Enhancements to Direct Communication for Proximity-based Applications

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Base Contribution:

None

Purpose:

To propose initiation of a new project for the IEEE 802.16 Working Group regarding direct communication for proximity-based applications

Introduction

- Discussion on BS-controlled direct communication in Session #79
  - Doc. #16-12-353r1 by Wooram Shin, *et al*.
    - Introduction to use cases of proximity-based applications
  - Solicitation of PPC inputs regarding BS-controlled direct communication (DC) for proximity-based applications
    - Project Planning Committee Report and Minutes - Session #79

- This contribution supports for BS-controlled direct communications
  - Additional examples for proximity-based application
  - Requirements of infrastucture-depent direct communication
  - Something beyond the current IEEE 802 GRIDMAN specifications

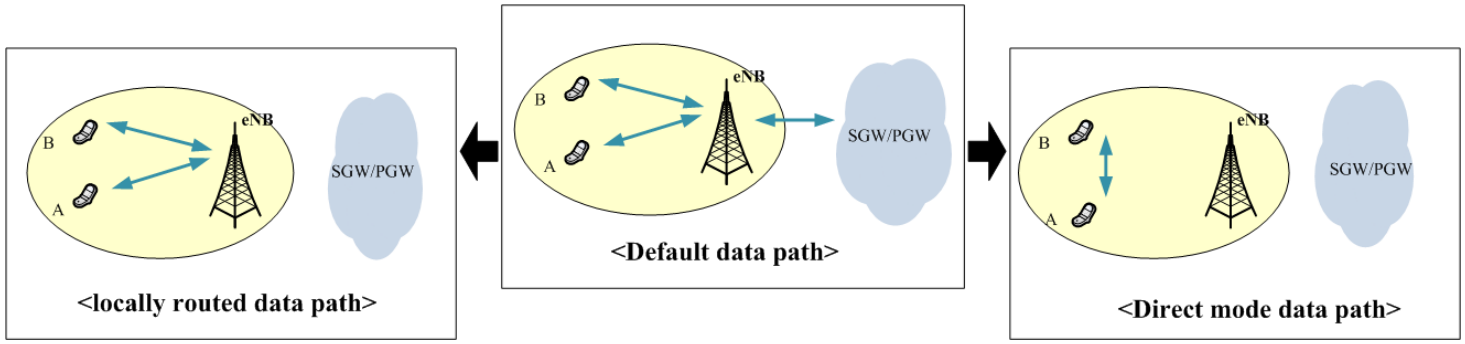
Direct Communications in IEEE 802

- IEEE 802.11
  - Direct Link Setup (DLS) / Tunneled DLS (TDLS)
- IEEE 802.15
  - Bluetooth
- IEEE 802.16
  - BS-controlled direct communication for smart-grid / M2M application
  - Talk-around communication for voice communication
- IEEE 802.15 PAC for devices in the proximity
  - *Infrastructure-less* communication with *fully distributed* coordination
  - Discovery for peer information without association
  - TG formation on March 2012

Direct Communications in the outside world of IEEE 802

- Wi-Fi Alliance
  - Wi-Fi Peer-to-Peer Specification (Wi-Fi Direct™)

- 3GPP Direct Communication
  - Good interest in D2D for LTE Rel-12 and beyond
    - Focus on network-assisted proximity detection first
    - Specific use case: public safety
  - 3GPP Proximity Service (ProSe) is being discussed in 3GPP SA1

