



## LTE: What, Where, and When

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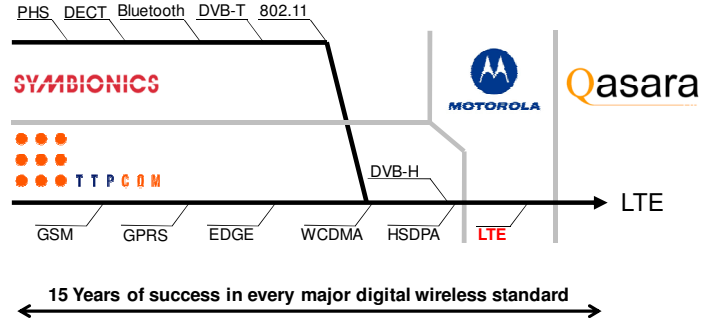
## Summary

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- LTE What, Where and When
  - Who is Qasara..?
  - What new services and capabilities will LTE enable..?
  - Who is going to brave the crunch to lead its deployment..?
  - Which parts of the world will deploy LTE, and when will your 4G iPhone be ready..?

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# Qasara – who are we..?



- A team that has worked together for many years
  - Desire to build a strong, innovative business
  - Seed funding secured in April 08, business now self-funded
  - Technology licensing, services and niche products

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# What is LTE..?

- LTE → “Long Term Evolution”
- The next child in a long generation of 3GPP standards



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## What is LTE..?

- OFDM based, high data rate technology
  - Only does data, no in-built support for voice
  - Marketing headline rate up to 300Mbits/sec
  - User experience likely to be a lot less than that
- Two flavours
  - FD: Frequency Diversity (separate channels for uplink/downlink)
  - TD: Time Diversity (shared channel for uplink/downlink)
- Is it ready..?
  - Standard is maturing, but more slowly than the PR
  - Physical layer very stable, protocol less so

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## LTE Categories & Rates

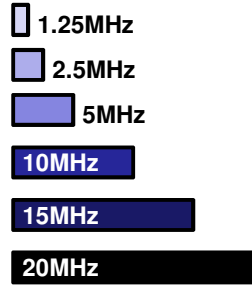
Max data rate =

$f$ ( Channel Bandwidth ,	MIMO Mode ,	Category )
<ul style="list-style-type: none"> <li>• Channel bandwidth of LTE can be set based on spectrum availability               <ul style="list-style-type: none"> <li>– 1.25MHz, 2.5MHz, 5MHz, 10MHz, 15MHz, 20MHz</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• MIMO (Multiple In, Multiple Out) used to increase data rate</li> <li>• More transceivers means more cost in basestation &amp; mobile</li> </ul>	<ul style="list-style-type: none"> <li>• Determined by MIMO mode and transport block size</li> <li>• Bigger transport block means more memory in mobile</li> </ul>

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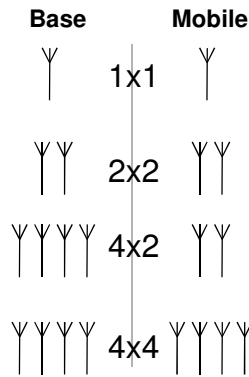
# LTE Categories & Rates - Theory

## Channel Bandwidth



(Resource availability)

## MIMO Mode



(Equipment cost)

## Category (& max up/dn rate in Mbits/sec)

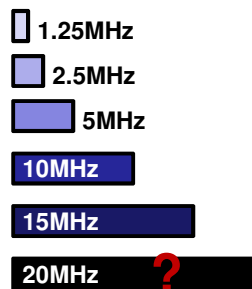
- ① 10M / 5 M
- ② 50M / 25 M
- ③ 100M / 50M
- ④ 150M / 50M
- ⑤: 300M / 75M

(Silicon cost)

