PSCR Conference

LTE User Equipment

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Items to Cover…….

1. General LTE UE availability, IOT and certification
2. Band 14 support – chipsets, filters
3. Multi-band support – 700 MHz band classes, other bands
4. Multi-mode support for roaming – W-CDMA / EVDO
5. Power class
6. Volumes and pricing
7. Devices for PSCR

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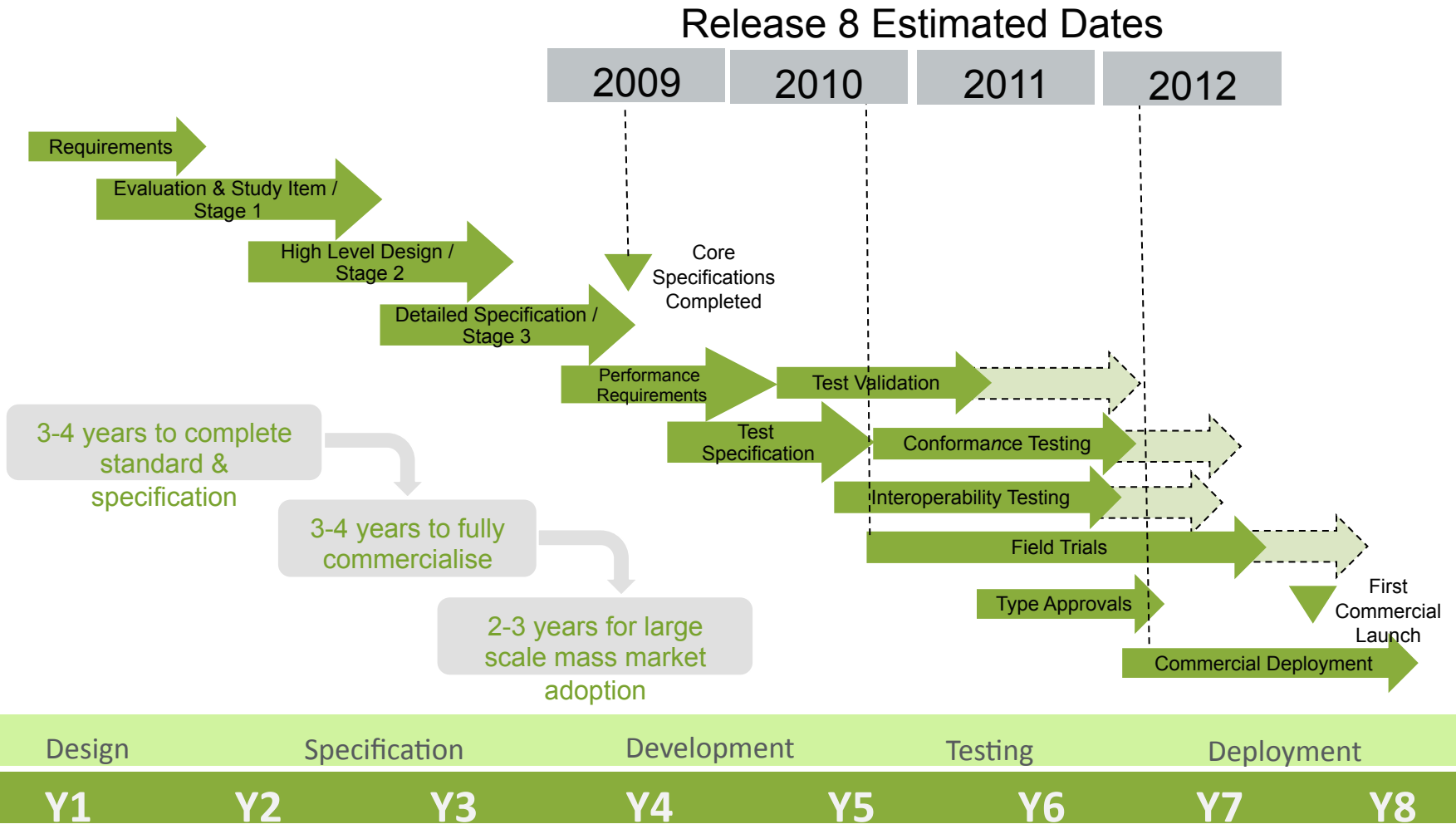
3GPP Timeframe for a New Standard - With Reference to LTE



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IOT testing / UE certification

- Process
  - 3GPP prepares test suites (end 2010)
  - Implemented by test system manufacturers (end 2011 +)
  - Testing of UEs (2011 – 2012)
  - Certification by GCF (international) and PTCRB (US) - mid 2011 +
  - Commercial operators often do own IOT in addition
- Prior to certification
  - "Private" IOT between UE and Infrastructure vendors
    - Logistical limit to how many combinations can be tested
- Any new features for public safety will require additional tests

