[Fully distributed infrastructure-less proximity based direct communication for 802.16]

[IEEE 802.16 Mentor Presentation Template (Rev. 0)]

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Base Contribution:

[None]

Purpose:

[To instigate discussion regarding a new project for the IEEE 802.16 Working Group, and to propose a development on infrastructure-independent direct communications for proximity-based services]

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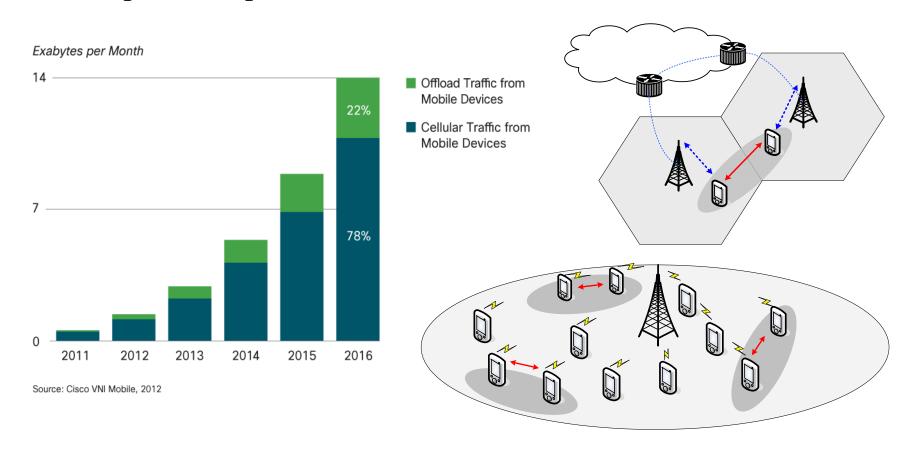
Proximity based applications (aforementioned in [1])

- What can we get with proximity based applications?
  - Cellular traffic offloading (or data content sharing)
  - Proximity based P2P (device/service) discovery feature
  - Proximity based social commerce and advertisement
  - Proximity based social networking service (gaming, chatting, etc.)
  - Etc.

- Current issues/trends of 3GPP LTE (ProSe)
  - Network controlled proximity service
    - Discussions on supporting proximity based service are active (D2D direct discovery & local routing)
  - Proximity service for public safety
    - Out of BS coverage case

<locally routed data path>   <Direct mode data path>

Proximity based applications via Direct Communication

- Why traffic offloading?
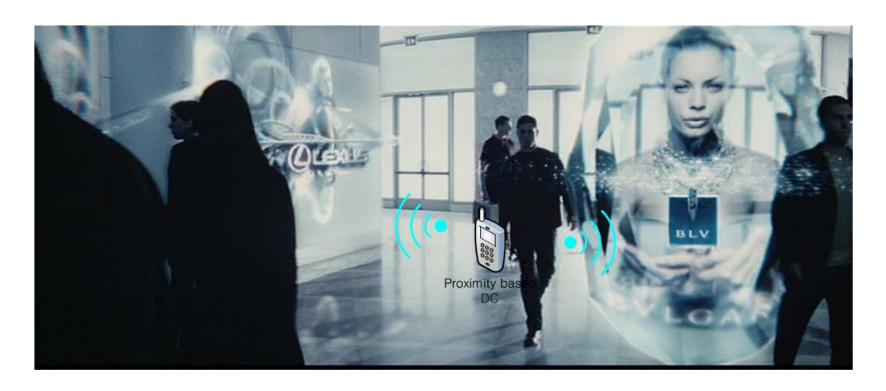 - Expected exponential increase of mobile traffic

Proximity based applications via Direct Communication

- Benefits of proximity based service
  - Public information service: MS initiates direct device/service discovery

Proximity based applications via Direct Communication

- Business model of proximity based service
  - Social commerce and advertisement: MS initiates device/service discovery (e.g. iridodiagnosis)
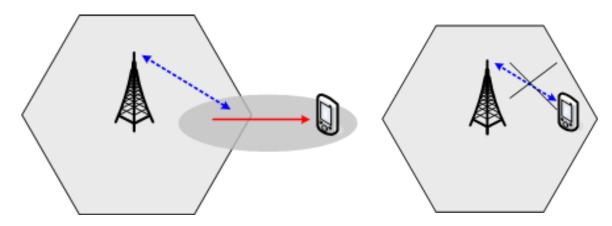
Thoughts on current 802.16.1/1a standard