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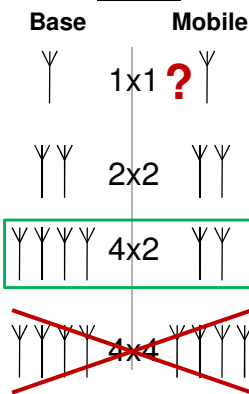
# LTE Categories & Rates - Practice

## Channel Bandwidth



(Resource availability)

## MIMO Mode



(Equipment cost)

## Category (& max up/dn rate)

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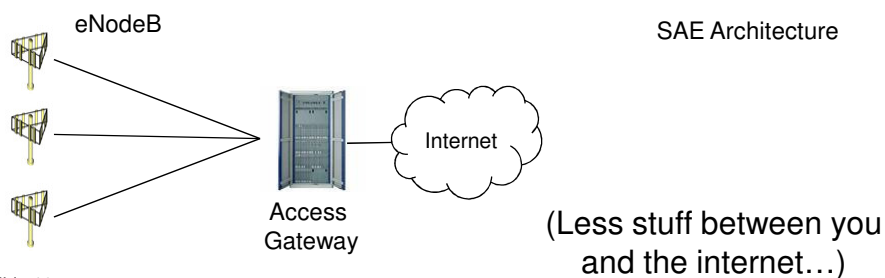
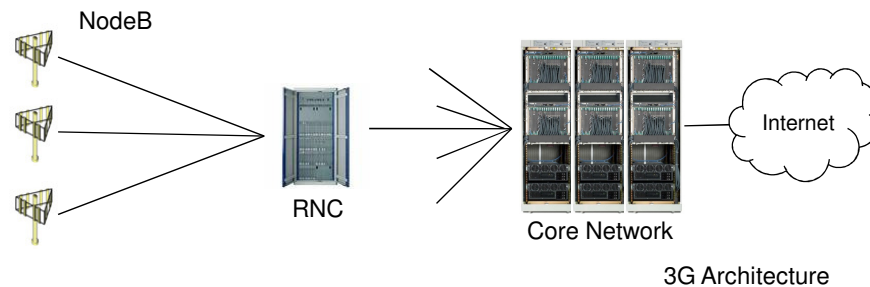
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## So... who needs 100Mbps/sec..?

- The use of the internet is changing: For the first time in 2008, consumer based traffic exceeded business traffic
  - Social networking
  - Video uploads/downloads
  - Personal communications
- The Internet is becoming the way to manage personal data and social interaction
  - This trend will continue to drive the internet mobile
  - Mobile data growth is increasing exponentially, capacity increase is linear
- LTE offers more capacity, better experience
  - Approaching Shannon limit for spectral efficiency
  - More responsive

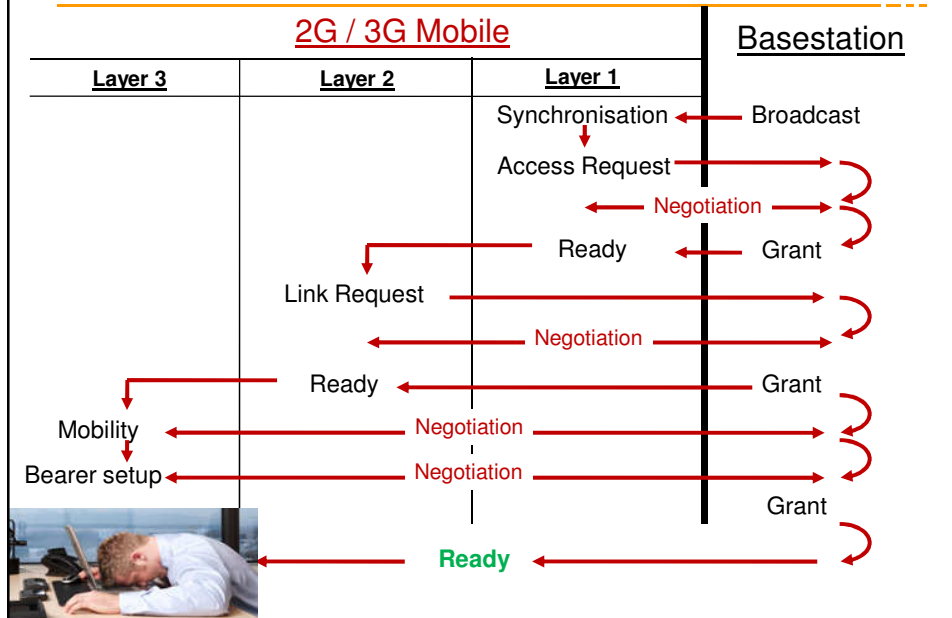
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## System Architecture Evolution

