# 5G AIR INTERFACE DISCUSSION

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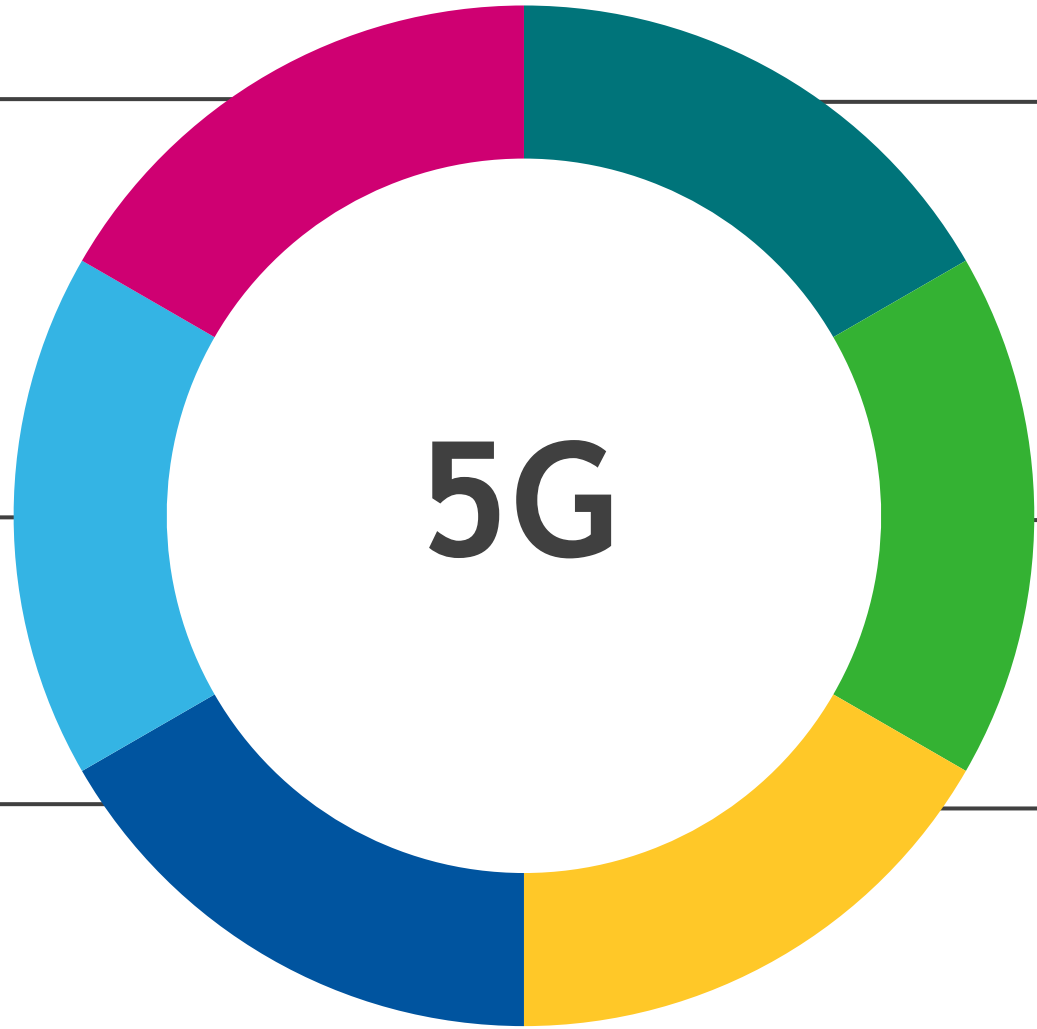
# WHAT'S DRIVING 5G?

**BROADBAND**
Massive traffic capacity
Reduce Cost
Spectrum efficiency
Access new spectrum

**INNOVATIVE SERVICES**
Flexible bearer design
3rd party policy

**CROWD**
Massive user density
User content
Correlated behavior




**MISSION CRITICAL**
Latency
Reliability
Availability
Security

**BATTERY LIFE**
Signaling reduction
Energy optimization

**NON TRADITIONAL DEVICES**
Short packet
Sporadic access
More devices
More device types

5G SHOULD FOCUS ON SOLVING THESE ISSUES

# SMALL TRAFFIC

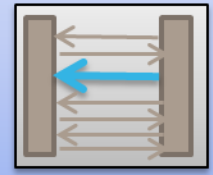
- Three sources for small packets today:

Machine type:
Sensor reports
Position data …

New appli-cations

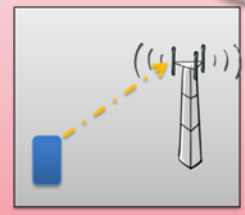
Messaging:
Messaging service
+ TCP keep alive …

