

TIA and Mobile & Wireless Forum Joint Meeting with FCC Labs and OET

March 22, 2019





AGENDA

- Introductions and Opening Remarks
- Invitation to FCC for their Items of Concern
- Technical Items of Concern to Industry
 - PAG issues
 - Streamlining approvals
 - Software defined radio
 - Occupational limits for portable devices
- Streamlining Approvals
- Update on Standards
 - EMF exposure standards
 - EMF compliance standards
- Importance of Updated Standard for the U.S.

Pre-Approval Guidance and Equipment Authorization

- Revision to Pre-Approval Guidance to reduce manufacturer costs and burdens built into the process
- Address outstanding issues from the 15-170 NPRM that would streamline equipment authorization process for manufacturers:
 - Permissive Changes
 - Move Module Approval to Part 2 of the Commission's Rules
 - Software Defined Radio

Streamlining Approvals: Radio Declaration of Conformity

- Commission's to consider modifying TCB program to allow full approval to be issued by TCB without FCC review
- Proposed program to be called RDoC (Radio Declaration of Conformity)
- Modeled on SDoC process but TCB would issue an actual approval number
- Restricted to technology that does not need FCC SAR (less than 1.2W/kg) or PAG review and not likely to fail FCC audits
 - For example: BT, Wi-Fi client cards, Zigbee, garage door openers, RFID, 3G, 4G technology
- Approval be based on a summary review of documents on SDoC process and manufacturers Declaration
- Subject to FCC / TCB audit

Application of Occupational Limits for Portable Devices

- Effectiveness and safety of first-responders and of the communities they serve and protect hinges on reliable mission-critical wireless communications
- Per current FCC regulations (47 CFR §1.1310), the criteria for occupational exposure require a professional user to be aware that the device is an RF emitter and to be able to control or limit exposure
- Per current FCC regulations, there are no restrictions on occupational exposure to specific bands or specific technologies for trained professional users
- Thus, per current FCC regulations, occupational devices specially designed for trained professional users, operating in bands including traditionally “consumer” bands, are permitted use of occupational levels across all bands being used
 - Examples of “consumer bands” : LTE, WiFi, CBRS, CDMA, GSM ... 5G

Update on EMF standards

- International EMF *exposure* standards
 - IEEE & ICNIRP revisions
 - Updates & timelines
- International EMF *compliance* standards
 - Fast SAR systems
 - Computational SAR
 - 5G mm-wave exposure assessment
 - New metrics for 5G mm-wave exposures
 - Incident & transmitted (epithelial) power density
 - » Surface & time averaging



International EMF *exposure* standards status

- **IEEE:**

- IEEE C95.1-2019 was approved by IEEE-SASB in Feb 2019
- The approved standard is undergoing final editorial review by IEEE
 - Publication expected by the end of 2019 (IEEE editorial delays)
 - The approved draft is [available online](#)



- **ICNIRP:**

- Draft guidelines unveiled at BioEM 2018 & [available online](#)
 - Steady progress addressing subsequent public consultation comments
 - More information on publish date after ICNIRP meeting in April 2019
 - The draft is targeted to be mostly ready by BioEM 2019 in June
 - Publication expected by the end of 2019



- IEEE and ICNIRP limits are well aligned
 - Limits are supported by scientific evidence
- Excellent opportunity for regulators worldwide to update their EMF exposure guidelines

International EMF *compliance* standards status



■ IEEE & IEC standards below 6 GHz:

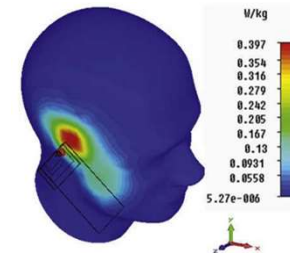
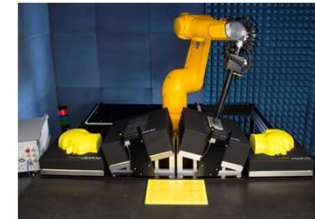