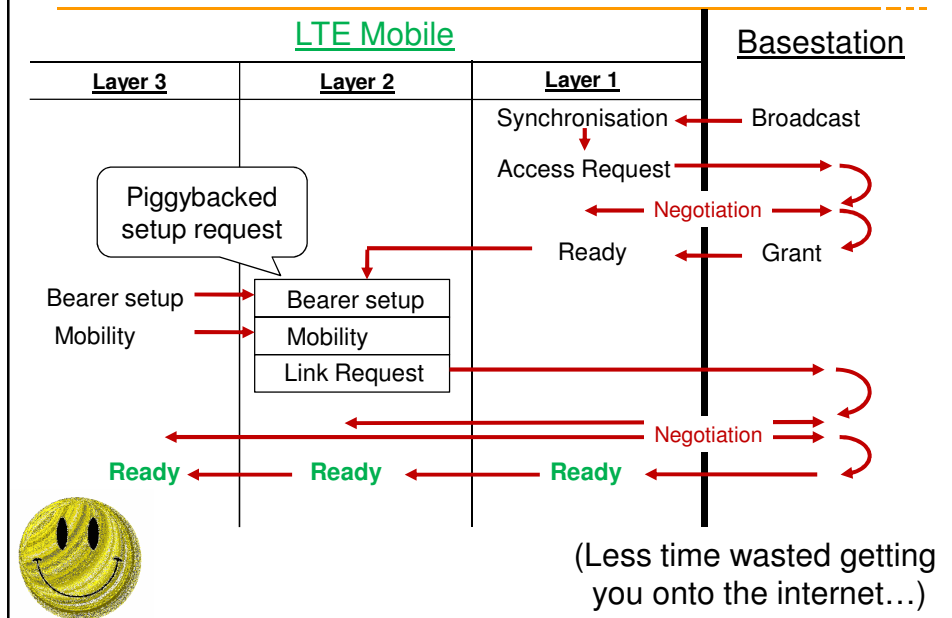


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## Latency in the mobile device (1)



## Latency in the mobile device (2)



## What of WiMax..?

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- LTE basically won a standards war about a year ago
  - WiMax Mobile (IEEE standard), vs
  - UMB (Qualcomm proprietary standard), vs
  - LTE
- Battle fought for operator roadmaps / market share
  - All significant mobile operators round the globe chose LTE
  - UMB rejected as closed, proprietary technology, now abandoned
- But why was WiMax rejected by incumbent operators..?
  - Performance of WiMax (Mobile) is pretty similar
  - WiMax had initial deployments while LTE was paper standard
  - Technical factors did not make the difference for WiMax

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## What of WiMax..?

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- WiMax heritage is in 802.11
  - Unregulated spectrum, fragmented suppliers, computing
- LTE heritage is in Mobile
  - Tight regulation, concentrated supplier base, voice
- Operators control today's market
  - Continuing the 3GPP roadmap very compelling
- WiMax is beginning to be deployed as a metropolitan area network in selected geographies
  - New entrants in developed & developing markets
  - US, India, Korea, provision of fixed & nomadic data
  - Likely to retain a small proportion of the global market

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## But standards war was good for LTE

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- Competitive pressure from WiMax had a positive influence on LTE
- IPR fees
  - Massive and ongoing challenge for 3G
  - IPR licensing issue not solved, but progress made
  - NGMN (Next Generation Mobile Networks) adding to pressure
- Technical progress
  - Pressure being felt within 3GPP to get the standard done more quickly, with some effect
- Operator commitment
  - The need for momentum has forced operators to declare roadmaps aggressively, leading to accelerated investment

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## Why does the world need LTE..?

