

### GOALS

- In-lab calibration of **UXPERT** using the state-of-the-art measuring equipment from PerformLTE.
- Testing **UXPERT** in a real LTE network under controlled conditions, using the NITOS testbed.
- Showcasing **UXPERT** using the Wi-Fi testbed in City of Things.

### CHALLENGES

- To gain competitive advantage network operators are focusing their strategy in delivering the best quality of experience (**QoE**) to their customers in a daily effort.
- However the high cost for running these tests results in a low frequency of execution.
- ALLBESMART wants to test and validate an affordable solution for drive tests – **UXPERT**.

### DEMO SETUP

The Fed4QoE experiment is structured in three phases:

- **Phase 1:** In-lab calibration of **UXPERT** using state-of-the-art measuring equipment from PerformLTE. Four different scenarios were tested Ideal-Init 20 @20MHz; Ideal-Init 20 @5MHz; Urban Office - Default working conditions; Urban Pedestrian - City main square;
- **Phase 2:** Testing **UXPERT** in a real LTE network under controlled conditions using NITOS Testbed in two different configurations LTE band 7 @ 10/5 MHz;
- **Phase 3:** Showcasing **UXPERT** using the City of Things Wi-Fi Testbed. Measuring the impact of the Wi-Fi network load/interference on KPIs measured by **UXPERT**;

### RESULTS

#### Phase 1 – PerformLTE - Malaga

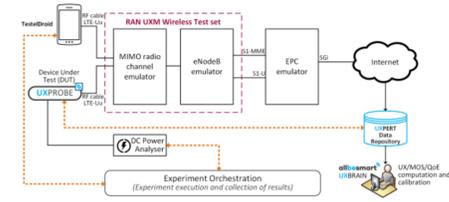


Figure 1: Experiment Phase 1 reference architecture, using the PerformLTE testbed.

Measured Parameter	PerformLTE	UXPERT	error (%)	
UE Radio link measurements	RSRP	-	-96.9	
	RSRQ	-	-5.6	
	SINR	-	26.6	
	RSSI	-	-82	
Ookla speedtest	Downlink bitrate (Mbps)	27.6	28.0	1.4%
	Uplink bitrate (Mbps)	13.0	13.0	0%
	Round trip time (ms)	19	18	3.2%
FAST by Netflix	Downlink bitrate (Mbps)	24.8	25.4	2.3%
	www.facebook.com	n/a	4.5	n/a
Web browsing MOS	www.google.com	n/a	4.5	n/a
	www.youtube.com	n/a	4.4	n/a
	www.allbesmart.pt	n/a	3.4	n/a
	www.fe4fire.eu	n/a	3.6	n/a
Video	Time to start (ms)	n/a	5419	n/a
	Lost frames (%)	n/a	0	n/a

Figure 2: Measurement comparison from ideal-init @ 5MHz scenario.



Figure 3: UXPERT integrated in Perform LTE testbed.

### MORE RESULTS

#### Phase 2 – NITOS - Volos



Figure 4: Experiment Phase 2 set up, using the NITOS LTE test network.

VideoUX KPIs (Average values)	
URL	https://youtu.be/ORIQW6s1-ew
Time To Start (video)	3230.25 ms
# stalls (video)	0.03
Stall Duration (video)	1490.7 ms
% Lost Frames (video)	0.03 %
Bitrate (A/V)	16.05 Mbps
% Lost Buffers (audio)	0.01 %
Times Played	364

Figure 5: Video KPIs measured by UXPERT over LTE in Band 7 @ 5MHz.



Figure 6: UXPERT integrated in NITOS testbed.

#### Phase 3 – City of Things – Antwerp

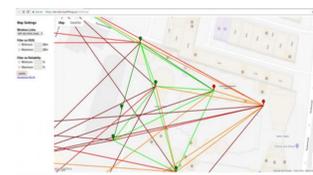


Figure 7: Wi-Fi network used for experimentation in City Of Things testbed.

NO OF LINKS	MOS	TIME TO START	BITRATE	LOST FRAMES (%)	LOST BUFFERS (%)
1	4.31	3.30 s	1550 Kbps	0	0
2	4.28	5.20 s	1500 Kbps	0	0
3	4.27	5.60 s	1437 Kbps	0	0
4	4.19	7.10 s	1400 Kbps	0.12	0

Figure 8: Video QoE MOS and QoS KPIs @ 2.4 GHz.

NO OF LINKS	MOS	TIME TO START	BITRATE	LOST FRAMES (%)	LOST BUFFERS (%)
1	4.38	3.50 s	1560 Kbps	0	0
2	4.24	5.60 s	1540 Kbps	0	0
3	4.27	5.60 s	1538 Kbps	0	0
4	4.21	6.80 s	1521 Kbps	0	0

Figure 9: Video QoE MOS and QoS KPIs @ 5 GHz.



Figure 10: jFED GUI showing the 5 nodes used in City of Things

### CONCLUSIONS

- There is a good match between the network KPIs measured by the PerformLTE equipment and the values measured by the **UXPERT** framework developed by ALLBESMART;
- Fine tuning of QoS/QoE conversion algorithms was possible with exhaustive testing, supported and enabled by NITOS testbed;
- Results from City of Things testbed are useful to improve ALLBESMART's Wi-Fi planning with a focus on QoE optimization rather than classical QoS approaches.

### POST MORTEM

- This experiment has enabled us to speed up our **UXPERT** prototype demonstration in operational environment (TRL7), complete it and qualify it for commercial adoption (TRL8).
- This experiment was an important showcase to promote the **UXPERT** framework as a SoA product for network performance analytics.
- Follow-up experiment: Big data analytics for LTE networks benchmarking and optimization.
- Contact: [pmarques@allbesmart.pt](mailto:pmarques@allbesmart.pt)