



# Bluetooth 4.0

April 2012 TCB Workshop

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Office of Engineering and Technology

Federal Communications Commission



# Bluetooth 4.0

- Core feature: BT LE (Bluetooth Low Energy, BLE; sometimes called Bluetooth Smart) – needs DTS Grant
- **3 versions of chipset** available: classic BT (< 3.0, DSS only), single mode BLE (DTS only), dual mode (DSS and DTS), **inputs solicited**
- Can be a software upgrade to existing chipset, processed by C2PC if DTS equipment type already exists; new application if no existing DTS

BT 3.0 (+ opt. EDR, HS)	BT 4.0
GFSK (mod index 0.35), pi/4-DQPSK, 8DPSK	GFSK (mod index 0.5)
≤ 3 Mbps (EDR) ≤ 24 Mbps (HS)	≤ 1 Mbps
2402-2480 MHz	2402-2480 MHz
79 channels	40 channels
1 MHz spacing	2 MHz spacing
32 advertising channels, 79 data channels	Mainly protocol change: 3 advertising channels (2402, 2426, 2480 MHz) for fast connection, 37 data channels



# Bluetooth 4.0

- Low power consumption (not low TX power), low duty cycle; mainly affects EMC, not SAR and HAC; however, variations can be expected for BLE in various vertical applications
- Typically for bursty data applications; however, synchronous connection-oriented (SCO) mode supports voice application, may require head SAR
- Regulatory requirements common to BT 2.1/3.0 and BLE: conducted emission, radiated emission, band-edge, PSD, antenna, power & PSD backoff
- Requirements differ in:

BT 3.0 (+ opt. EDR, HS)	BT 4.0
Number of hops	6 dB bandwidth
Dwell time	Peak output power <1W
Emission bandwidth	
Hop channel randomness	
Equal use of channels	
Receiver bandwidth	
Peak output power < 125 mW (typ. BT)	



# TETRA Discussion

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# TETRA

- FCC policies on TETRA
  - FCC 11-63 (4/26/2011) NPRM and Waiver Order (Tetra Waiver)
  - DA 11-1604 (9/28/2011) Clarification Order
  
- Background
  - TETRA meets 4.8 kbps/6.25 kHz efficiency standard of 90.203(j)(3), necessary for 25 kHz operation after 1/1/2013
  - Flat TX spectrum w/ fast roll-off, due to TDMA/FDM, 4 channels per 25 kHz, 36 kbps raw data rate (28.8 kbps payload), linear modulation (RRC shaped  $\pi/4$ -DQPSK) > 3.5 dB PAR
  
- Waiver Order
  - Waiver 90.209, 90.210 and 2.1043 requirements
  - **Authorized bandwidth:** 25 kHz channel spacing with 22 kHz authorized BW allowed (20 kHz before waiver); 406-512 and 806-824/851-869 MHz
  - **Emission Mask:** 450-470 and 817-824/862-869 MHz bands equipment **may** meet the ACP (Adjacent Channel Power) limit of 90.221 instead of Mask B, C, G, or 90.691
  - **C2PC** is allowed for already granted (4/26/2011) low power equipment, power increase by software upgrade can be C2PC except end user upgrade; power increase by hardware would need a new application (can be same ID if dismiss first)
  - For S/W upgrade by distributors, description of the process and control should be provided, end user upgrade has to be processed by FCC



# TETRA

- Proposed rules: 90.221 if adopted will be used in certification, ACP specifications, taken from EN 300 392-2:

- Below 700 MHz

Freq. Offset	Max. ACP for device $\leq 1$ W	Max. ACP for device $> 1$ W
25 kHz	-55 dBc	-60 dBc
50 kHz	-70 dBc	-70 dBc
75 kHz	-70 dBc	-70 dBc

- Above 700 MHz

Freq. Offset	Max. ACP for device $\leq 15$ W	Max. ACP for device $> 15$ W
25 kHz	-55 dBc	-55 dBc
50 kHz	-65 dBc	-65 dBc
75 kHz	-65 dBc	-70 dBc

- 43 + 10 log (P) dB attenuation for displacement > 75 kHz
  - No requirements in excess of -36 dBm shall apply
- Additional important notes:
    - Station ID and other applicable Part 90 rules should be addressed
    - Waiver only applicable to **450-470 and 817-824/862-869 MHz** bands and must be submitted in filing with grant condition quoting Tetra Waiver
    - Current Equipment authorization can only address the points in the waivers and the order related to certification, **licensing issues** not in scope