[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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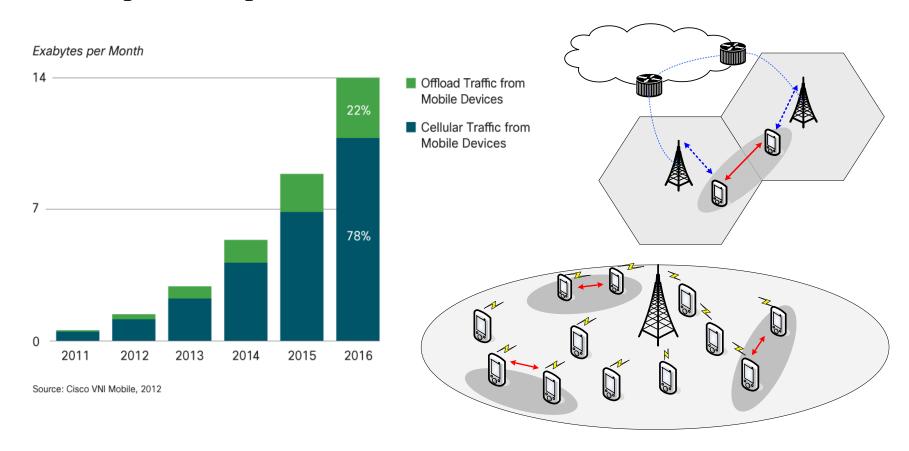
Proximity based applications (aforementioned in [1])

- 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
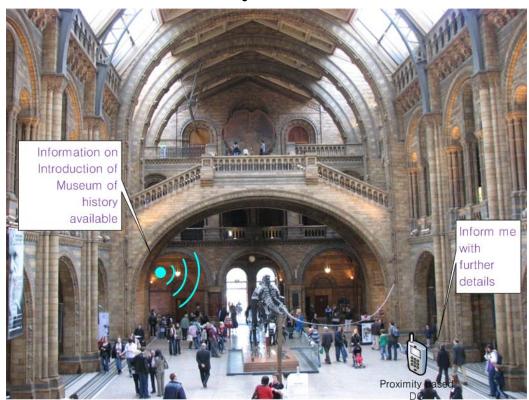   - Out of BS coverage case

Proximity based applications via Direct Communication

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

Exabytes per Month

Offload Traffic from Mobile Devices

Cellular Traffic from Mobile Devices
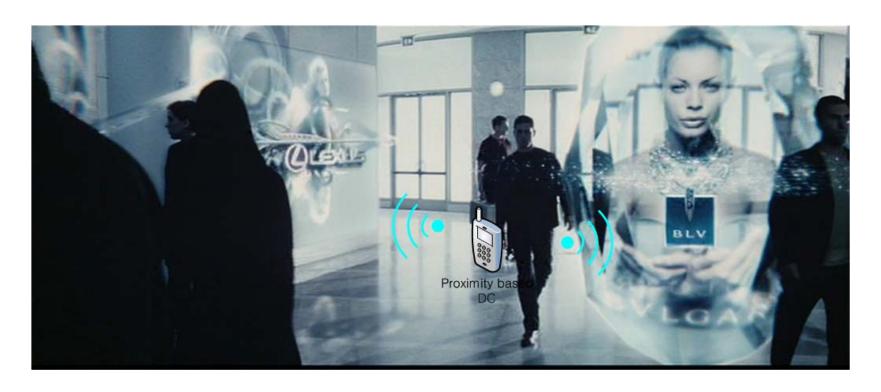
Source: Cisco VNI Mobile, 2012

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
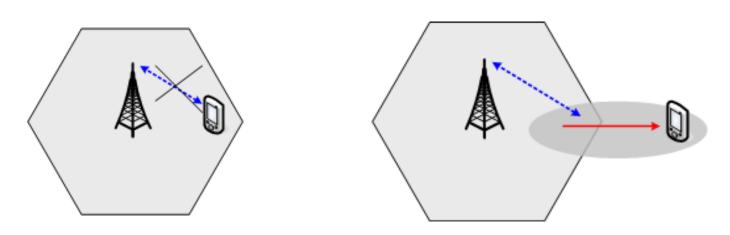
Thoughts on current 802.16.1/1a standard