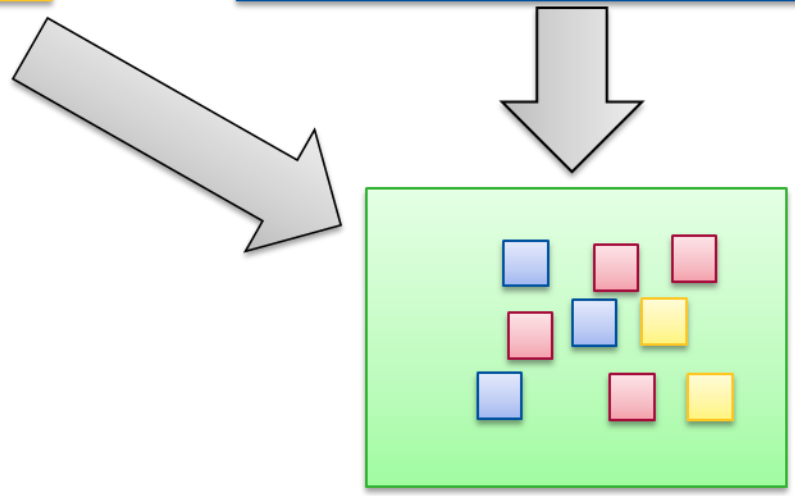
Efficient provisio ning



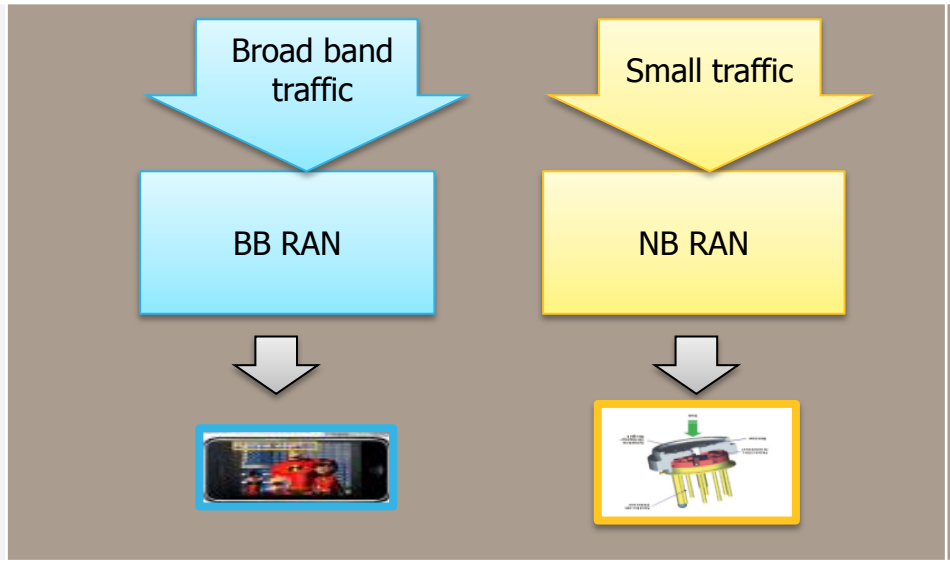
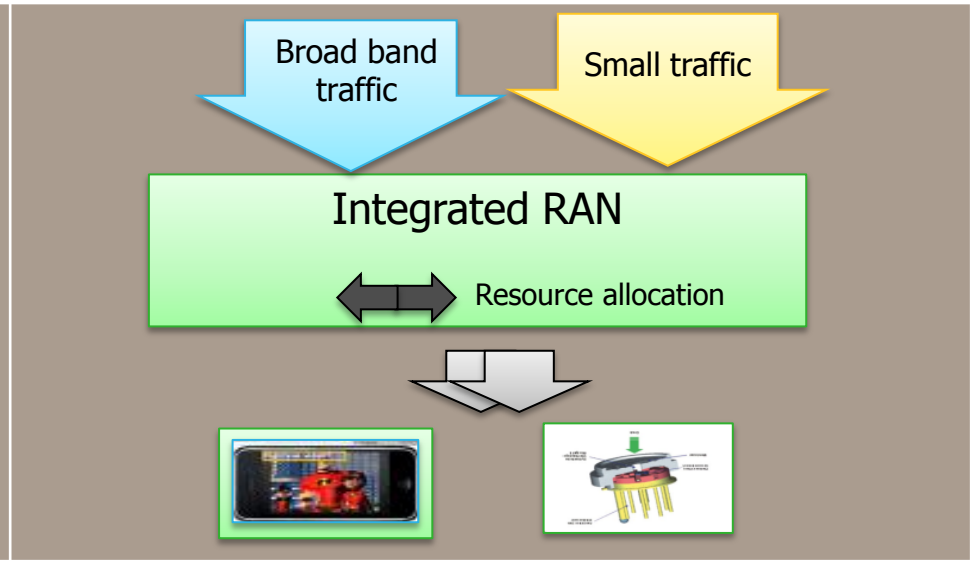
System internal:
e.g. unscheduled signaling

