









Mobile Spectrum Roadmap

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Spectrum key ideas & needs

- The Mobile Industry is keen to develop mobile broadband services at lowest possible cost for consumers and boost Internet penetration. To achieve that goal it needs:
  - *Sufficient bandwidth* to accommodate subscriber growth and to accommodate the increasing traffic generated by new application and services.
  - The right combination of *coverage* bands and *capacity* bands to allow mobile broadband technologies to unleash its potential and best answer market needs.
  - To benefit the most of *global economies of scale* in production of radio equipment and handsets to allow greater access. This means it needs to be able to access to *internationally harmonised mobile bands* under technical/operational harmonised terms and conditions (bandplans).
  - *Timely issuance of licenses and spectrum award roadmaps*. Without regulatory certainty of spectrum availability, investment will be impeded as the business case is not secured.
- Previous success stories - the GSM story - proves we can do it again!

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From voice to broadband → increase band width

Aggregated Band Width

X3

1987-2010	2010-2020
450-600 MHz	1.3GHz-1.7GHz
in each market	in each market

Regulators are allocating more band width and eliminating or redefining spectrum caps as they realize broadband requires more spectrum

According to the **ITU-R Report M.2078** by the year 2020 mobile services (IMT-2000) will need:

- 1.280 MHz for low market demand (rural areas)
- 1.720 MHz for high market demand (urban areas)

Chairman Genachowski of the FCC – the regulator - stated in October 2009: *"In fact, I believe that that the biggest threat to the future of mobile in America is the looming spectrum crisis."*

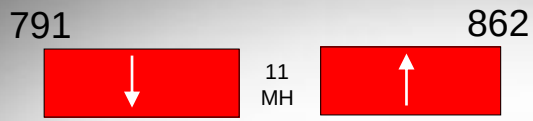
US broadband plan of March 2010: Make 500 MHz of spectrum available for broadband within 10 years, of which 300 MHz should be made available for mobile use within five years

Candidate bands mobile broadband

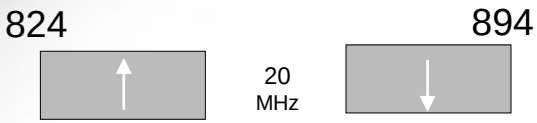
The coverage bands



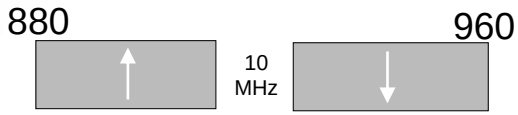
2X45 MHz



2X30 MHz

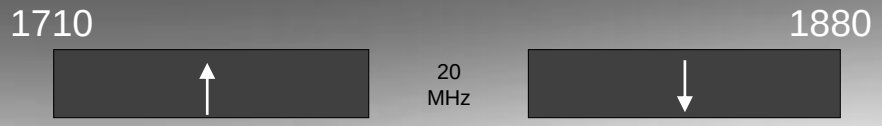


2X25 MHz

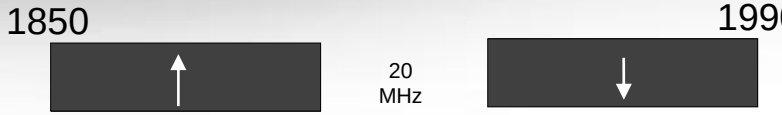


2X35 MHz

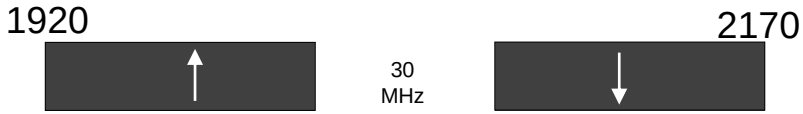
The capacity bands



2X75 MHz



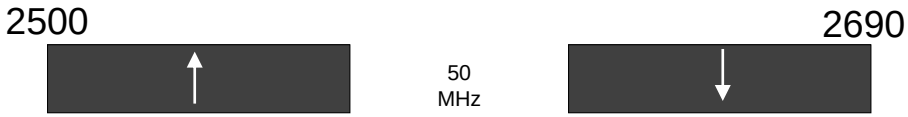
2X60 MHz



2X60 MHz



100 MHz



2X70 MHz

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Importance of harmonisation (1)