- Can IEEE 802.16 GRIDMAN TG's BS-controlled/talk-around communication support proximity based services?
  - 1) Cellular traffic offloading (Inter-BS data content sharing)
    - BS-controlled DC:
      - Limited to a single BS service area (not specifically defined for inter-BS case)
    - Talk-around DC:
      - Focused on voice application (low capacity)
  - 2) Proximity based P2P (device/service) discovery
    - BS-controlled:
      - No MS initiated proximity discovery
      - No support for device/service discovery in idle mode (before MS network entry)
    - Talk-around DC:
      - Not considered, no MS initiated proximity discovery

New amendments for 802.16 standard
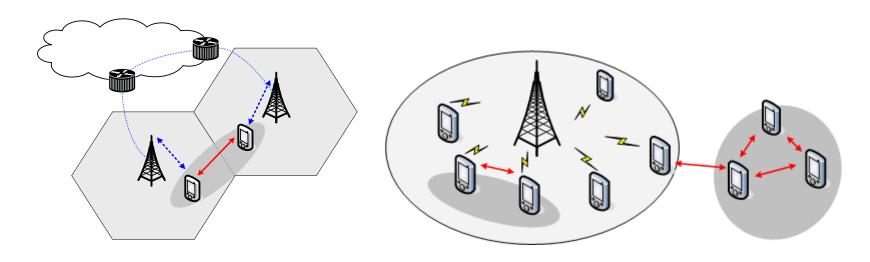
- In order to support proximity based direct communication (DC) services in the current 802.16 standard, we need a new amendment (not a revision of GRIDMAN TG).

  - The intent of DC feature in GRIDMAN TG is primarily focused on enhancing the link reliability, not for proximate based services.

  - Undoubtedly, the GRIDNMAN's schedule for sponsor balloting is approaching in a few months.

  - Therefore, the DC feature for supporting proximity based service needs a new approach/enhancement different from GRIDMAN's.

New amendments for 802.16 standard

- To build a new PHY/MAC protocol, technically, we can think of two hierarchically top level ways
  - **a) BS dependent way**: D2D communication with the help of BS or network
  - **b) BS independent way**: let D2D communication do discovery, resource allocation, and scheduling independently. In addition, we can extend the coverage of proximity based services.

- We suggest proximity based DC (PDC) PHY/MAC protocols as an 802.16 enhancement.
  - In this contribution, we suggest infrastructure-independent mode.
  - In the other contribution (16-12-461-0x-Gcon), BS dependent mode will be presented.

New amendments for 802.16 standard
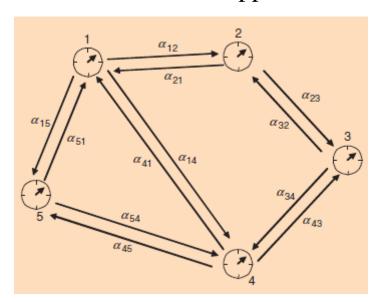
- The prime focus is on infrastructure-dependent DC. However, it is possible that this feature can be extended to out of BS coverage (infrastructure-less) situation.
    - Why not exploit the licensed band for out of BS coverage area cases?
    - Then, infrastructure-independent mode can setup D2D links where an MS is located out of BS coverage area (the corresponding pair is in the BS's coverage)
    - Also, infrastructure-independent mode can apply to the case of infrastructure failure due to disasters
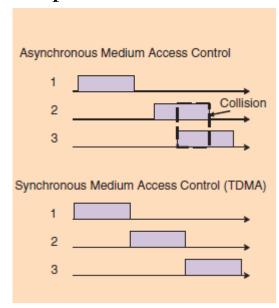
New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features:
  - A) Direct MS initiated device/service discovery
    - Within BS coverage: BS assists finding peers, including a situation with densely populated PDC nodes
    - Out of BS coverage: devices independently finds PDC peers
    - Large number of device discovery within a given time
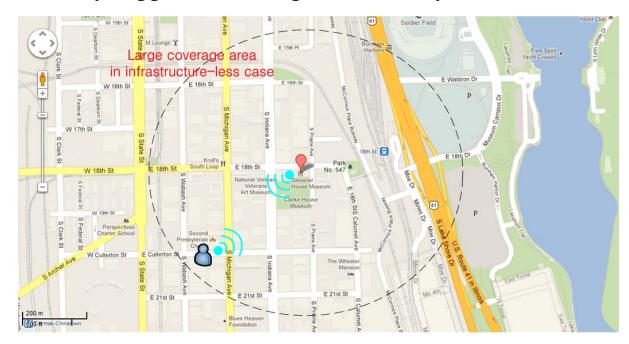
New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features: (cont.)
    - B) Synchronization and multiple access scheme
        - MSs are able to support distributed synchronization
        - MSs are able to support distributed multiple access coordination