System efficie ncy



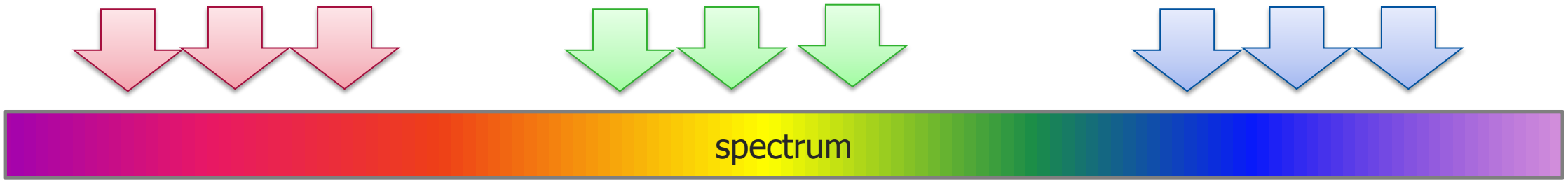


# INTEGRATED OR SEPARATE AIR INTERFACES?

| |  |  |
|---|---|---|
| Time to Availability | Separate development,<br>earlier availability possible | After first network deployment, software updates can handle new/changing requirements |
| Spectrum allocation, scaling | Inter RAT<br>Fixed or slow spectrum sharing | Intra-RAT resource allocation<br>(semi-static or dynamic) |
| Cost/ Coverage | Separate deployments<br>Higher cost due to separate deployment | One deployment, lower cost for coverage |
| Devices/ Service | Separate M2M and mobile devices | Dedicated M2M devices.<br>Small traffic for messaging, sleep mode<br>Small packets for signaling within system |
| Market window | 2015-2025 | 2020 + |

# SPECTRUM CONSIDERATIONS / REQUIREMENTS

| Low bands<br>Connectivity and signalling<br>High availability services<br>Coverage | Classical cellular bands<br>carrier aggregation for high peak rates<br>Modular 5G air interface<br>Multi – RAT and 5G-4G integration | Mm-wave<br>Capacity in densely populated area, small cells<br>Gb/s data rates |
|---|---|---|
| Common connectivity band ? | Migration from 3G, 2G and 4G to 5G | |




- mm-wave for high peak rates and capacity off-loading but it will not replace classical bands

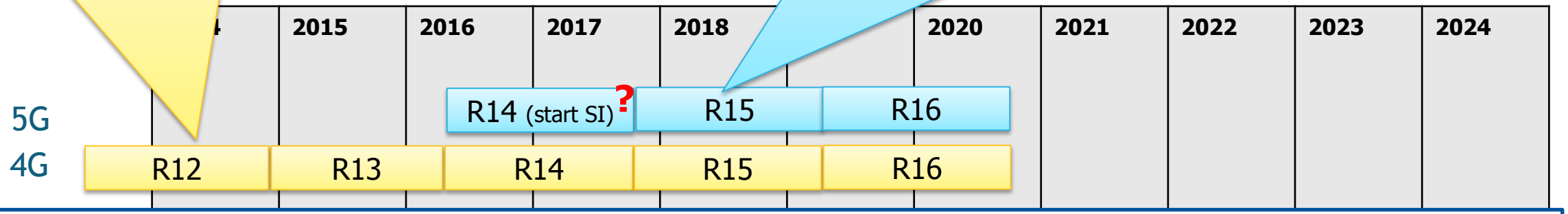
# TRANSITION FROM LTE ++ TO 5G

LTE will **evolve** adopting new concepts

Compromises will be necessary for backwards compatibility

Some solutions will not fit to LTE in a backwards-compatible way, or be sub-optimal

It makes sense to bundle changes into in one "**big leap**" release




**Drivers for a 5G air interface:**

Diverse services:

- -Support of small traffic / high number of nodes / massive access
- -Low latency, high availability options

-Efficiency (spectrum, energy, cost):

- -Blanking for energy efficiency and interference management
- - optimized set of multi-antenna methods

-Future proofness: Separation of signaling and data and a modular design for flexibility

# OUTLOOK

- 5G networks will be used in the timeframe from 2020 on  to 2035 (and beyond)
  - Future proofness: Shall be able to follow an evolution of the requirements
  - Need  open design: open for backwards compatible extensions
- Heterogeneity in terms of use cases, services and traffic  characteristics
  - Modularity and configurability
- Need for efficiency
  - Configurability  for optimum operation: modular air interface, virtualized networking

No rush: Maturity of the design is more important than early availability!

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