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Radio Standardization

From Vision to Reality – 1 GB per User per Day

Nokia vision in 2011 ”1 GB per user per day in 2020”

1GB per user per day in 2020: Do you need a small cell on every street corner?

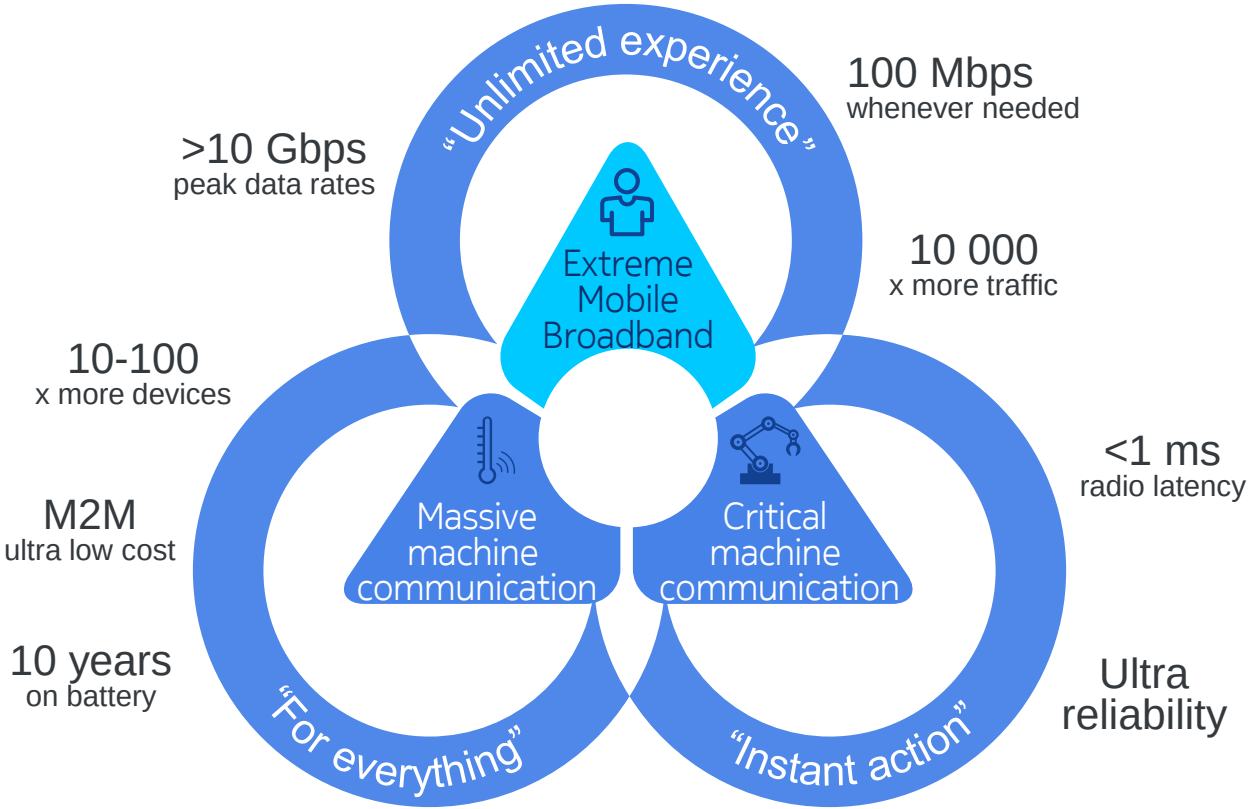
By Ruth Lileg on Thu 4 October 2012

Mobile data in Finland 1 GB per day by end-2017