New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features: (cont.)
  - C) Support of large coverage area
    - MSs may provide large link coverage
    - MSs may support multi-hop functionality

New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features: (cont.)
  - D) Additional features
    - Power saving features
      - A fixed frame structure is preferred
    - Resource reuse
      - Spatial reuse with transmit power control
    - Possible interference [2-4] reduction by new frame structures
      - Non FDM based user resource allocation could be effective

New amendments for 802.16 standard

- 2) Compatibility to current standard?
  - Backward compatibility with 802.16 OFDMA based standard? Yes
  - No change required for legacy 802.16m PHY/MAC specification, but some additional protocol amendments are expected.

- Amendment to the 802.16 could make above possible
  - The amendment shall be a comprehensive standard of BS dependent DC for proximity based applications supporting various use cases:
    - MS to MS associated with BSs
    - MS to MS each associated with different BSs
    - MS to MS, only one of the pair is associated with a BS
    - MS to MS not associated with any BSs (out of BS coverage)

Conclusions

- Both contributions (12-461-03-Gcon and 12-462-04-Gcon) have a common notion that quite a few proximity based direct communication use cases expect MS to trigger device/service discovery.

- The discussion on infrastructure-dependent case is discussed in 16-12-0461-0x-Gcon, whereas this contribution is focused on infrastructure-independent cases. Both cover proximity based direct communication in the following situations:
  - MS to MS paired/associated with a single BS
  - MS to MS pair, each associated with different BSs
  - MS to MS pair, only one of the pair is associated with a BS
  - MS to MS not associated with any BSs (out of BS coverage)

Why a new TG?

- To fully support the aforementioned proximity based applications and new features currently unavailable in the latest 802.16 standard

- To develop a distinctive MS-initiated infrastructure-dependent and/or infrastructure-independent direct communication standard with backward compatibility to existing 802.16 protocols

- Therefore, we need a comprehensive amendment of infrastructure-dependent and infrastructure-independent proximate DC to support such.

Proposal

- Call for contributions
  - Seeking contributions and participations for building a new PAR & 5C on proximate direct communication (PDC) to support proximity based applications

Suggested Tentative Timeline for TG PDC

- Forward draft PAR and 5C statement to IEEE 802 EC   Sept. 2012
- Submit PAR and 5C to NesCom   Nov. 2012
- PAR approval by IEEE-SA Standards Board   Dec. 2012
- TG formation (IEEE 802.16 WG #83)   Jan. 2013
- IEEE 802.16 WG #84   Mar. 2013
- IEEE 802.16 WG #85   May 2013
- IEEE 802.16 WG #86   July 2013

Thank You
Questions?

References

- [1] W. Shin, J. Cha, A. Lee, E. Kim, and K. Lim, "802.16 enhancements to support direct communications for proximity-based applications", IEEE 802 doc. 16-12-0353-01-Gcon.

- [2] K. Doppler, M. Rinne, C. Wijting, C. Ribeiro, and K. Hugi, "Device-to-device communication as an underlay to LTE-advanced networks", Communications Magazine, IEEE, vol.47, no. 12, pp.42-49, Dec. 2009.

- [3] P. Janis, V. Koivunen, C. Ribeiro, J. Korthonen, K. Doppler, and K. Hugi, "Interference-aware resource allocation for device-to-device radio underlaying cellular networks", IEEE VTC Spring 2009, IEEE 69th, pp.1-5.

- [4] T. Chen, G. Charbit, and S. Hakola, "Time hopping for device-to-device communication in LTE cellular system" IEEE WCNC 2010, pp.1-6.