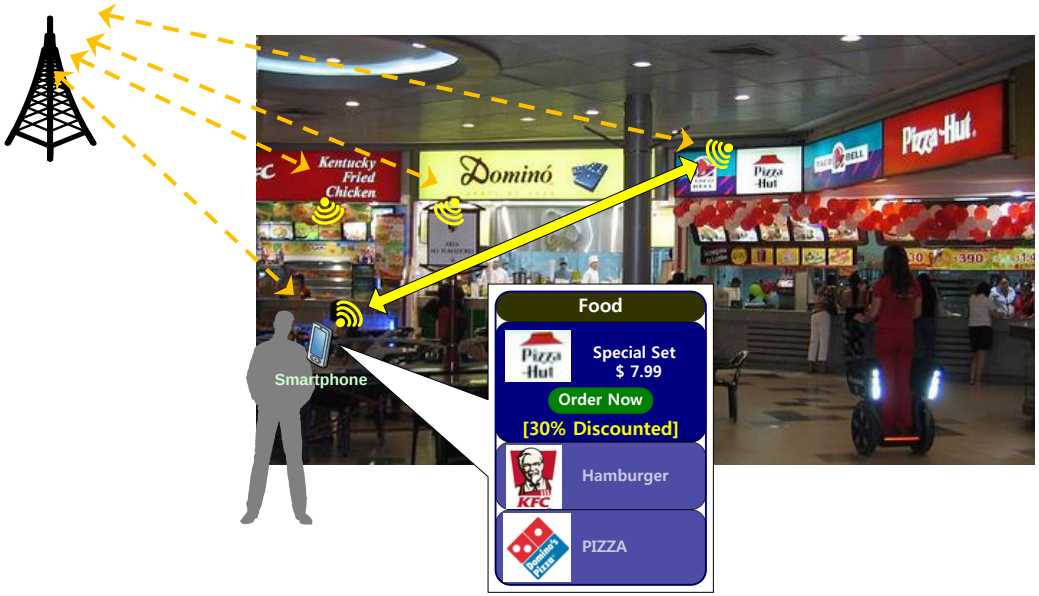


Proximity-based Applications

- Use cases introduced in Doc. #16-12-353r1 are good examples
- Use cases from the previous contribution
  - Social Commerce and Advertisement
  - Augmented Reality (AR) Services
  - P2P and Content Distribution Services
    - Local Cloud Services
    - Personal Broadcasting
    - Concert Guide Services
- Additional use cases in this contribution
  - Proximity-based Mobile Advertisement
  - Interactive digital signage

Application Example

- Proximity-based Mobile Advertisement
  - In the food court, a customer runs a smartphone application that shows advertisements of restaurants in proximity of user.
  - The customer selects one of cafeterias and he orders some food
  - The cafeteria directly receives the order and reports waiting time using direct message to the customer
  - The cafeteria sends another message when the food is ready



Application Example

- Interactive digital signage for not broadcasting but "narrowcasting" to target users in proximity of advertising board
  - A man is looking for a gift for his wife wandering around duty-free area
  - He searched information about women's perfume using his smartphone but he failed to find a suitable one.
  - The advertising board notices someone in local vicinity is looking for women's perfume and it shows the advertiser's product with discount information

Infrastructure-based direct communications for proximity-based applications

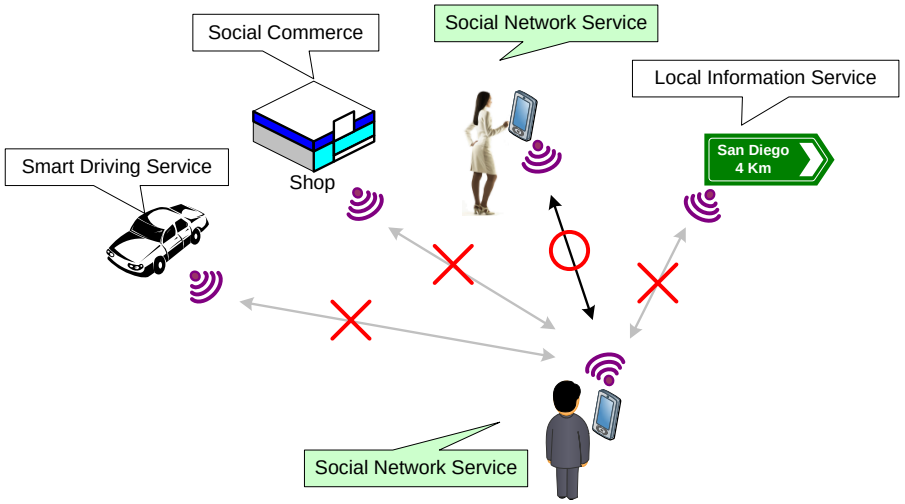
- Needs for enhancements to infrastructure-dependent direct communications in order to fully support the proximity-based applications.
  - Direct communication with the help of BS

- Two discussions on direct communications
  - MS-to-MS associated with BSs: the scope of this contribution
  - One or more MSs out of BS coverage:
    - “Fully distributed infrastructure-less proximity based direct communication for 802.16”, IEEE 802.16-12-462-01-Gcon

Requirements of direct communication for proximity-based applications (1)

- Device discovery
  - Discovery of other devices in proximity
  - Only devices in local vicinity are eligible candidates for the peer in proximity-based applications

- Service discovery
  - For autonomous discovery of device supporting the requested service



Requirements of direct communication for proximity-based applications (2)