- Economies of scale affects consumers
- The more consumers that can use *exactly* the same handset the lower the price of the handset will be
- Consumers can use the same handset for networks that are technically harmonised
  - Common band edges
  - Common duplex gaps
  - Common duplex directions
  - Common filtering requirements because of adjacent services etc

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Importance of harmonisation (2)






- Price on handsets affects up-take of services and society's welfare
- Mature markets / rich countries have higher up-take of high-priced terminals
- Emerging markets / poorer countries rely heavier on low-priced terminals → economies of scale more important
- Highest possible up-take of services potentially gains emerging markets countries more than mature market countries
  - Marginal welfare improvement potentially larger when moving from no Internet connection to mobile Internet connection in a emerging market than additional or improved Internet connection in a mature market

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Importance of harmonisation (3)





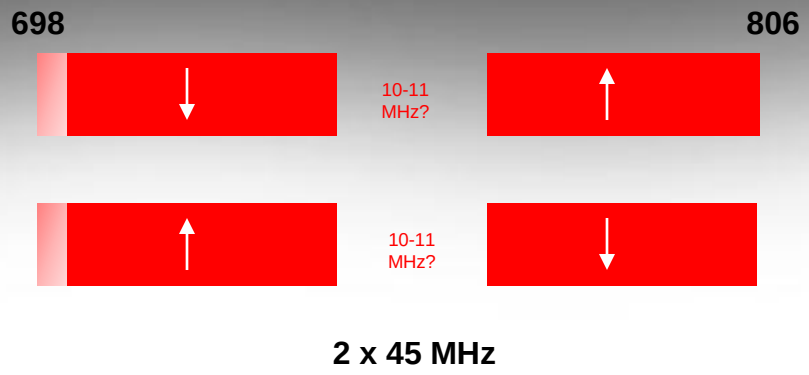

- Roaming : harmonised band plans makes ideal roaming conditions

- Solution:
  - Allocate mobile bands in accordance with internationally harmonised bands:
    - Inline with the ITU RR allocations
    - Inline with the bands defined by 3GPP for standardization purposes
  - Design usage rights / licenses inline with internationally harmonised band plans
    - Inline with APT/CEPT/EU/CITEL harmonised band plans
    - Inline with technical definitions of (3GPP) standards

