

New NB-IoT Band: Upper 700 MHz A block

Discussion Document

Puloli, Inc.

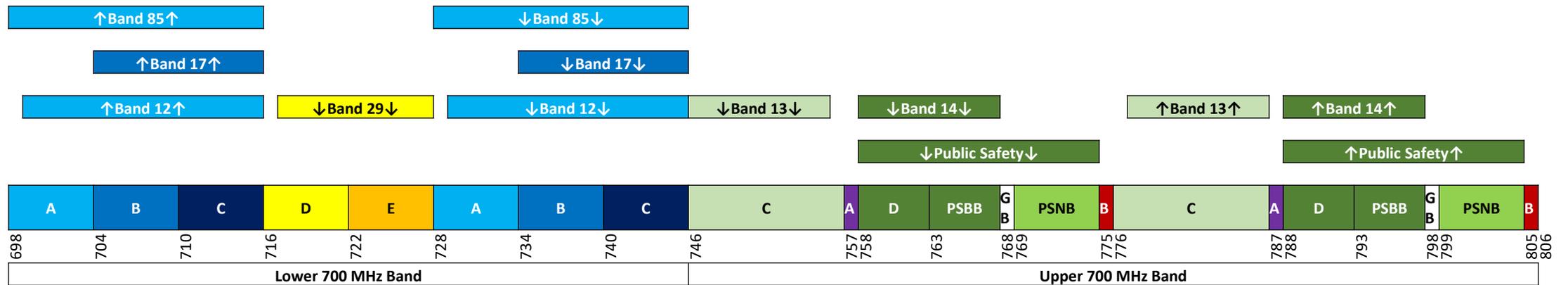
Supported by

Utility Technology Council, First Energy, WFECC, Idaho Power, Puget Sound Energy, Power South

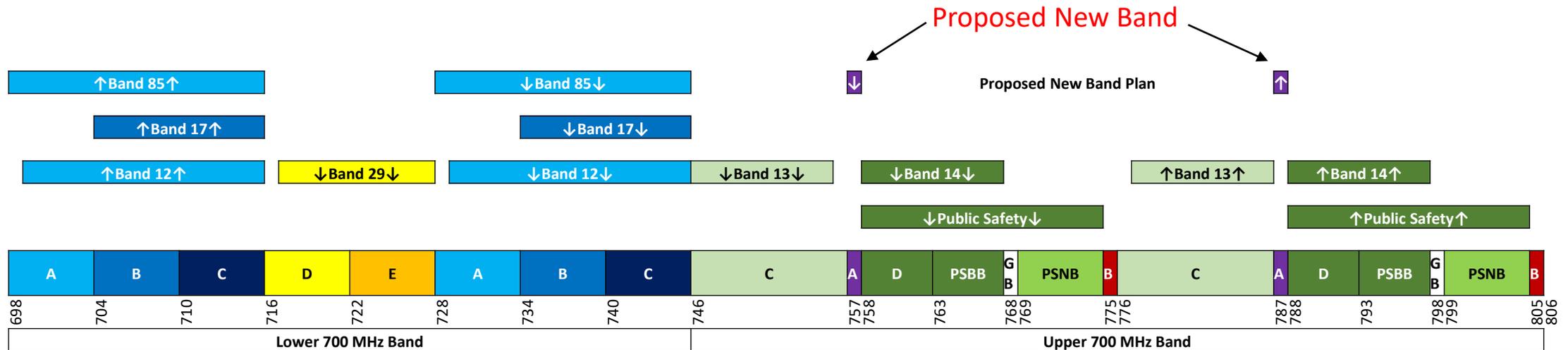
Overview

- **Spectrum**
 - 1+1 MHz band in the Upper 700 MHz A Block (UL 787-788 MHz / DL 757-758 MHz) in the USA
- **Strong utility industry interest & market need**
 - 20+ US utilities and other entities own the spectrum; currently proprietary technologies deployed
 - NB-IoT demonstrated as suitable technology with a live standard-compliant production network and devices in operation for 2 years
 - Supported by many utility companies, industry trade associations (UTC), and research institutions (EPRI)
- **Proposed Plan**
 - Solicit RAN4#100-e feedback on 3GPP standardization of this band as a new standalone NB-IoT band
 - Open to other options (evaluated extensions of Bands 13, 14, and 13+14)
 - Submit Work Item Document and Liaison Statement from utilities, UTC, and EPRI to RAN#93-e
- **Benefits the entire 3GPP ecosystem**
 - Brings utilities into 3GPP roadmap and opens up brand new market opportunity for the whole ecosystem
 - Meets 3GPP's goals of efficiently addressing needs of critical infrastructure industries and related verticals
 - Better coexistence with neighbors

