
3GPP TSG RAN Meeting #63
Fukuoka, Japan, 3 - 6 March 2014

RP-140056

Document for: Discussion
Agenda Item: 14.1.1

Background document for 'LTE Device to Device Proximity Services' - Work Item

Qualcomm Incorporated

Benefits of LTE D2D Proximity Services

Benefits of D2D Proximity Services

From the proposed WID

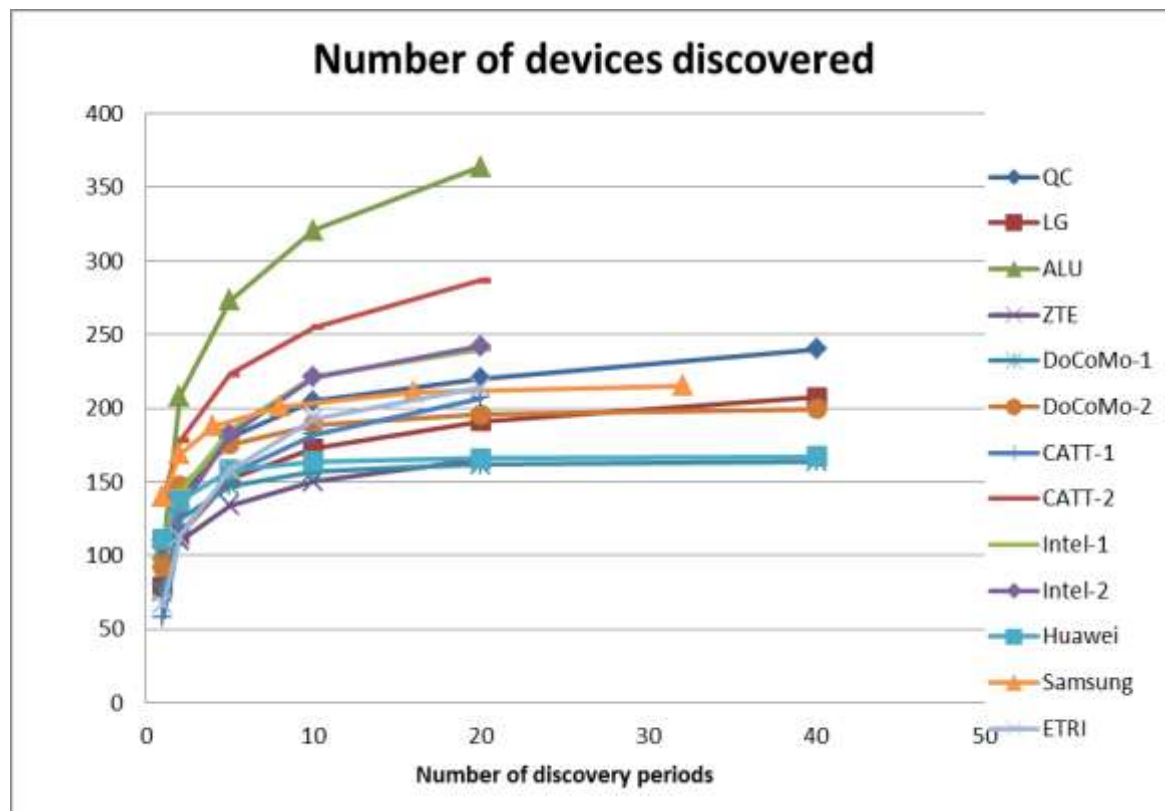
“Proximity-based applications and services represent an emerging social-technological trend. The introduction of a Proximity Services (ProSe) capability in LTE allows the 3GPP industry to serve this developing market, and, at the same time, serve the urgent needs of several Public Safety communities that are jointly committed to LTE”