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The 700 band Asia Pacific

The optimised 2 x 45 MHz option



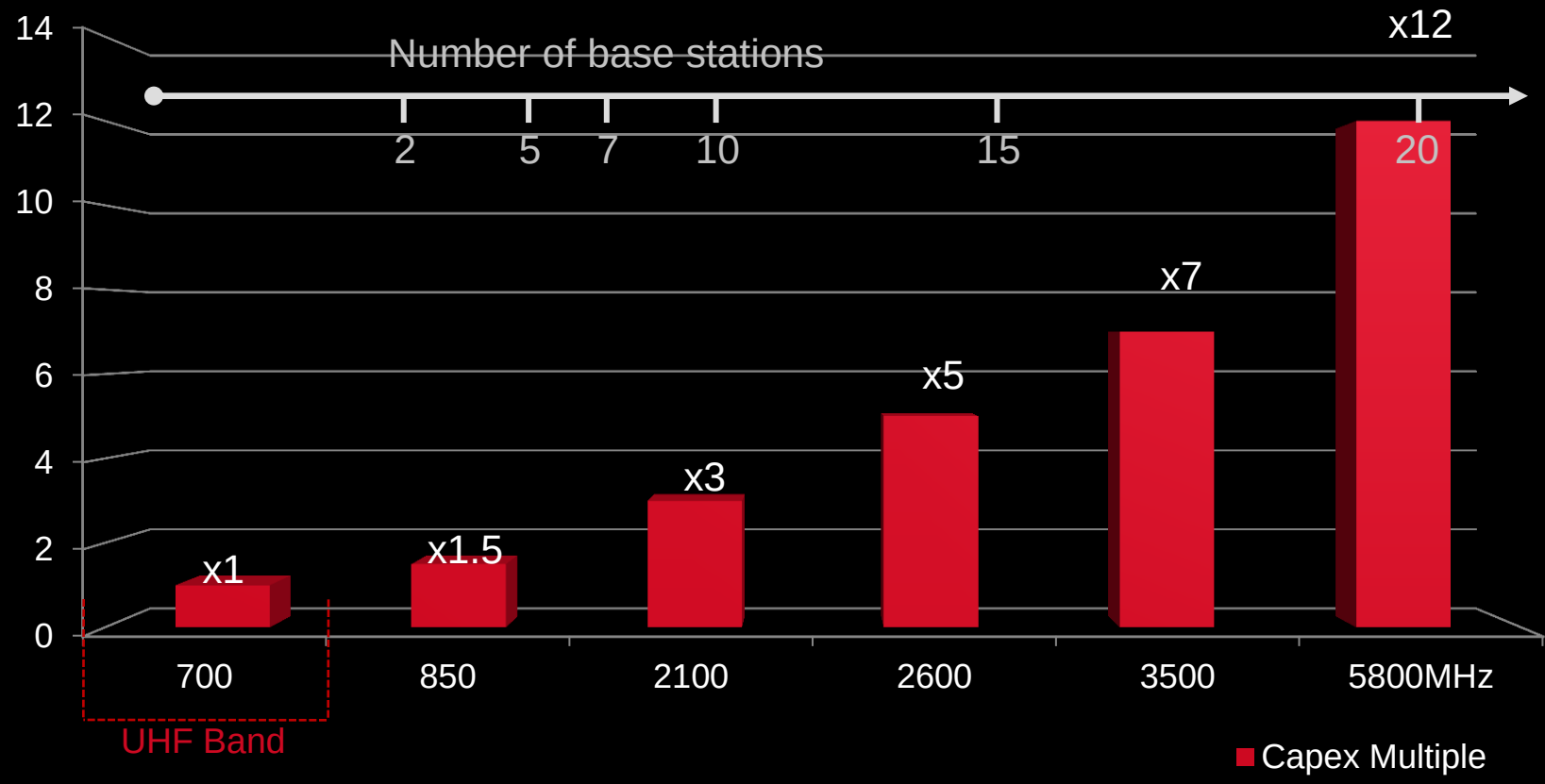
2 x 45 MHz

- Band edges at 698 MHz and 806 MHz but more work to be done before concluding on whether implementing guardbands are necessary (hence the lighter color at the 698 MHz band edge
- Result of the APT Wireless Forum meetings in Tokyo in March 2010: FDD mobile bandplan of 2X45 MHz
- Final decision on duplex gap to be made when ongoing studies are finalized but it will most likely be 10-11 MHz (hence the red color and the question mark)
- Both duplex directions still discussed (hence the figure showing both opportunities)

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Why is UHF band so important for mobile?

- Price of providing mobile broadband using the 700/800 MHz band is approximately 70% lower than providing the services based on 2100 MHz band
- This means UHF based networks can be rolled out quickly, cost effectively, bringing cheaper services to consumers



Source: SCF Associates Study

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The 900 band (880-915 / 925-960 MHz)