4300 TB/day today with 5.4M population = 0.8 GB per user/day

NOKIA

5G Enables New Capabilities Beyond Mobile Broadband



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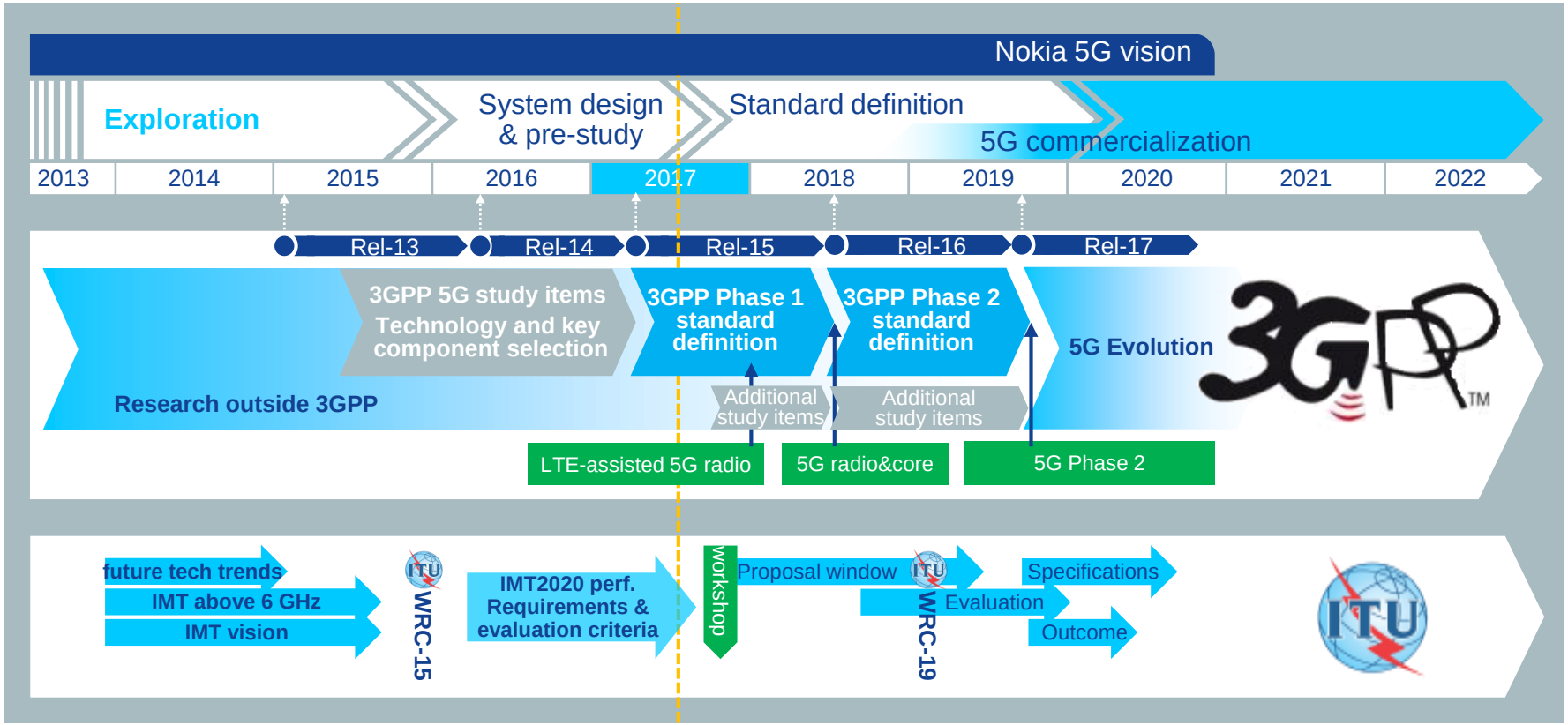
5G from research to standards



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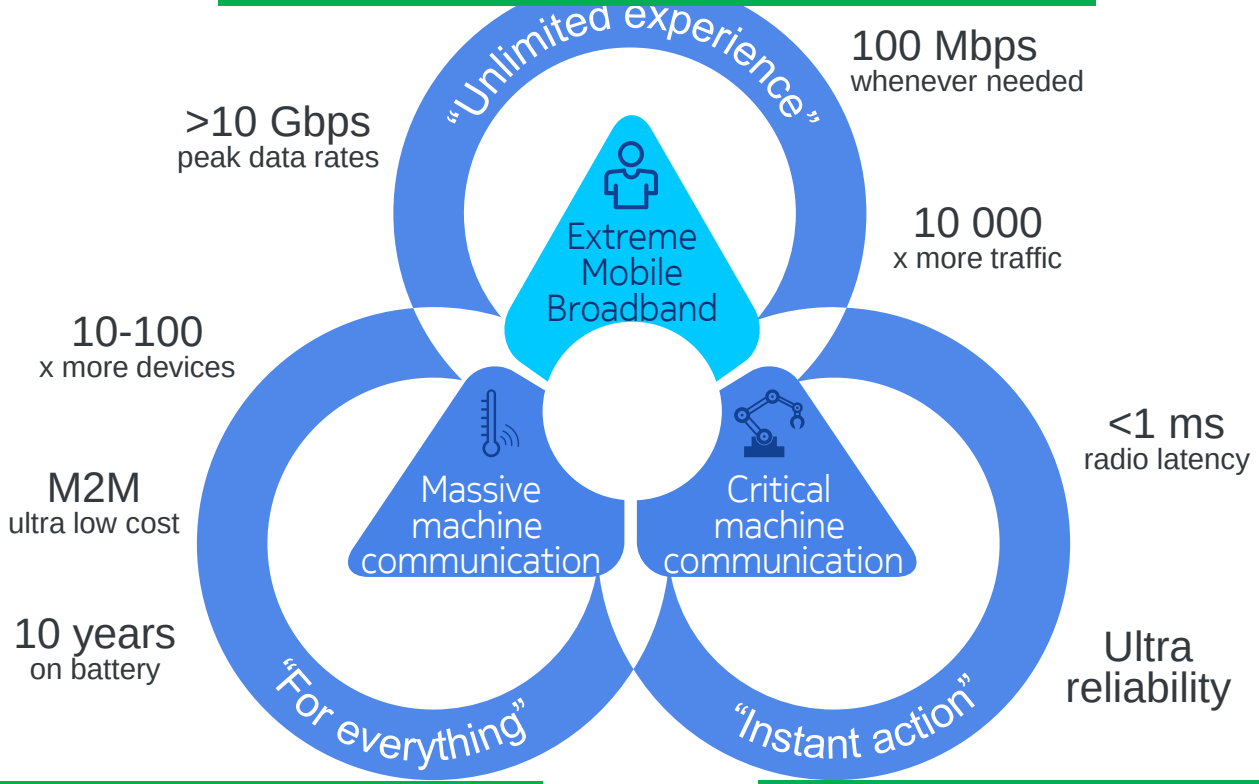
5G Enables New Capabilities Beyond Mobile Broadband