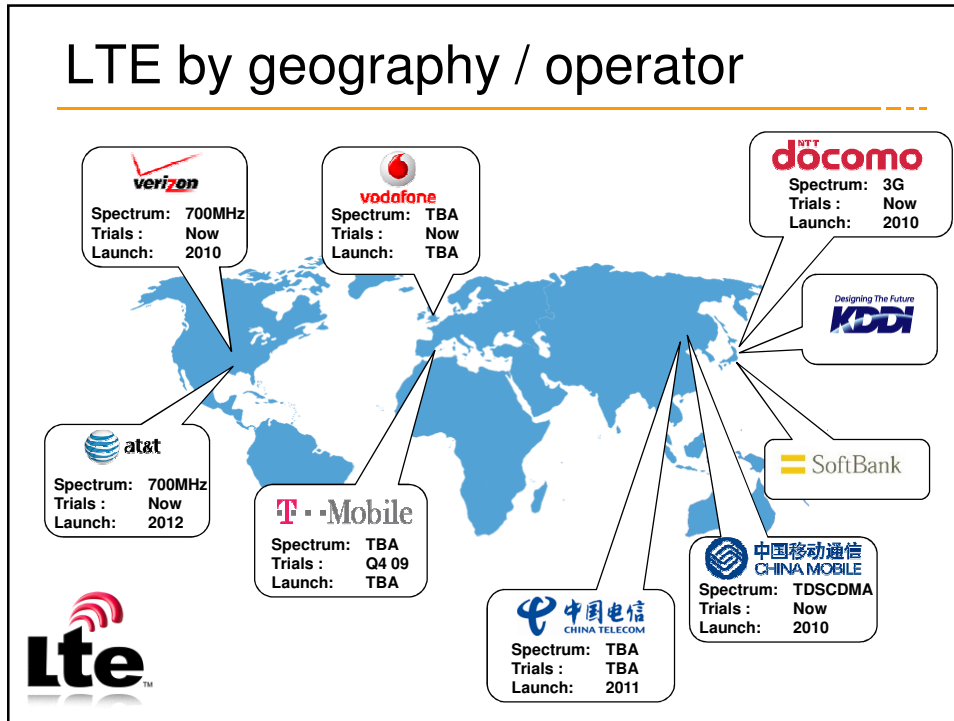
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- Why does the world need LTE right now..?
  - It takes time to test, trial and deploy a new standard
  - An investment in LTE now will begin commercial service, just as the world begins to emerge from recession, in theory
  - There are some other strong drivers for LTE...
- China
  - In 3G, China experimented with a native standard (TD-SCDMA), with the aim of promoting local suppliers
  - Its difficult to underestimate the challenges of creating and launching a new standard and TD-SCMA has struggled
  - China has the resources to invest, political will to lead in LTE and little deployed 3G technology
- In LTE, China is the country to watch