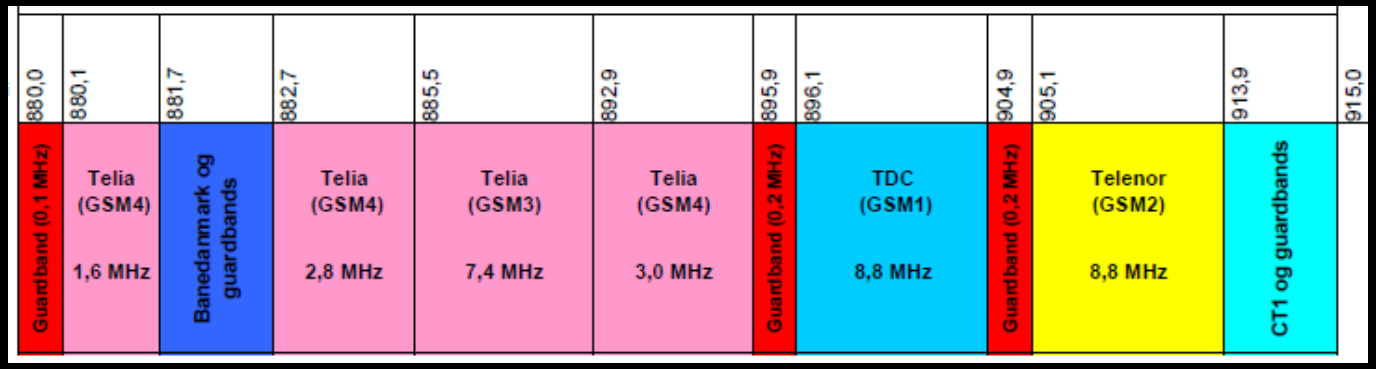
2 x 35 MHz

- The 880-915 / 925-960 MHz band
- Internationally harmonized band plan
- Classic FDD mobile band plan of 2X35 MHz band width and 10 MHz duplex gap
- Used as basis for production of radio equipment and handsets by all major vendors for GSM/EDGE/GPRS and UMTS (LTE in the future)
- Currently refarming is the hottest 900 band topic
- Overlaps with the 850 MHz bandplan → in Indonesia the band is 890 – 915 MHz / 935 – 960 MHz to enable successful adjacent 850 MHz band operation

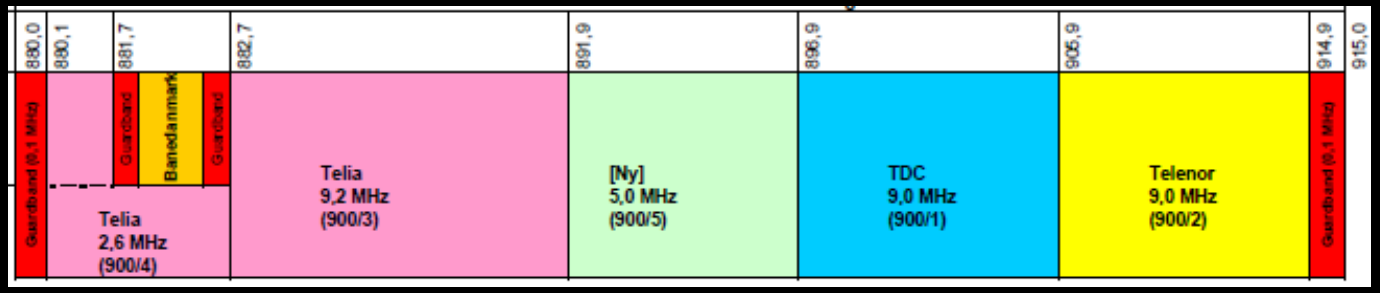
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Example: Danish 900 refarming

Danish 900 assignments before refarming



Danish 900 assignments after refarming



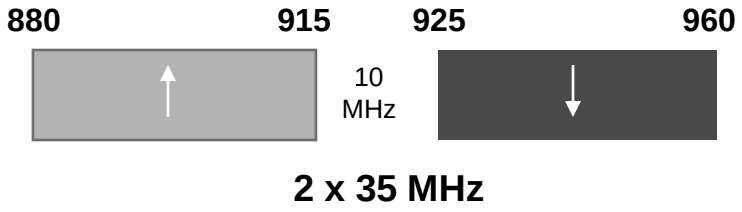
900 band expanded, external guardbands between licensees removed, reshuffling of spectrum between licensees, introduction of new licensee

Source: NITA, Danish regulator

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900 refarming – learnings

- Change of technology in the 900 band is exiting and challenging
- All countries are basically different
  - Aggregated band width differs between countries – can band be expanded?
  - Number of existing licensees differ – 900 band is divided into licenses differently in different countries
  - Number of existing subscribers accommodated differs (level of GSM congestion)
- Tailor made solutions required
  - Period of future GSM operation will probably be different
  - Period of co-existence between GSM and UMTS/LTE will differ
  - How to transform existing band plan and licensees will differ depending upon existing situation
  - Existing licensees spectrum portfolio and technology deployment differ