LTE-assisted 5G radio – end of 2017



GPRS/3G/LTE/eMTC/NB-IoT/5G

5G radio&core – mid-2018

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3GPP M2M, IoT radio technologies

Cost, coverage, energy efficiency							Latency, reliability	
Radio	**GPRS/ EDGE**	**3.5G**	**LTE Cat-1**	**LTE Cat-0**	**eMTC Cat-M1**	**NB-IoT Cat-NB1**	**5G Phase 1**	**5G Phase 2**
3GPP release	Rel'97 Rel'98	Rel-6	Rel-8	Rel-12	Rel-13		Rel-15	Rel-16
Year	98/99	2004	2008	2015	2016		2018	2019

GPRS/EDGE coverage and module costs excellent

3.5G (HSPA) radio more capable than GPRS/EDGE, but also of higher costs

Long term service availability uncertain and market dependent

LTE Cat-1 unnecessarily powerful (pricey, power hungry) for basic IoT

LTE Cat-0 with reduced capabilities enabled lower costs

eMTC and **NB-IoT** further cost-reduction with improved coverage and reduced energy consumption – first 3GPP IoT-targeted radios

5G introduces ultra-low latency and ultra-high reliability IoT radio to complement the eMTC/NB-IoT low-capability, low cost, high battery life radios

5G radio integrates eMTC and NB-IoT as part of the 5G system

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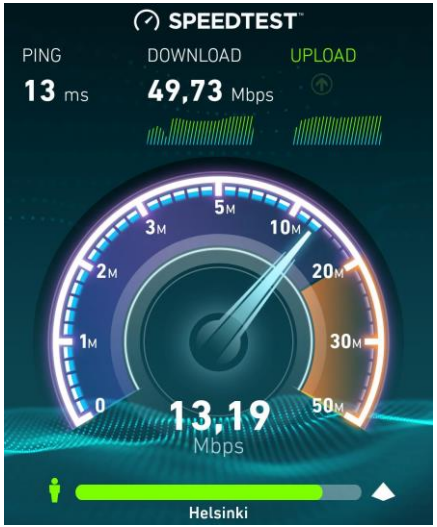
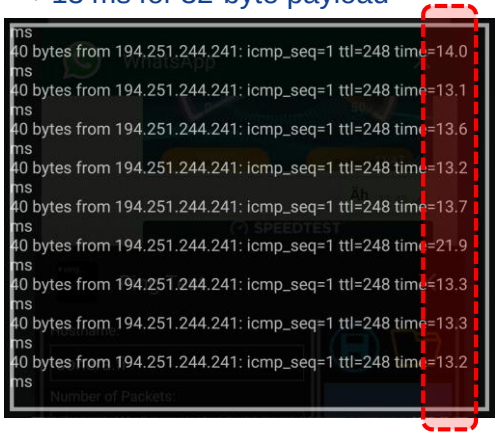
Latency today and tomorrow