Existing 700 MHz band plan in the USA



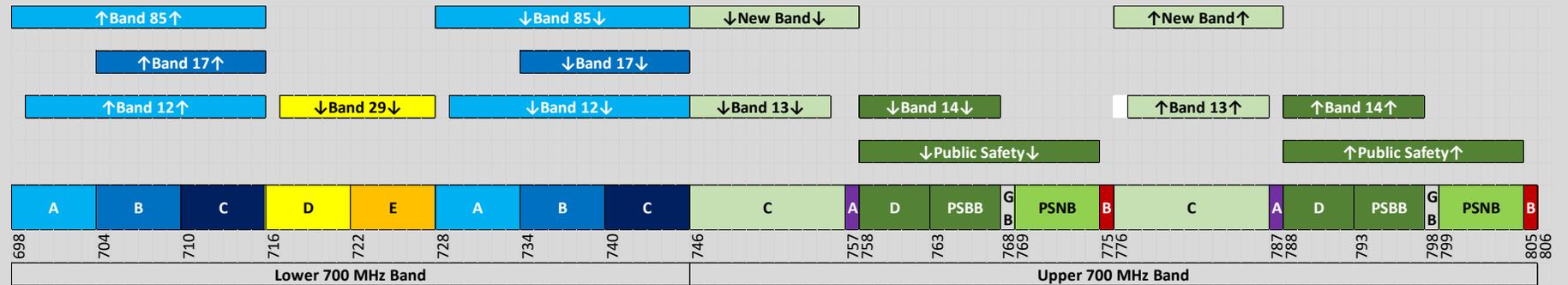
New standalone NB-IoT-only band



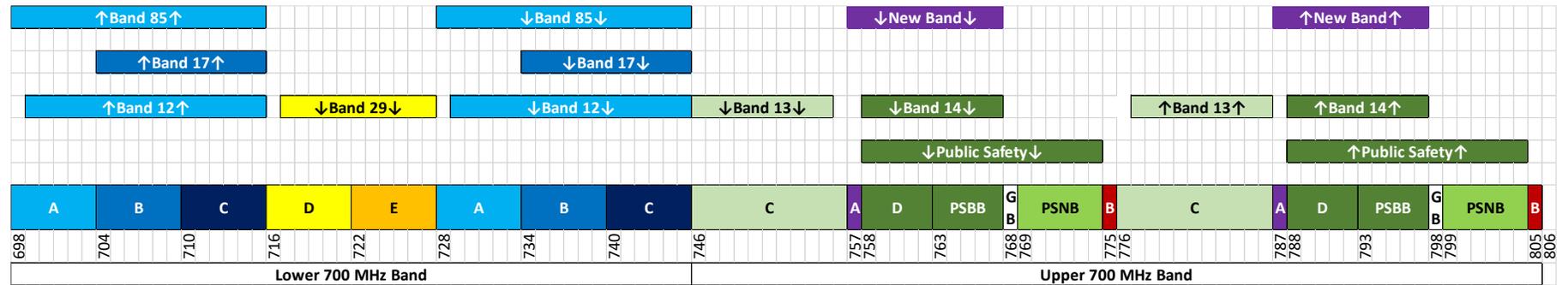
- Suitable for NB-IoT mMTC applications
 - Ideal for private networks for utilities in the US
- No complex spectrum ownership issues
- No mixed regulatory requirements
- Successfully demonstrated in the field using FCC compliant network and UE (multiple vendors)