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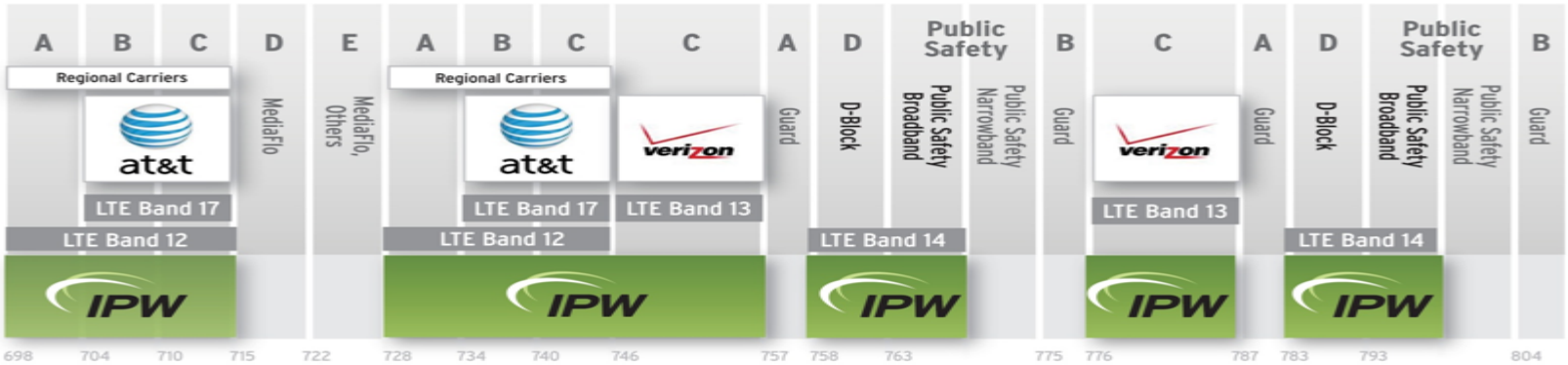
Releases 9 and 10

- Release 9
  - Includes features such as:
    - *MIMO enhancements, Femtocells, Self Organizing Network, Public Warning System, IMS features, MBMS, End User Identity (EUI), Personal Area Networks, security enhancements*
  - Specs frozen. Timing of upgrade very dependent on IOT
  - SDR eNodeB and UE supports software upgrade
- Release 10
  - Includes features such as:
    - *Relay Nodes, UE Dual TX options, Local area optimization, Flexible Spectrum Usage, Cognitive radio, Automatic Network Configuration, Enhanced Coding and FEC, Enhanced Interference Management, Asymmetric FDD, Hybrid OFDMA and SC-FDMA in uplink, inter eNB coordinated MIMO*
  - Some features require hardware changes, others supported in SDR

700 MHz Band Class Support

- There are >24 3GPP band classes for LTE, plus 3G bands to support. 4 band classes in 700 MHz alone
- Chipsets
  - **Baseband chips:** frequency independent
  - **RF chipsets:** Some cover multiple bands (IPW), some are band-specific, some 700 MHz chips not spec'd / tested for band 14
  - **Filters / Front End Modules:**
    - Front End Module (multiple filter) manufacturers only addressing major commercial bands -e.g. band 17 / 13 in 700, in combination with other bands.
    - Band 14 filters are available (smaller volumes)
    - Multiple filters for UE covering all 700 MHz band classes- Size / cost issue rather than technical



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Multi-Band and Multi-Mode

- Multi-band support
  - Volume commercial UE's likely to address major commercial LTE bands
  - Multi-band UEs including Band 14 will be available from specialist suppliers such as IPW.
- Multi-Mode support
  - Single chip LTE / W-CDMA and LTE / EVDO solutions are 1-2 years out
  - Dual chip solutions becoming available from IPW and others

Coexistence Issues

- Narrow duplex gap between band 13 and band 14
  - Duplexor achievable with current technology
- D-Block / Public safety (if different operators)
  - Small probability of receiver blocking / adjacent channel interference of PS UE very close to D Block cell site
  - No different to situation in commercial FDD bands – operators deal with by handoff to other (higher) bands
  - Small guard band proposed by some would not achieve much
  - Co-siting of PS and D Block would avoid problems
- Commercial Band 12 Interference Issues:
  - TV channel 51 interference is not a UE interference issue
  - UE blocking / coexistence issue from D & E (MediaFlo, Echostar)

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UE Power Class

- Frequent questions on increasing UE power to extend coverage
  - Standard 3GPP LTE power class is 23 dBm (1/4 watt)
- Increase to 27 – 30 dBm, or even higher ?
  - Would require new 3GPP power class
  - Battery issues less in larger PS devices that commercial UE
  - Potential issue with inbound roamers with standard UE's into a network designed for higher power
    - Translates to reduced coverage probability
    - May be acceptable in some cases
      - Analogous to hand-portable vs. mobile in PS voice networks
  - Requires analysis / testing of any increases interference

Volumes and Pricing

- High volume Commercial UE manufacturers typically look to 1 million + quantities
  - These volumes needed to get to prices in the ~$100 range
- Specialist UE suppliers such as IPW are able to supply PS-specific product in smaller volumes
  - Some price premium, but still relatively low in PS industry terms

IPWireless Equipment for PSCR

User Equipment

- Band 14 USB stick available now in trial quantities
- To complete IOT with selected Band 14 infrastructure vendors
- Expect to supply to NIST this month

- Infrastructure (eNodeB and EPC)
  - Provide to NIST in 2011

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