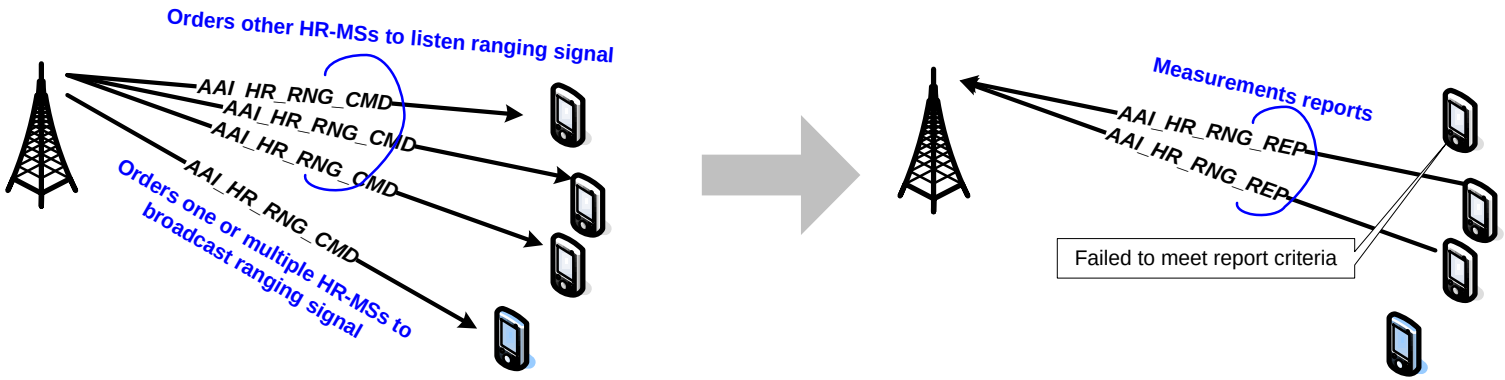
- Support for Billing
  - MNO has little interest in the free allocation of their valuable bandwidth to direct communications among subscribers
- Privacy in direct communication link
  - Applications such as social networking requires secured communication

Something beyond the current BS-controlled direct communication in IEEE 802.16 GRIDMAN TG (1)

- To support requirements imposed by proximity-based applications, we need followings that are not in the current specification
  - MS-based device discovery in proximity of each other
    - MS should be able to make decision on the relative proximity

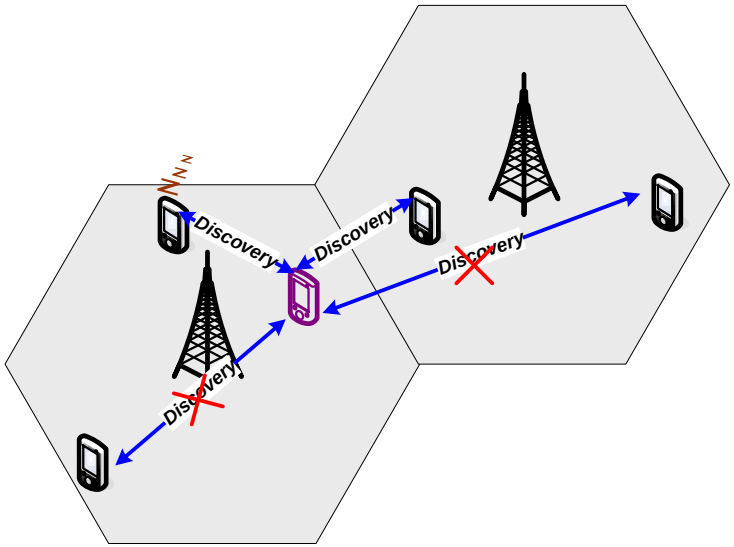
cf) Typical approach in BS-controlled direct communication in IEEE 802.16n

- Only HR-BS can trigger the discovery procedure
- Not HR-MS but HR-BS can make decision on the relative proximity



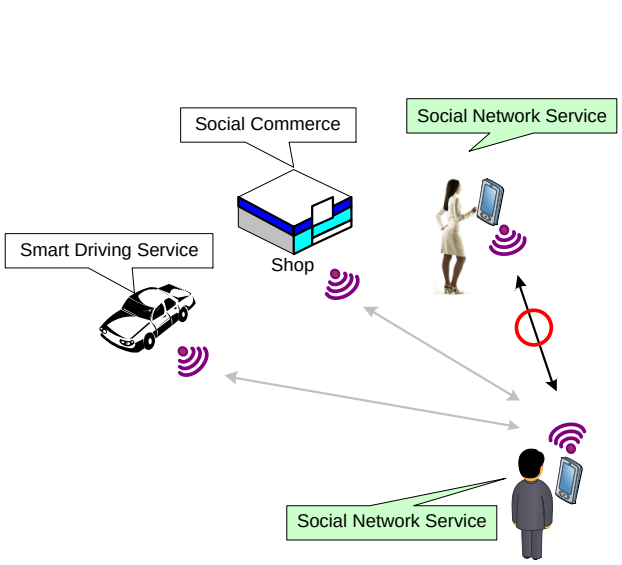
Something beyond the current BS-controlled direct communication in IEEE 802.16 GRIDMAN TG (2)