- 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
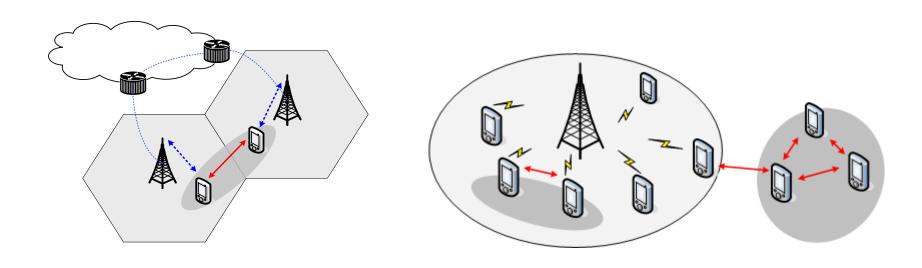
- In order to support proximity based direct communication (DC) services in the current 802.16 standard, we need a new amendment (not a revision of GRIDMAN TG).
  - The intent of DC feature in GRIDMAN TG is primarily focused on enhancing the link reliability, not for proximate based services.
  - Undoubtedly, 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

- 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.

- In this contribution, we suggest proximity based DC PHY/MAC protocols as an 802.16 enhancement.
  - In this contribution, we suggest infrastructure-independent mode
  - In the other contribution (16-12-461-00-Gcon), BS dependent mode will be presented
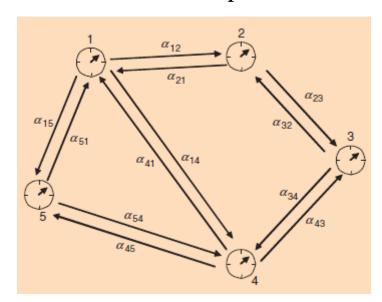
New amendments for 802.16 standard

- The primarily focus is on BS-dependent DC. However, technically this feature extends to out of BS coverage (infrastructure-less) situation
    - Why not exploit the licensed band for out of BS coverage area cases?
    - Can setup D2D links where an MS is located out of BS coverage area (the corresponding pair is in the BS's coverage)
    - Can apply to the case of infrastructure failure due to disasters

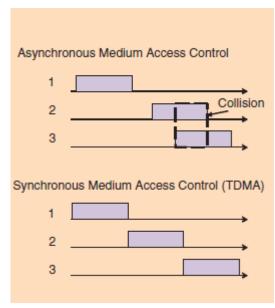# New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features:
  - Direct device/service discovery
    - Within BS coverage: BS assists finding peers
    - Out of BS coverage: devices independently finds peers

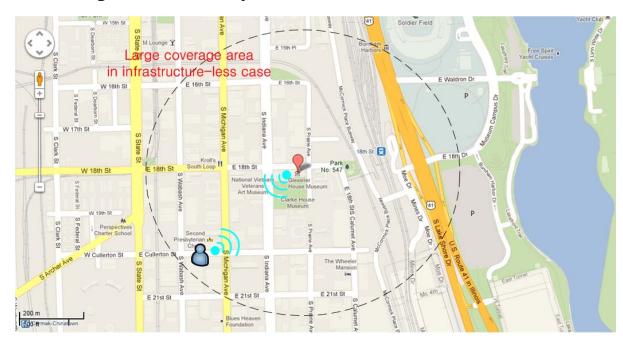# New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features: (cont.)
  - Out of BS service area case
    - Distributed synchronization
    - Distributed multiple access coordination

New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features: (cont.)
    - Out of BS service area case
        - Basic large link coverage
        - Multi-hop functionality

New amendments for 802.16 standard

- 1) Infrastructure-independent proximity based DC's enhanced features: (cont.)
  - 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
  - To be added…

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 amendments for proximate DC PHY/MAC protocol.

- Amendment to the 802.16 could make above possible
  - A comprehensive standard of BS dependent DC for proximity based applications supporting use cases:
    - MS to MS associated with 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)

Summary

- Quite a few proximity based direct communication use cases expect MS to trigger device/service discovery.
- Proximity based direct communication could be categorized with following situations:
    - MS to MS associated with 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)
- Therefore, we need a new amendment of a comprehensive BS dependent DC to support such.

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.

Suggested Tentative Timeline for TG PDC

- Forward draft PAR and 5C statement to IEEE 802   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

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.