Evaluation results from the D2D Study Item

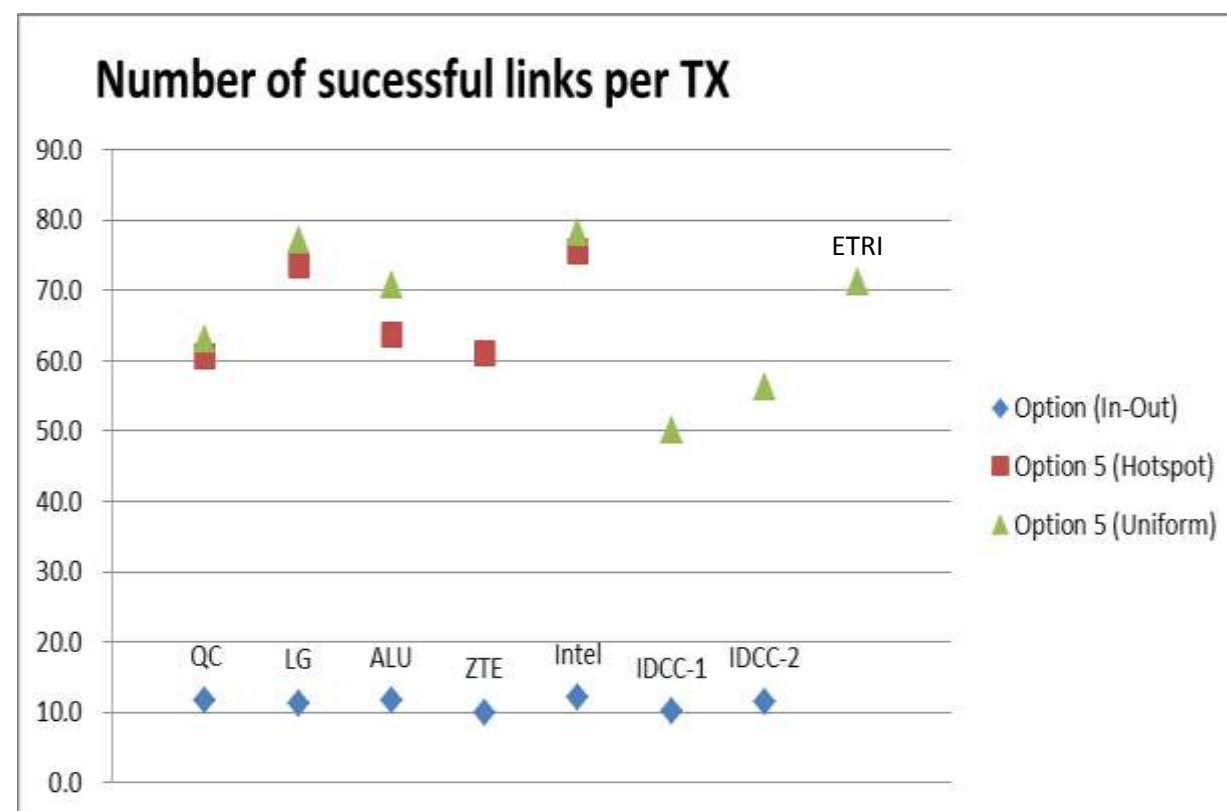
From the D2D Technical Report TR36.843

Evaluations showed that sufficient number of links can be maintained

Discovery



Communication



Objectives and Conclusions of the D2D Study Item

Objectives of the D2D Study Item

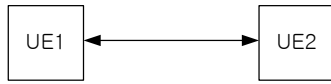
From the D2D Technical Report TR36.843

The objectives of this feasibility study are to evaluate LTE Device to Device proximity services, as follows:

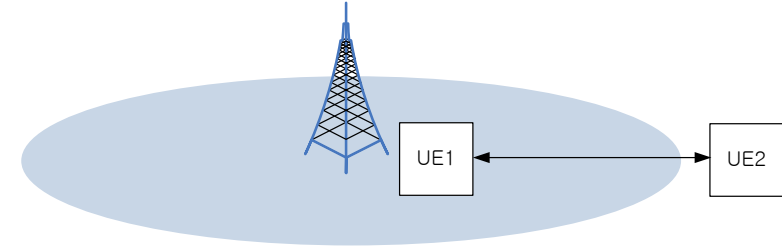
	Within network coverage	Outside network coverage
Discovery	Non public safety & public safety requirements	Public safety only
Direct Communication	At least public safety requirements	Public safety only

Objectives of the D2D Study Item (Cont.)