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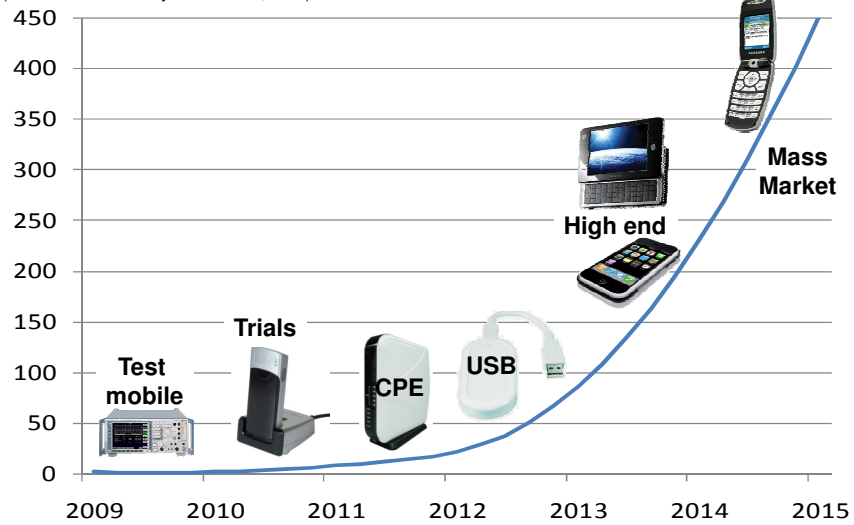


# LTE by geography / operator



# Market evolution & opportunity

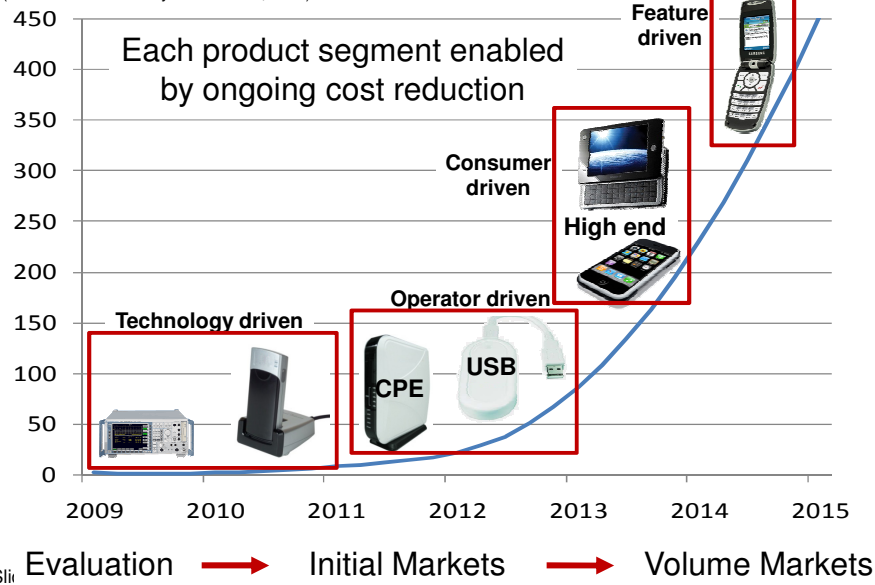
(Market size from Analysis Research, 2007)



si Evaluation → Initial Markets → Volume Markets

# Market evolution & opportunity

(Market size from Analysis Research, 2007)



## LTE: What happens next..?

- Hype is cheap, real technology is more difficult
  - Infrastructure
  - Mobile silicon
  - Testing, testing and more testing
  - Initial products that are too expensive/power hungry
  - Real products that sell in volume
- Where is LTE today..?
  - LTE Infrastructure: still immature
  - Mobile silicon: Lots of announcements but no real availability
- What next..?
  - Hype (& real investment) in China during 09/10
  - Initial deployments in Japan, during 09/10 but tough market
  - Initial deployments in US, but nomadic data / WiMax killer only
  - Europe driven (reluctantly) by capacity constraints during 12/13/14

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# Summary

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- Standards war is done, but that's just the first step
- There is a need for more mobile data
  - Real demands for mass mobile data are latent today (cool to have, not must-have applications)
  - Capacity constraints not an ideal driver: prices go up first
- Political and self-inflicted factors will determine initial deployment
  - China will deploy aggressively
  - Japan and US not far behind
  - Europe may take time to see the value
- LTE will happen, but we may well be the last to see it...

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