Evaluation Environments and Requirements for LTE-A

R1-082328

Motorola

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LTE-A Evaluation Methodology #1

- **Mobility in System Simulation Tools for Modeling HO & PC Dynamics**
  - **Not obvious such capability is always needed to evaluate t-put performance**
  - **Are users doing text messaging while driving their car?**
    - According to some car insurance companies some teenagers are ☺
    - Is LTE-Advanced about streaming video to automobiles (passengers) or is it mainly hot spots?
  - **Urban canyon or "stop sign" effect were evaluated in LTE (Malta) regarding PC**

- **Traffic Models In Addition to Full Buffer (or FTP)**
  - **Motorola always proponent of using bursty traffic models (e.g. HTTP, Gaming, NRTV)**
    - What do we learn from them? Control Channel efficiency is paramount
  - **HTTP and NRTV (streaming video) were proposed in 25.814 for LTE**
    - HTTP WB model includes modeling of TCP Handshake, ACK/NACK and slow start, ETSI WB model did not
    - Motorola modeled aspects of RLC for HSUPA to account for added latency
  - **Require operator input on which traffic type(s) are the most important**

LTE-A Evaluation Methodology #2

- **Concurrent Modeling of UL and DL Sometimes Useful – Especially VoIP**
  - **Motorola already has this capability in its LTE system simulation tools – e.g. for modeling PDCCH performance/loading while evaluating PDSCH performance.**
    - Uplink UE's also scheduled and allocated PDCCH resources including power allocation
  - **Even for VoIP it is still possible to effectively evaluate system performance of each link separately**
  - **Concurrent modeling best used on an "as needed" basis. One link maybe more highly modeled.**

- **Heterogeneous & Hierarchical Network Layouts**
  - **New nodes – pico cells, Home NBs, relays will impact how we simulate a "typical" network**
    - Backhaul methods can impact data performance (X2, S1, air interface)
  - **Evaluation of ICIC, SON are obviously impacted by having these new nodes**
  - **Previous evaluation showed performance of non-uniform cell layout worse**
    - Based on evaluation of cities in US and Asia using measured path loss
    - More important for optimizing ICIC and SON or determining corresponding features/metrics to be specified

LTE-A and IMT-A – Mobility Classes & Deployment

- **Alignment with IMT-A Requirements (IMT.TECH, IMT.EVAL)**
  - **Not essential to align every aspect of LTE-A and IMT-A evaluation scenarios/method**
  - **But substantial alignment of LTE-A and IMT-A processes useful to reduce workload**
- **Mobility Class Definition**

Mobility Class	Velocity Range (km/h)	Typical Velocity (km/h)
Pedestrian	0-10	3
Vehicular	10-120	60
High Speed Vehicular	120-350	250

- **Mobility Class Mapping to Test Environment**

Test Environment	Base Coverage Urban	Microcellular	Indoor	High Speed /Rural
Rename	Urban	Microcell	Indoor	Rural
Mobility Class	Pedestrian (Vehicular)	Pedestrian	Pedestrian	(Vehicular) High Speed Vehicular

  - **Proposal – simplify test environment names and applicable mobility classes**
  - **Proposal – limit maximum number of mobility classes per test environment**
    - Maximum of 2 mobility classes per test environment (could be simplified to a single mobility class)
    - Mobility classes can be distributed over mixed population or tested separately

Proposed LTE-A Environments

Parameter	Units	Case 1	Urban	Microcell	Indoor	Rural
ISD	m	500	500	200	N/A	1732
Topology	-	Cellular (hex)	Cellular (hex)	Cellular (hex)	N/A	Cellular (hex)
Carrier Freq.	MHz	2000	2000	2000	3400	800
Bandwidth	MHz	10	FDD: 10+10 TDD: 10	FDD: 20+20 TDD: 20	FDD: 40+40 TDD: 40	FDD: 10+10 TDD: 10
eNB Tx Power	dBm	46	46	46	21-23	49
Speed	km/h	3	Ped: 3 Veh: 60	Ped: 3	Ped: 3	Veh: 60 Hsv: 250
Pen. Loss	dBm	20	Ped: 20 Veh: 10	Ped: 20	N/A	Veh: 10 Hsv: 10

- **Notes**
  - **Proposed environments aligned with Motorola IMT-A proposals**
  - **Potential simplifications:**
    - Merge Case 1 and Urban scenario yielding a total of 4 scenarios
    - Reduce mobility models – i.e. eliminate Pedestrian model for Urban and Vehicular model for Rural

LTE-A Performance Requirements

Configuration		Spectral Efficiency (bps/Hz/cell)				
		Case 1	Urban	Microcell	Indoor	Rural
UL	1x2	1.2				0.9
	2x4	2	1.9	2.1	*TBD*	
DL	2x2	2.4				
	4x2	2.6	2.5	2.7	*TBD*	2.2
	4x4	3.7	3.5	3.8	*TBD*	