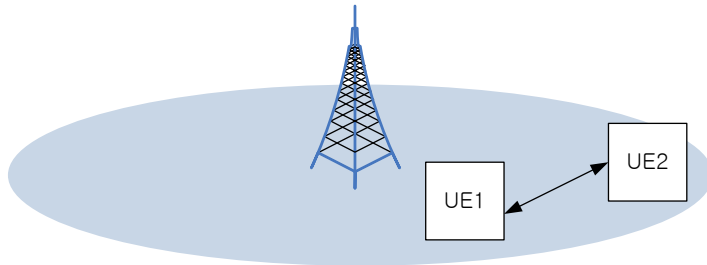
D2D Scenarios



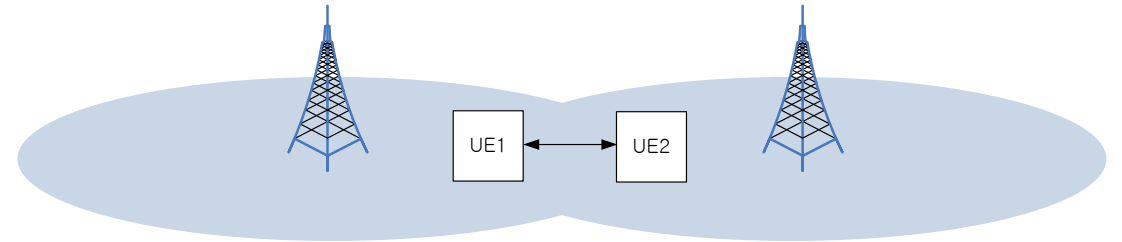
(a) Scenario 1A



(b) Scenario 1B



(c) Scenario 1C



(d) Scenario 1D

Scenarios	UE1	UE2
1A: Out-of-Coverage	Out-of-Coverage	Out-of-Coverage
1B: Partial-Coverage	In-Coverage	Out-of-Coverage
1C: In-Coverage-Single-Cell	In-Coverage	In-Coverage
1D: In-Coverage-Multi-Cell	In-Coverage	In-Coverage

Conclusions of the D2D Study Item

From the D2D Technical Report TR36.843

- With the current status of work, adding D2D discovery techniques is considered compatible to LTE standard.
- With the current status of work, adding D2D broadcast communication techniques is considered compatible to LTE standard, and can fulfill the voice and data needs of the public safety community both within network coverage and outside network coverage.

Commonality of Discovery and Communication

Commonality of Discovery and Communication

- Synchronization represents a large portion of the remaining work and it is required for both discovery and communication
- Removing either discovery or communication would not halve the amount of work required because the common parts and overlaps
 - In particular, the difference in focusing on communication only or focusing on both discovery and communication is not great in terms of required time
- Separating the WI would be tied to an undesirable decoupling the completion schedule of the two components (discovery and communication)
 - Decoupled time frames for discovery and communication would increase the effort needed to avoid inconsistent and contradicting designs

Use case and scale

Benefits of consumer use case

- There is a vast number of operators interested in the consumer use cases in the context of D2D (see SP-130293 and SP-130457)
 - And specifically in the **proximity discovery functionality** that would enable new business models and opportunities for the operators
- LTE as a choice for Public Safety air-interface was motivated by **the beneficial scale** effects it can provide.
 - If the specified Rel-12 D2D solution provides no support for any consumer use case, it is not possible to achieve this goal

