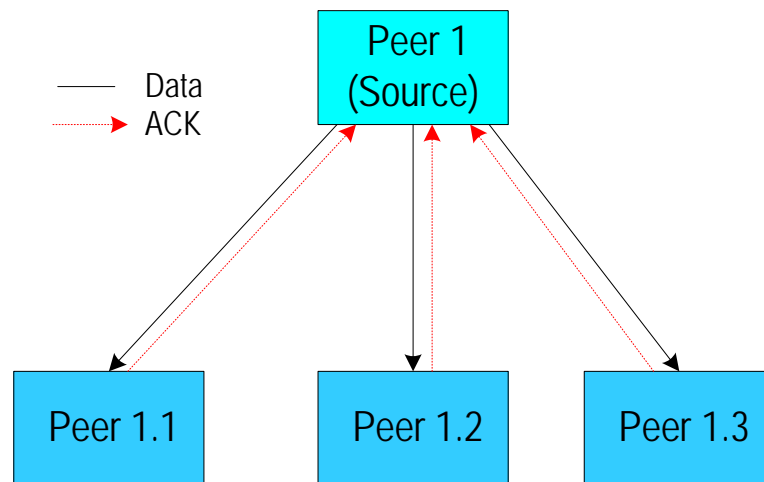
# Fast Intra-P2PNW Channel Accessing Procedure



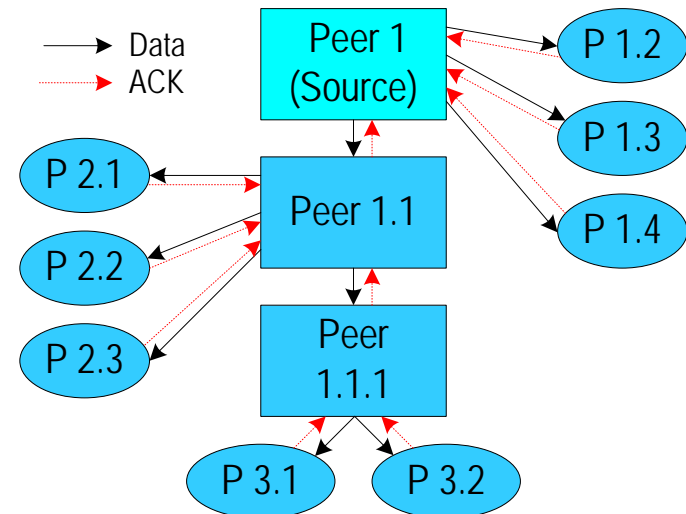


# Reliable MAC Multicast Transmissions

- MAC Multicast Scenarios: One-Hop & Multi-Hop
- Context-Aware Reliable MAC Multicast
  - Flexible Reliability
    - ACK Type (Contained in MAC Data Frame): Full ACK, Partial ACK, Any ACK, Location-based ACK, Context-based ACK, Information-based ACK
  - ACK Collision Avoidance
    - ACK Broadcast, ACK Alignment, ACK Aggregation



**One-Hop**



**Multi-Hop**

# Context-aware Power Control Procedures

- TBD

# Measuring and Reporting Procedures

- TBD

# Cross Layer Function

- TBD

# Conclusion

- TBD

# Contributors

- InterDigital Communications Corporation
  - Zongrui Ding
  - Hongkun Li
  - Qing Li
  - Paul Russell, Jr.
  - Chonggang Wang

# Thank You

## Any Questions?