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The 1800 band (1710-1785 / 1805-1880)



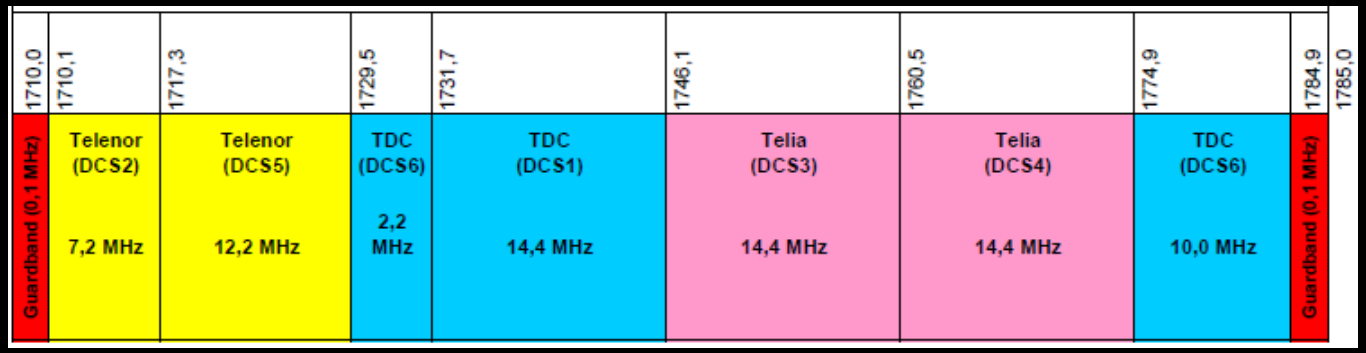
2 x 75 MHz

- The 1710-1785 / 1805-1880 MHz band
- Internationally harmonized band plan
- Classic FDD mobile band plan of 2X75 MHz band width and 20 MHz duplex gap
- Used as basis for production of radio equipment and handsets by all major vendors for GSM/EDGE/GPRS (and possibly LTE in the future)
- First 1800 refarming decisions are accomplished and we see increasing interest in refarming of this band
- Overlaps with the 1900 bandplan → the 1800 and the 1900 bandplans mutually excludes each other

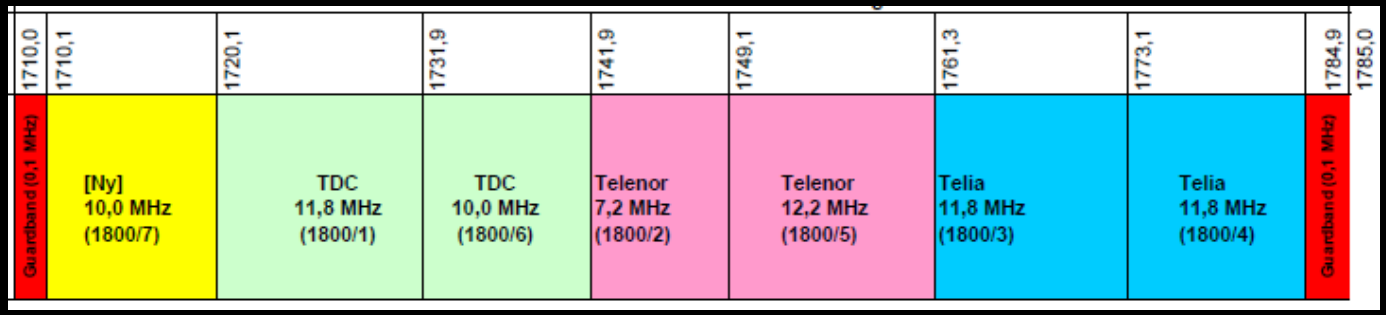
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Example: Danish 1800 refarming