Other options considered

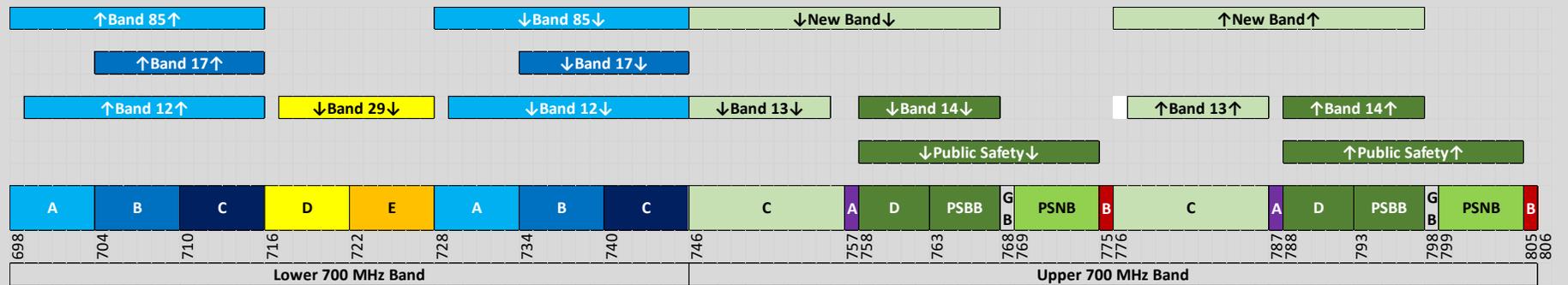
Option II
(Band 13 Extension)



Option III
(Band 14 Extension)



Option IV
(New band
Band 13 + 14)



Strong utility interest and market need

- 20+ US utilities own this spectrum today with many more showing strong interest
 - Until recently, proprietary technologies were the only option
- NB-IoT recognized as suitable technology
 - Utilities traditionally prefer standards-based technologies, whenever available
 - Feasibility of NB-IoT already proven in this spectrum (see slide #8)
- “Shovel-ready” projects waiting for 3GPP band support
 - Utility use-cases such as metering, sensors, SCADA, and many others
- Estimated >\$1B market opportunity for NB-IoT vendors within first 5 years*
- Supported by many utility companies, Utility Technology Council (UTC), Electric Power Research Institute (EPRI)

Benefits to 3GPP ecosystem

Brings utilities firmly into 3GPP technology roadmap

- Allows better positioning against competing technologies (LoRa, SigFox, etc.)
- Ensures harmonious coexistence with neighbors
- Sets the utility industry oncourse for 5G adoption in eMBB, mMTC, and URLLC

Opens up large market opportunity for the ecosystem

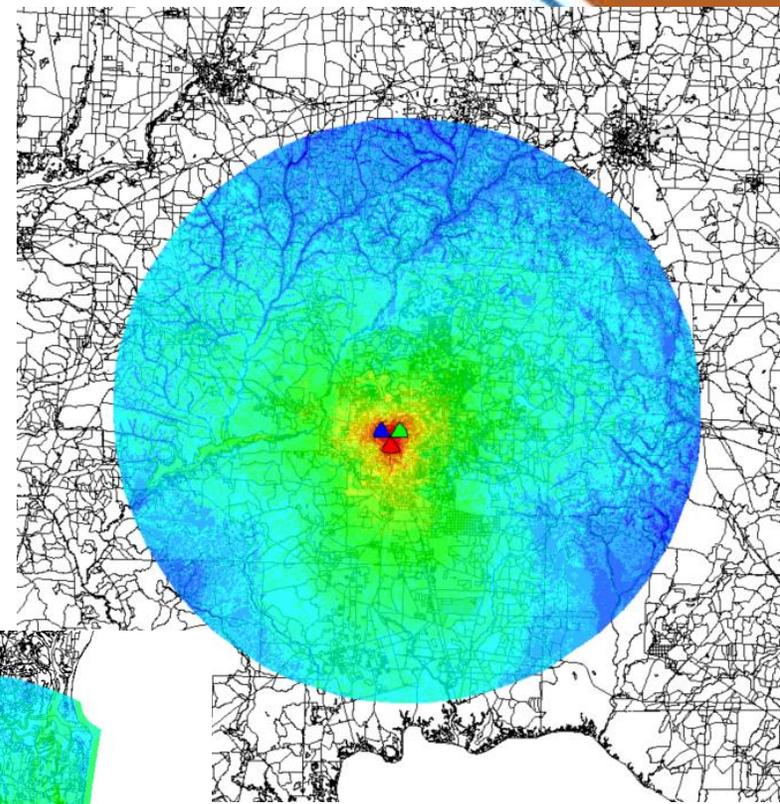
- Migrate proprietary systems to NB-IoT for metering, SCADA, environmental monitoring, machine health
- Large market opportunity for infra vendors, operators, IoT device vendors, applications, SIs