Work Status

D2D RAN Status Overview

Design Issues	Current working assumption
Sync Signal design (RAN1)	PD2DSS is ZC sequence with FFS length, SD2DSS is m-sequence PD2DSCH is FFS
Sync resource selection (RAN1)	
Data signal design (RAN1)	PUSCH
Control signal design (RAN1)	SA use PUSCH
Discovery signal design	PUSCH
Resource allocation and signalling for communication (RAN1/2)	Mode 1 (eNB control) for in-coverage Mode 2 (Distributed) for out/edge-of-coverage
Resource allocation and signalling for discovery (RAN1/2)	Both Type 1 (distributed) and Type 2 (eNB control) Type 1 uses random selection as baseline Type 2B uses RRC messages for resource request and response as baseline
Protocol structure for discovery and communication (RAN2)	MAC and PhyL for discovery (no IP needed – pending SA3 input for security) Use legacy as much as possible for communication
Coexistence study (RAN4)	WF agreed: reuse 36.942 (RAN4 TR) and 36.843 (RAN D2D TR) methodology

Summary of RAN1 aspects

- Given the current status, the remaining work is
 - D2D Synchronization (40% of the total work)
 - Signal design for discovery and communication (25% of the total work)
 - Additional control for communication – including signal design (10% of the total work)
 - Resource allocation
 - Resource allocation for communication (20% of the total work)
 - Distributed for out/edge-of-coverage agreed at RAN1 #76
 - Resource allocation for discovery (5% of the total work)
 - Already a working assumption to make random selection a baseline for Type 1
- There is significant commonality between discovery and communication

RAN1 – current status on synchronization

- Synchronization is the main part of D2D WI
 - Needed for communication and also for out-of-coverage discovery
- Sync signal design (15% of the total remaining work)
 - D2DSS comprises of PD2DSS and SD2DSS
 - PD2DSS is an ZC sequence, SD2DSS is an m-sequence (may be revisited)
 - PD2DSCH design and content is FFS
 - Periodicity of D2DSS/PD2DSCH is likely different from traditional periodicity of 5 ms
- Sync resource allocation (15% of the total remaining work)
- UE behavior for sync (when to transmit D2DSS) (10% of the total remaining work)
 - Some criterion have been identified for D2DSS selection
 - Main agreement is to prioritize UEs in network over UEs out of network

RAN1 – current status on signal design

- Signal design for scheduling assignments, data, and discovery (25% of the total remaining work)
 - All three have a working assumption of PUSCH
 - We believe all remaining details can be common for all three
 - with possible exception of CRC size and PRB size
- Additional control for communication (10% of the total remaining work)
 - Need to agree on what additional control is needed and corresponding signal design
- WAN D2D Multiplexing
 - Link level – TDM between WAN and D2D
 - Current agreement to prioritize cellular in case of conflict between D2D and cellular
 - No additional work needed at the link level

RAN1 – current status on resource allocation

- For communication
 - Mode 1: eNodeB explicitly allocates for in-coverage (agreed)
 - Mode 2: UEs select in a distributed way from a pool
 - For out-of-coverage and edge of coverage (agreed)
 - For in-coverage (FFS)
- For discovery
 - Type 1: UEs select in a distributed way from the pool (agreed)
 - Type 2: eNodeB allocates in UE specific way (agreed)
- Remaining work
 - What distributed algorithms to use for Mode 2 (20% of the total remaining work)
 - What distributed algorithms to use for Type 1 (5% of the total remaining work)
 - RAN1 doesn't need to spend time on Mode 1 or Type 2 (leave it to eNodeB/operator control)

RAN2 – current status

- Consistent with RAN1 status on discovery and communication resource allocation, and required signaling
- Protocol stack and required changes in legacy stack for both discovery and communication identified
 - SA3 input on security aspect is pending
- MAC header/content for discovery and communication identified
- Remaining Work
 - Inter-cell discovery and communication
 - eNB control of Mode 1 and Mode 2 for communication

RAN3 – current status

- Initial discussions on Inter-cell resource coordination
- Agreement: it may be beneficial for eNBs to signal each other over backhaul E-UTRAN interfaces (e.g. X2 interface) the resources used for D2D