Danish 1800 assignments before refarming



Danish 1800 assignments after refarming



Bandwidth have been slightly reduced for two licensees, new license introduced, reshuffling of spectrum between licensees

Source: NITA, Danish regulator

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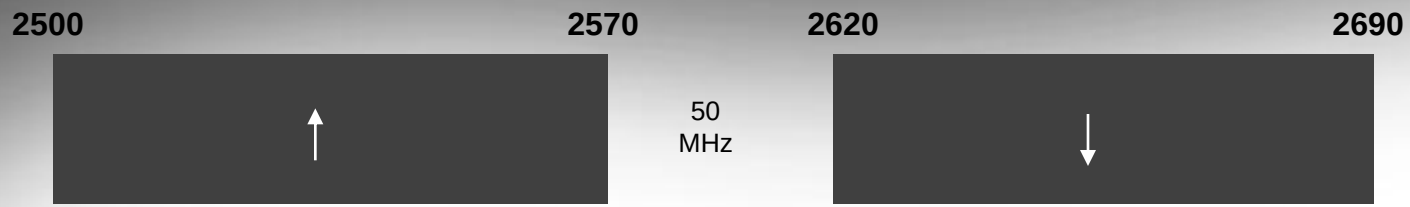
The 2100 band (1920-1980 / 2110-2170)



- The 1920-1980 / 2110-2170 MHz band
- Internationally harmonized band plan
- Classic FDD mobile band plan of 2X60 MHz band width and 30 MHz duplex gap
- Used as basis for production of radio equipment and handsets by all major vendors for UMTS and HSPA

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The 2600 band



2 x 70 MHz

- The 2500-2570 / 2620-2690 MHz band
- Internationally harmonized band plan
- Classic FDD mobile band plan of 2X70 MHz band width and 50 MHz duplex gap but with TDD operations in the duplex gap
- Used as basis for production of radio equipment and handsets by all major vendors when preparing for commercial LTE launch

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Tie between band and technology broken

- Did you recognise that we have mentioned more than one IMT technology as options for the various bands?
- Have you realized that when discussing re-farming of the 900 band UMTS used to be the alternative mentioned but currently we discuss LTE and co-existence between GSM and LTE are currently a topic for technical studies?
- Have you heard about market players thinking about re-farming of the 1800 band and looking at HSPA and LTE in the band?
- Have you liaised with vendors lately and as a response to your questions on technology roadmaps they ask about what would be your demand?
- 10 years ago: 900 band = GSM
- 10 years from now: 900 band = UMTS/HSPA, LTE and GSM?

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Need for spectrum roadmaps

- Ties between band and technology means increased complexity for network operators when assessing combinations of spectrum bands and technologies
- Decision making under uncertainty is one scenario that reduces the price of the assets to acquire (and goverment revenue!)
- Mobile operators needs to know what spectrum they should expect to be allocated and awarded in the future when making investment decisions
- Equipment manufacturers needs a spectrum availability roadmap when deciding upon their go-to-market strategies
- Governments / regulators can reduce uncertainty by publishing spectrum allocation and award roadmaps!
  - Tell us what you'll do next year
  - Tell us what are your 3 year allocation and release plan
  - Tell us what are your 10 year allocation and release plan

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Recommendations for Indonesia

- Short term:
  - Release and award additional 2100 spectrum to make it possible for mobile operators to implement at least one voice carrier and one data traffic carrier
  - Allocate the 700 band to mobile, adopt the APT band plan and release it so that it can be used as LTE coverage band
  - Aim at future use of the 2600 band as a capacity band for LTE by moving towards adoption of the global band plan using government intervention and/or private agreements to achieve the desirable result
  - Prepare for 900 and 1800 refarming to allow UMTS/HSPA and LTE deployment in addition to GSM
  - Technology neutral licensing in all mobile bands – LTE TDD will become available and WiMAX says they'll do FDD
- Medium to long term:
  - Make plans for international cooperation and commitment towards making more bandwidth available for mobile broadband – remember US have a plan for adding 300 MHz of bandwidth to the mobile spectrum portfolio shortly
- And we need the spectrum roadmap!

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