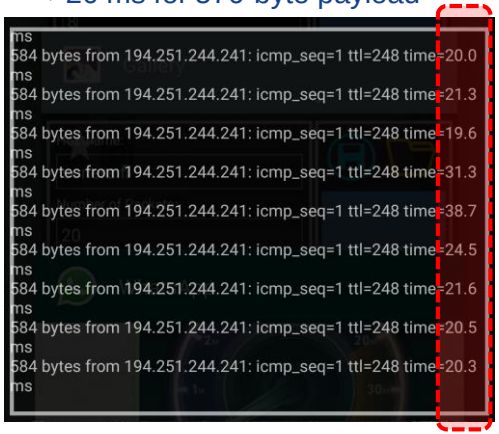


13 ms LTE latency in a commercial network today

>13 ms for 32-byte payload



>20 ms for 576-byte payload



LTE best case latency
~10 ms

Typical LTE latency
20-50 ms

5G target latency
1 ms

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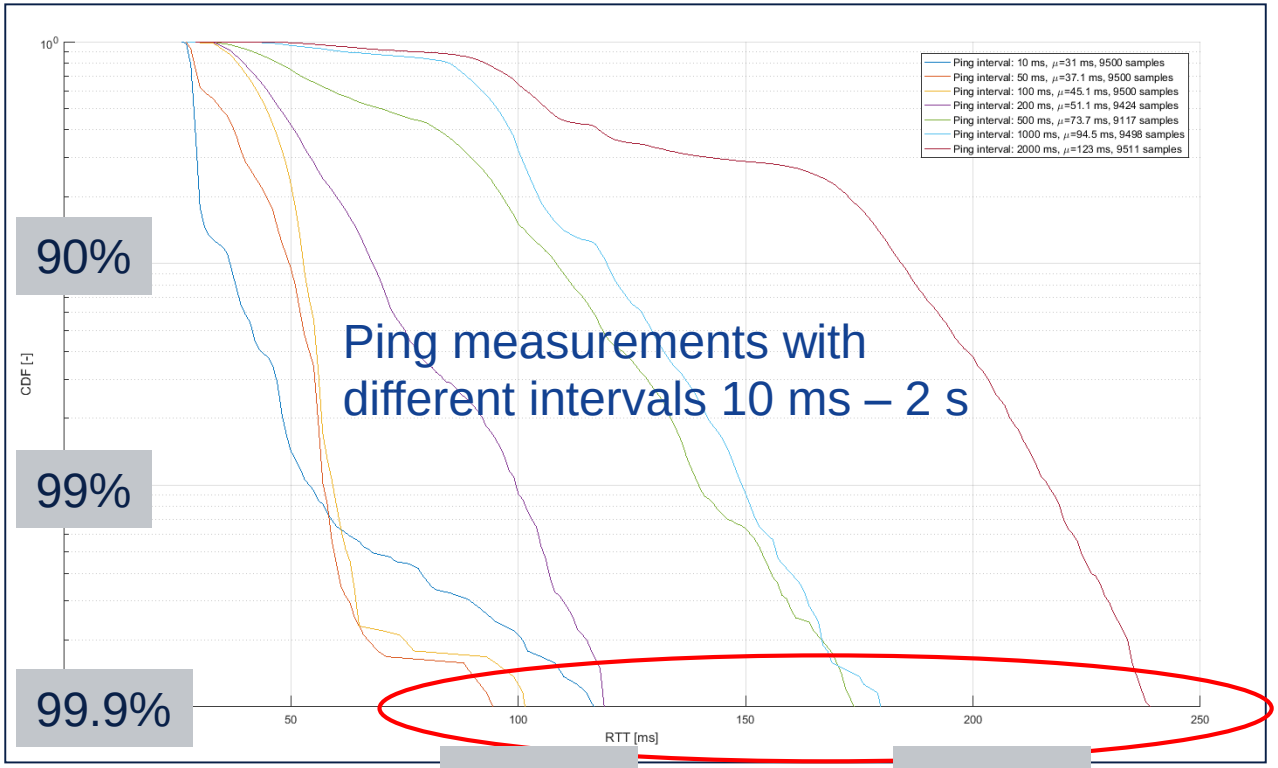
Reliability of latency



LTE measured latency reliability:

99.9% of packets under 100-250 ms

5G target for low-latency optimized links:

99.999% of packets under 1 ms

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How 5G will blend into everyday life

Is it possible to coordinate millions of sensors in a cell?
Only if the system of network and devices work efficiently

Can I trust machines that act autonomously?
Only if they interact absolutely reliable and fast enough

Can I stream my 4k videos/movies instantly?
Only if sufficient bandwidth on demand is guaranteed