RAN4 – current status

- All the LS from RAN1 replied to during the SI phase
 - In-band emissions model, AGC time, initial frequency offset agreed for RAN1 evaluation
 - RAN4 validated RAN1 working assumption of SC-FDMA
 - Minor FFS on frequency stability that from our view is not crucial
- Co-existence study has started in RAN4
 - Initial simulations discussed for co-existence from QC, Ericsson and Motorola Solutions
 - A way forward on co-existence study was agreed to align simulation assumptions
 - Way forward agreed states that it can continue in the WI phase
- Demod part waiting for RAN1 to complete signal design details

Proposed WI plan

D2D WI plan

Overview

- RAN1: required TUs: 8 TUs/meeting
- RAN2: required TUs: 3 TUs/meeting
- RAN3: required TUs: 1 TUs/meeting
- RAN4 : required TUs: 1.5 TUs/meeting (including RF and RRM/demod)
 - RF: Required TUs: 1 TU at #70BIS; 0.5 TUs from #71 to #72 ; 0 TU from #72 to #73
 - RRM/demod: Required TUs: 0.5 TUs at #70BIS; 1 TU from #71 to #72 ; 1.5 TU from #72 to #73

D2D WI plan

Time budget proposal

RAN #63										Q2/2014										RAN #64			
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf	R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf				
76bis	76bis	85bis	85bis	85bis	83bis	70bis	70bis	70bis	70bis	77	77	86	86	86	84	71	71	71	71				
8		3			1	1	0.5			8		3			1	0.5	1						

RAN #64						Q3/2014				RAN #65			
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf				
78	78	87	87	87	85	72	72	72	72				
						0.5	0.5		0.5				

RAN #65										Q4/2014										RAN #66			
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf	R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf				
78bis	78bis	87bis	87bis	87bis	85bis	72bis	72bis	72bis	72bis	79	79	88	88	88	86	73	73	73	73				
									1.5														1.5

L: LTE, U: UMTS, J: Joint, RD: RRM/demodulation

D2D WI plan

RAN1

- Required TUs: 8 TUs/meeting including
 - Synchronization (3.5 TUs)
 - Signal design (2.5 TUs)
 - Resource allocation for discovery and communication (2 TUs)

	Synchronization	Signal Design	Resource allocation
3GPPRAN1#76-BIS	PD2DSCH content and design D2DSS design	Details of PUSCH design Identify control for comm	Schemes for Mode 2
3GPPRAN1#77	D2DSS design, resource allocation, signal periodicity	Details of PUSCH design Design of control for comm	Finalize schemes for Mode 2 & Type 1

D2D WI plan

RAN2

- Required TUs: 3 TUs/meeting including

	Resource Allocation	Protocol Stack	Headers
3GPPRAN2#85-BIS	Signaling for Type 1 & 2, Mode 1 & 2	Stack for discovery and communication	No MAC header for discovery, conclude MAC header content for communication
3GPPRAN2#86	Finalize Signaling for Type 1 & 2, Mode 1 & 2. Finalize parameters to be part of SIB and dedicated signaling. Procedural details and stage 3	Finalize protocol stack for discovery and communication based on SA3 input on security aspect. Stage 3	Changes to any other header, New MAC CEs (e.g. BSR for in-coverage D2D). Details and stage 3

D2D WI plan

RAN3

- Required TUs: 1 TUs/meeting

	Resource Allocation
3GPPRAN3#83-BIS	Identify backhaul mechanism for inter-cell resource coordination
3GPPRAN3#84	Define backhaul signaling for inter-cell resource coordination Procedural details and stage 3

D2D WI plan

RAN4

- Required TUs: 1.5 TUs/meeting (including RF and RRM/demod)

	RF	RRM/Demod
3GPPRAN4#70-BIS	Adjacent channel co-ex study	RRM Core requirements
3GPPRAN4#71	Adjacent channel co-ex study, Tx and Rx RF requirements	RRM Core requirements
3GPPRAN4#72	Finalizing Tx and Rx RF requirements	Finalizing RRM Core requirements Demod requirements – PUSCH
3GPPRAN4#72-BIS		Demod requirements – PUSCH
3GPPRAN4#73		Demod requirements – D2DSS RRM tests

Thank you