- To support requirements imposed by proximity-based applications, we need followings that are not in the current specification
  - MS-based device discovery in proximity of each other (cont.)
    - For the MSs associated to not only the same BS but also different BSs
    - Discovery of MSs even in sleep mode / idle mode
    - A possibility of discovery with the help of BS or network for charging

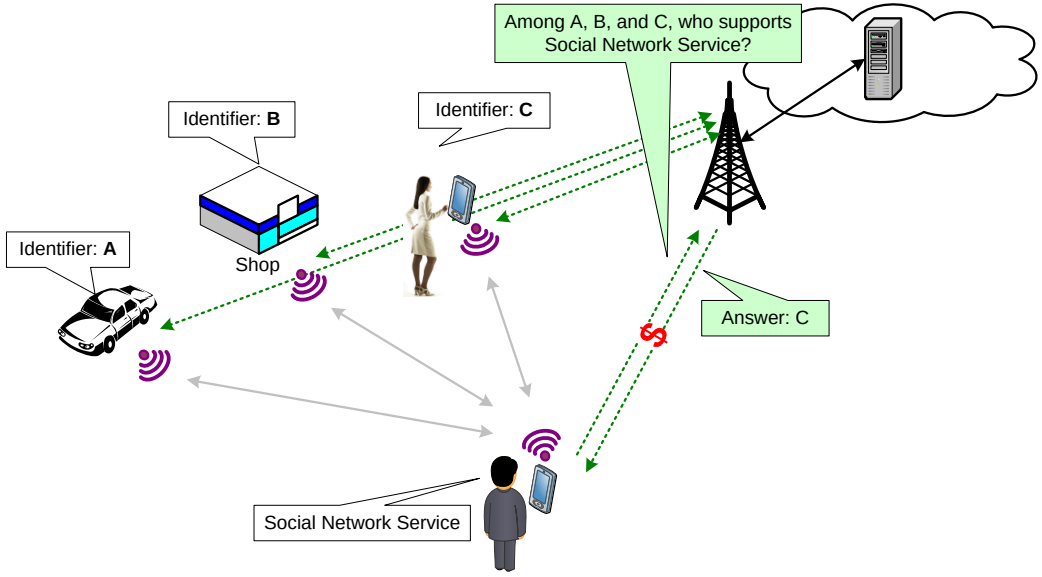


Something beyond the current BS-controlled direct communication in IEEE 802.16 GRIDMAN TG (3)

- To support requirements imposed by proximity-based applications, we need followings that are not in the current specification
  - Service Discovery
    - Autonomous discovery of device supporting the requested service
    - A possibility of network-assisted service discovery for charging



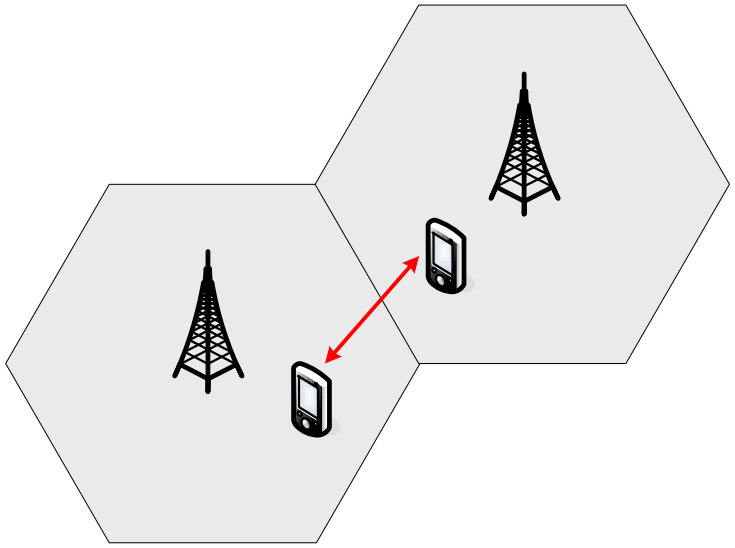
Direct service discovery



Network-assisted service discovery

Something beyond the current BS-controlled direct communication in IEEE 802.16 GRIDMAN TG (4)