- Slow SAR tests: incremental updates driven by 4G technologies
 - IEEE 1528, IEC 62209-1&2 (to be unified in IEC 62209)
- Fast SAR tests: probe array technologies
 - IEC 62209-3 in final approval stages
- Computational SAR standards published: IEC/IEEE 62704-1&2&3&~4

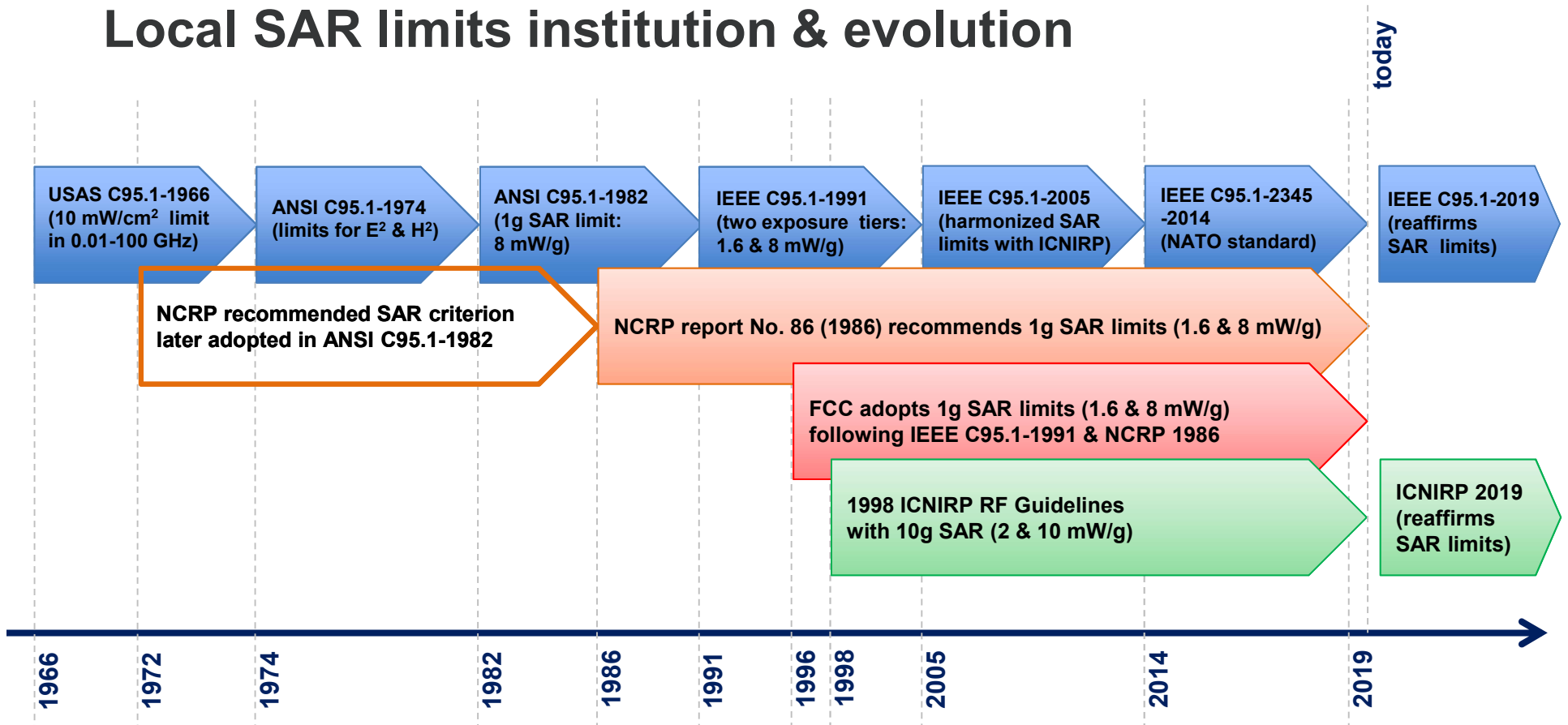
■ IEEE & IEC standards above 6 GHz (at CD stage):



