Device to Device (D2D) proximity service in LTE

NTT DOCOMO, INC.
**Background – Use Case of D2D**

**D2D (Device to Device proximity services)**

### Key features

- **Direct communication**
- **Location based services**
- **Discovery**

### Application / service

- **Public safety**
- **Public**
  - Special offer!
- **Commercial**
  - Advertisement
  - SNS
  - Geo-fencing
  - Gaming

Various applications and services can be enhanced by D2D.
**Background – Spectrum scenario of D2D**

### Unlicensed band
- WiFi Direct, Bluetooth (iBeacon), WiGig, IrDA, ...

### Licensed band
- NW assisted access
- Existing public safety
- LTE D2D

**Radio access**

**Access control**

**Expected for LTE D2D**

- Larger coverage than unlicensed band
- Higher reliability than unlicensed band
- Less power consumption, signaling overhead than both existing solutions
- Efficient co-existence with WAN
- Support of out-of-coverage of cellular LTE
**LTE Release 12**

**Service oriented enhancements**
- D2D (Device to Device) communication/discovery
- MTC (Machine Type Communication)

**Enhancements for higher spectrum efficiency**
- NAICS (Network Assisted Interference Cancellation and Suppression)
- MIMO enhancement
- eCoMP

**Small cell**
- High capacity
- High traffic fluctuation
- Low Tx power node
- (TDD with higher frequency band)

**Small cell related enhancements**
- TDD-FDD CA (Carrier aggregation)
- SCE (Small cell enhancement)
- Dynamic TDD
Device to Device (D2D) proximity service in Rel-12 LTE

- D2D in LTE
  - Discovery and communication is supported
  - Use LTE uplink spectrum/resource
  - NW assisted configuration for D2D
    - eNB as synchronization source
    - Resource pool configuration
    - Dynamic resource allocation
  ➔ Efficient operation in-coverage

Rel-12 LTE schedule

<table>
<thead>
<tr>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE Release 12</td>
<td></td>
</tr>
</tbody>
</table>

Now
Rel-12 D2D Discovery

- Discovery in Rel-12 LTE
  - Message transmission over UL data channel (Physical UL shared channel (PUSCH)) based signal
    - E.g., message = Prose (proximity service) UE ID and Prose Application ID.
  - Receiving UE can detect multiple messages
    - Upper layer filtering for detected messages assumed

- Scenario
  - Intra-cell and inter-cell
  - In coverage is supported. No out of network coverage discovery

In NW coverage

Synchronous / Asynchronous

Inter-cell

Cell 1

Discovery

Cell 2

Out of NW coverage
Rel-12 D2D Communication

- Communication in Rel-12 LTE
  - Broadcast only
  - SA (Scheduling Assignment) and data will be sent for communication

- Target service
  - Targeted to apply only to public safety
  - Non-public safety service could be supported for economy scale

- Target scenario
  - Intra-cell and inter-cell operation
  - In coverage and out of coverage is supported
Summary

- Specification work of D2D discovery/communication for LTE release 12 is ongoing
  - **Basic design**
    - Use LTE uplink spectrum/resource
    - Physical Uplink Shared CHannel (PUSCH) based signal design
      - Single carrier FDMA based multiple access
    - Network assisted configuration
  - **Scope**

<table>
<thead>
<tr>
<th></th>
<th>Intra-cell / inter-cell</th>
<th>In coverage / out of coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery</td>
<td>Both</td>
<td>In coverage only</td>
</tr>
<tr>
<td>Communication</td>
<td>Both</td>
<td>Both</td>
</tr>
</tbody>
</table>