Demonstrates 3GPP's willingness to work with industry verticals

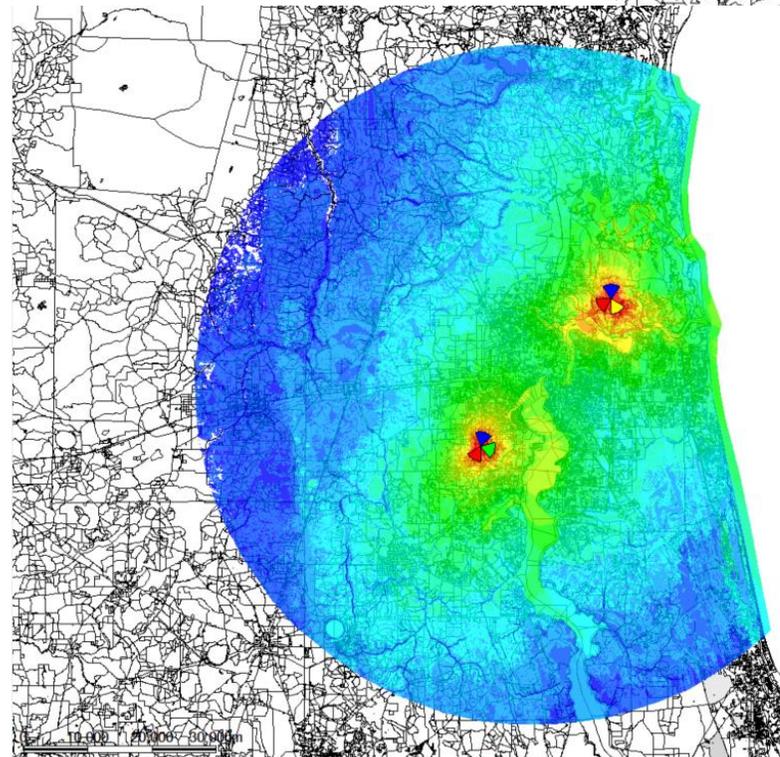
- Perfectly aligned with 3GPP's theme for Rel. 16 and beyond
- Blazes the trail for other 3GPP technologies (Rel. 16 and beyond) into utility space

Early success: Private NB-IoT network

- In production since June 2019
- In North Florida with JEA (local utility)
- Deployment
 - Upper 700 MHz A Block
 - 3 sites covering 1.6M POPs
 - Stand-alone mode
- Full 3GPP NB-IoT stack
- FCC certified network equipment and UE devices from leading vendors



Tallahassee, FL



Jacksonville, FL

Unique aspects of stand-alone 1+1 MHz NB-IoT band

- All E-UTRA bands defined by the 3GPP to-date are 1.4 MHz or wider
 - This Upper 700 MHz A Block is 1 MHz paired FDD
 - No 1+1 MHz band has been defined to-date
- Study the impact on TSs in incorporating a 1+1 MHz band
 - Fully functioning production NB-IoT network using leading vendor equipment gives confidence in the underlying feasibility
 - Impact analysis on TSs will be proposed as a study item in the WID to the RAN#93-e
- Study the impact on TSs in creating a stand-alone NB-IoT-only band
 - Impact analysis of creating an NB-IoT only band will be proposed as a study item in the WID to the RAN#93-e

Unique aspects of Upper 700 MHz A Block

- The 2nd Harmonic of the UL falls in the GPS band
- Proper RF filter design is required to reduce the 2nd harmonic
- Several vendors products have been successfully certified against the GPS related regulatory requirements

Signal	Range (MHz)	
	Start	End
GPS	1559	1610
DL	757	758
UL	787	788
DL -2nd Harmonic	1514	1516
UL -2nd Harmonic	1574	1576

Band edge emission

- The emission requirements for Upper 700 MHz Block A are defined in CFR §27.53 (c) & (f)
- By keeping a 100 kHz exclusion at each edge of the band, Puloli and other vendor products were successfully certified by the FCC
- Same approach has been adopted by the 3GPP recently

Recent successes as reference

- Band 85
 - DL: 728 – 746 MHz / UL: 698 – 716 MHz in 700 MHz band
 - Extending 1+1 MHz (DL: 728 – 729 MHz / UL: 698 – 699 MHz) previous guard band to Band 12 (DL: 729 – 746 MHz / UL: 699 – 716 MHz) for NB-IoT services
 - Similar characteristics as this proposal
- Bands 87 & 88
 - Independent bands in 410 MHz spectrum
 - 5 MHz channel bandwidth
 - Supports 1.4 / 3 / 5 MHz LTE + NB-IoT / LTE-M