Average Spectrum Efficiency

Configuration		Spectral Efficiency (bps/Hz/cell/user)				
		Case 1	Urban	Microcell	Indoor	Rural
UL	1x2	0.04				0.025
	2x4	0.07	0.05	0.08	*TBD*	
DL	2x2	0.07				
	4x2	0.09	0.07	0.1	*TBD*	0.06
	4x4	0.12	0.1	0.13	*TBD*	

Cell Edge User Throughput

- **Notes**
  - **Specification of absolute value for performance is sufficient**
  - **Introduction of new deployment models renders relative performance w.r.t. e.g. HSPA labor intensive for modest benefit.**
  - ***Indoor* environment values TBD pending of interference scenario definition**

LTE-A EMBMS Requirements

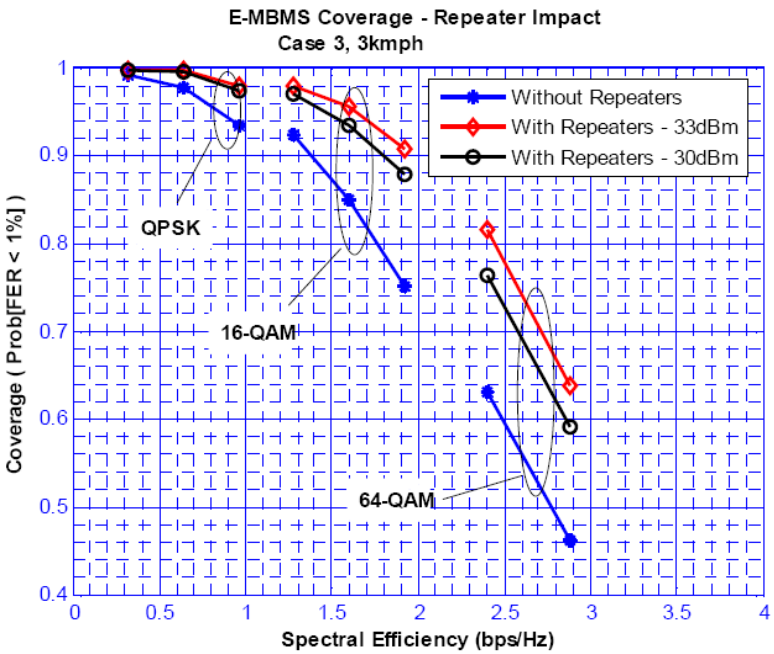
- **Existing Requirements**
  - **Applicable Performance Metrics**
    - **Cell edge MBMS spectrum efficiency**
    - **Maximum ISD to achieve 1bps/Hz cell edge efficiency**
  - **3GPP 25.913: 1.0bps/Hz**

- **Example Performance Requirements**

Mode	Traditional 1x2	2x2 SFBC		2x2 SM	
Metric	bps/Hz	bps/Hz	% gain	bps/Hz	% gain
Case 1	>2.55	>2.10		2.89	[5 13]
Case 2	>2.55	>2.10		3.18	[15 25]
Case 3	0.73	0.71	-3	0.72	-1
Case 4	>2.55	>2.10		3.18	[15 25]

R1-072681 – MBSFN Performance with SFBC and Spatial Multiplexing

  - **Case 1 (SM): 3bps/Hz**
  - **Case 3 (Repeater): 1.5bps/Hz**



R1-070569 – E-MBMS Performance with Repeaters

Dependency on Rel-9 EMBMS

- **EMBMS Rel-9 Status**
  - **EMBMS support has "low" status in RAN5 Feature List (vsn. 5.9c)**
    - Deferred by SA to Rel-9
  - **Significant number of elements for Rel-9 EMBMS still open**

- **New EMBMS Technical Opportunities (Examples)**
  - **Spatial Multiplexing (SM) extensions (using Rel-8 MIMO modes)**
  - **Multi-site non-linear encoding (DPC, T-H precoding etc.)**
  - **Outer codes (Fountain etc.)**
  - **Expected LTE-A inter-cell coordination means Rel-9 single cell and MBSFN MBMS modes could be revisited**

- **Potential Ways Forward on LTE-A EMBMS**
  - **Option 1: Avoid detailed technical discussion of LTE-A EMBMS until Rel-9 work substantially completed**
  - **Option 2: Fold Rel-9 work into LTE-A study and defer EMBMS feature delivery to LTE-A completion**
  - **Option X: ....**

Summary and Proposals

- **Simulation Criteria**
  - Traffic models other than full buffer should be prioritised by operators
  - Concurrent UL/DL simulation and mobility support feasible but need/benefits should be clearly demonstrated before adoption
- **Environments**
  - Should be broadly aligned with IMT-A
  - Propose: Case 1 + Urban, Microcell, Indoor, Rural
  - Case 1 & Urban could be merged

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- **Performance**
  - Proposed performance values defined in Slide 6
  - Indoor scenario proposals deferred until Indoor case interference scenario fully agreed
  - Discussion useful on need for EMBMS targets at this stage of LTE-A