- Methods and technologies to assess power density
 - IEC/IEEE 62704-5: **Computational** Procedure for the Assessment of Power Density of Human Exposure to Radio Frequency fields from Wireless Devices Operating in Close Proximity to the Head and Body (Frequency range of 6 GHz to 300 GHz)
 - IEC/IEEE 63195: **Measurement** procedure for the assessment of power density of human exposure to radio frequency fields from wireless devices operating in close proximity to the head and body (Frequency range of 6 GHz to 300 GHz)



Local SAR limits institution & evolution



5G mm-wave limits: new metrics & thresholds (i)

- Both ICNIRP and IEEE experts realized that SAR is not practical > 10 GHz
 - Steep SAR decay vs depth in tissue
 - Large tissue parameter variation over multi-octave mm-wave spectrum
- **Power density (PD)** defined as the applicable metric > 6GHz
 - Heat absorption and temperature rise essentially occur at the body surface
 - IEEE allows 1g SAR to still be used in the transition range 6 – 10 GHz
- Basic restriction (**DRL**): **Transmitted (epithelial) PD**
 - Time & surface averaged power density crossing the body surface
- Reference levels (**ERL**): **Incident PD**
 - Time & surface averaged power density impinging upon the body surface

5G mm-wave limits: new metrics & thresholds (ii)

- Surface averaging
 - e.g., 4 cm² up to 300 GHz
- Time averaging
 - Both standards provide frequency dependent time averaging windows to limit local temperature rise for waveforms featuring infrequent high-level short pulses
 - Similar windows defined by IEEE and ICNIRP
 - 5G waveforms are not expected to feature such short pulses

PD surface & time averaging at mm-waves

- MWF-funded research addressed conservative (adiabatic) exposure settings
 - Research team featured Prof. K. Foster, Prof. M. Ziskin, and Prof. Q. Balzano
 - Established upper bound (sheet surface-heat sources) for temperature
 - Allowed to derive frequency-dependent averaging area & time windows
- SPEAG-funded research conducted at IT'IS (Switzerland) addressed the same topics
 - Research team featured Dr. N. Kuster, Dr. E. Neufeld, and Prof. Q. Balzano
- Research also conducted independently by Prof. A. Hirata et al. (Japan), and others
- IEEE invited Prof. Foster, Prof. Kuster, Prof. Hirata to discuss their respective findings at the semi-annual ICES meetings last January (Florida)

Following the scientific exchange, IEEE and ICNIRP experts concluded that the metrics and limits in the respective draft revisions are sufficiently protective

Relevance of implementing harmonized standards

- Regulations that reflect the current scientific knowledge
 - International standards continually evolve to reflect latest science regarding safe exposure limits
- Establishes a uniform product approval process
 - Benefits U.S. consumers through global economies of scale
 - Relieves consumers' concerns arising from contradictory requirements
 - Facilitates product certification and reduces time to market

Importance of Updated Standards for the U.S.

- As U.S. develops and deploys new technologies, the regulatory exposure limits should be science driven to maintain consumer confidence.
 - Note: Age of exposure limits causing a lack of consumer confidence.
- Efficient deployment of new technologies is dependent on the application of a standard.
 - Manufacturers need to be able to anticipate the length of time for approvals
 - Consumers lose the benefit of global markets where standards are parochial
- **UPDATED STANDARDS WILL FACILITATE DEVICE APPROVAL AND THEREFORE ASSIST IN ATTAINING U.S. LEADERSHIP IN 5G**



Thank You

- Questions // Comments



BACK-UP SLIDES

SAR safety margins vs established health effects

- Whole body averaged
 - Behavioral effects in animals over many frequencies, threshold at 4 W/kg
 - 10X → 0.4 W/kg for upper tier
 - 50X → 0.08 W/kg for lower tier
- Localized exposure (averaged in 10 g)
 - Cataract observed in rabbits, threshold at 100 W/kg
 - 10X → 10 W/kg for upper tier
 - 50X → 2 W/kg for lower tier

Courtesy of Dr. C-K. Chou, Chair IEEE ICES

CFR excerpts on occupational criteria

- FCC regulations define the circumstances for occupational exposure as follows:

"(1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure (...)

The phrase *fully aware* in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment."

"(2) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure."

47 CFR §1.1310e(1)-(2)