- To support requirements imposed by proximity-based applications, we need followings that are not in the current specification
  - Support for inter-cell direct communication
    - MSs in proximity could associated to different BSs



Achievable features of a new infrastructure-dependent Direct Communication distinct from other DCs in IEEE 802 (1)

- vs. DCs in both IEEE 802.11 and IEEE 802.15
  - BS coordinates resources for direct communication links
  - Opportunity for MNO to charge in return for the *assistance* by BS
- vs. IEEE 802.11 DLS/TDLS
  - Direct communication in licensed band
  - Proximity-based device discovery
  - Relatively long link coverage (MAN vs. LAN)
- vs. IEEE 802.15 PAC
  - Infra structure-dependent direct communication
  - Discovery for peer after association with infrastructure

Achievable features of a new infrastructure-dependent Direct Communication distinct from other DCs in IEEE 802 (2)

- vs. IEEE 802.16 GRIDMAN TG
  - Full support for proximity-based application
    - MS-based device discovery
    - Support for Service discovery
    - Support for inter-cell direct communication
  - Candidate Technologies for infrastructure-dependent proximate direct communication
    - Advanced interference management for direct communication in dense device environment
    - Power saving scheme in direct communication link

Proposal of new PAR & 5C for proximate direct communication (PDC)

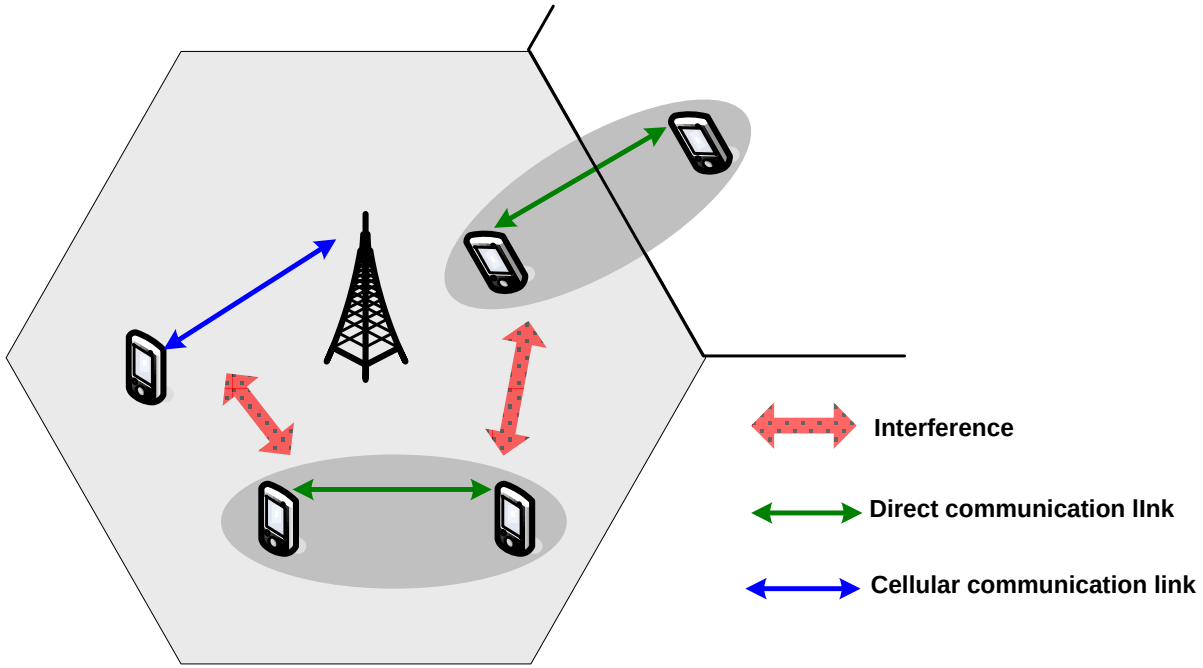
- Need for a new TG
  - To fully support the aforementioned proximity based applications and new features currently unavailable in the latest 802.16.1/1a standard
  - To develop a distinctive infrastructure-dependent and/or infrastructure-independent direct communication standard with backward compatibility to existing 802.16 protocols
  - To define 802.16 enhancements to support proximity based direct communication.

APPENDIX

Candidate Technologies for infrastructure-dependent proximate direct communication

Candidate Technologies for infrastructure-dependent proximate direct communication

- Advanced interference management for direct communication
  - Interference management for direct communication with the consideration to dense device environment



Candidate Technologies for infrastructure-dependent proximate direct communication

- Power saving scheme in direct communication link
  - Support for applications having a long link lifetime with low activity