The 1st SparkLink International mmWave Standards meeting

Location: Paris, France

Date: 19 – 20 November, 2024

Chairman (Lorenzo) introduced general guidelines of the meeting

**0 - Agenda 0000r0 approval**

* Approved.

**1 - Contribution 0001r0**

* Question about life cycle. What if REVISION approval fails (N)? – add and show feedback loops.
* Question about “functional blocks”. What is it? – The set of contexts/definitions/… in the TS/TR that indicate an independent function.
* Are use cases / requirements always updated if REVISION fails? - Not necessarily.
* Noted.

**2 - Contribution 0002r0**

* Where does 15.629 us deterministic latency come? – From the design of frame duration.
* What does the frequency reuse 320 GHz x n mean? – reusing the HW blocks of the other standards.
* What are the exact frequency bands? Need to study them.
* Timeline is noted. To be approved.

**3 - Contribution 0003r0**

* Question about the power consumption of the kiss data transfer. Minimize the power consumption, use only when needed.
* Need to clarify how SparkLink can do it better than existing standards.
* The mobile phone is already very full. Difficult to add chipset or antennas. We should have a plan. Otherwise, it will be an academic exercise. Not only nice use case but consider how quickly it can be. – second it by 1 attendee.
* Standard is one aspect. The market should be well analyzed. Benchmark market needs
* The industrial applications are also to be addressed.
* Need to do frequency band study in the very beginning of the WI.
* Multiple use cases increase the cost of testing a lot.
* Do we need to take all the use cases as mandatory requirements for the WI? Or more abstract vision? We may need to update the use cases later according to the work here and product development as well. The priority order is needed. Video, etc. Should consider both performance and implementation aspects. And should clarify who is behind the use cases. DEKRA has a lot of UCs collected from customers that would like to contribute.
* We plan to do minimum performance (like US) or fully interworking standard? - Fully interworking.
* Need to know what the other standards are doing.
* Use cases and benchmark are linked together. Need to clarify editor/leader role.
* Working Group should establish a template for use case/requirement. Make competition analysis (existing standards, how they meet the use case). To be approved.

**4 – Contribution 0004r0**

* For the template, we need to clarify whether the contribution is for approval or for discussion.
* Benefit of SparkLink: car key, tablet, mouse etc. much better than competitive technology.
* Large bandwidth
  + Increase SCS, or ?
  + Increase the number of SC
* Is this everything, or should support other network structures as well? - support broadcast, unicast, multicast
* Channel bandwidth has been decided? 2560 MHz maybe too much for battery operated devices. We should clarify the feasibility.
* Are you considering both multi- and single carrier? - We should start from SparkLink 1.0.
* battery powered vs main powered devices, more bandwidth --> more power or not possible for battery operated
* Noted

Lunch Break

Afternoon session

**5 - Contribution 0005r0**

* Understand and identify possible areas for contribution.
* Reason for WiFi success is easy of deployment, cost, accessibility, unlicensed band.
* Spin-off from IMEC
* Timeline: 2025 802.11ad/ay, 2027 5G mmW, 2028 WiFi8
* The Past 60 GHz
  + 802.15 TG3c
  + ECMA
  + WirelessHD
* The Future
  + Scaling down the bit rate for cost saving.
  + Need 10 Gbps data rate with low latency (deterministic) and reliability
  + AR/VR for medical is an interesting niche market
  + Logical access point the same, but physically separated in different rooms makes it easier to support human mobility.
  + The requirements
    - High TP, low latency, high reliability, low cost, low power.
  + Wi-Fi7 3 x 320 MHz
  + Not only technology but we need an ecosystem! Enough companies to build the system, enough companies to use it, etc.
* Challenge for SLA to identify compelling use-cases / deployments above and beyond those considered in WiFi.
* Currently using lots of digital signal processing tof compensate the RF impairments. Use high bit A/D converters…
* OFDM will be horrible for mmW because of PAPR. But needs more effort on PA design.
* TGbq in 2029-2030, opportunity for iSLA.
* Pharrowtech Demonstrator
* Base 11ac EVM -42 dB (ideas kind Keysight, horn antenna)
* Upclocking by 4 EVM -28 dB (realistic design)
* Upclocking by 8 EVM -22dB
* 80% of data usage WiFi, only less than 20% mobile.
* Lower nm increase chip design cost a lot
* 16 nm 90 M, 7 nm 249 M, 2 nm 725 M
* Revisiting old thinking could make sense, e.g. pre-distortion analog/digital, I/Q imbalance, linearity, carrier spacing, pilot setting, etc.
* We are not equalizing the channel but we are equalizing the modulated signal impacted by antenna, RF, channel, etc. Matlab usually assumes ideal equalizer leading to suboptimal solutions.
* There are significant gains outside traditional physical layer DSP.
* Max 22 ns delay spread in 60 GHz on 11ad measurements in indoor.
* Possible to use alternative channel raster at 60 GHz due to wider available band.
* Noted.

**6 - Contribution 0006r0 Latency and Reliability (Theodoros)**

* SLB specs summary
* Latency definition
  + E2E
  + User Plane
  + Control Plane
* Physical Layer Latency TL calculation
* Polar code provides about 1 dB gain compared to LPDC used in WiFi.
* Theodoros contribution to SL
  + 1) Beam Alignment Latency
  + 3) Effective Achievable Rate
* Beam alignment Latency? Initial Beam Alignment: In mmWave communications, beamforming using narrow beams or directional antennas is typically employed to achieve sufficient array gain over a larger antenna aperture. However, the implementation of narrow beamforming or directional antennas elevates the overhead associated with initial beam alignment. During the first beam alignment, the transmitter and receiver align their beams to establish the mmWave connection. In general, when directionality increases, the overhead of beam alignment escalates due to the rise in the number of beam candidates that must be searched. Furthermore, owing to the elevated mobility in V2X scenarios, prompt execution of initial beam alignment is crucial.
* how to select channel? How to coexist with LBT? Need to consider the FCC/CE/… regulation. Any system using unlicensed spectrum should use listen before talk. It is mandatory by regulation.
* FCC uses beamforming gain in measuring EIRP, but Europe is different.
* SLE has a smart frequency hopping in interference scenarios

**7 - Contribution 0006r0 Features of mmWave (Michele Zorzi)**

* Higher frequency because of more spectrum.
* Path loss problem
* Antenna gain can compensate more than lost in path loss.
* Material penetration is a problem.
  + E.g. human blockage
* Outdoor-to-indoor
* Coding gain in addition to the beamforming gain, SDMA.
* Reduced interference.
* Challenges of MIMO
  + Networking/protocol issues
* Discussion
* Is the beam direction the same across the 9 GHz band?
* Control plane vs. user plane combined low frequency and high frequency may be easier than stand-alone high frequency
* Control plane features like channel estimation is not useful as such for high frequency.
* Transmitter beamforming is more expensive than receiver beamforming in terms of power consumption. What if we use single antenna transmitter and array for receiver? Then listen before talk should be possible. – May be future study.
* Using low frequency AOA/AOD information for high frequency would be possible if there is and antenna array on both ends.
* What if we use AI for channel estimation? In indoor, the environment is quite stable, so some machine learning could be in possible.
* Beam forming is considered to near distance communication.
* Low frequency as control link. Higher frequency is for data? - May fail by using sub-6 and 60G same time.
* How many flexibilities to define the network layer and application layer? - to apply TCP/IP and higher layer protocol is preferred.
* Noted.

Day2 meeting. Agenda (Contribution 0001r1) approved.

**8 - Contribution 0008r0**

* 60 GHz measuring and testing have been supported.
* Introduce the regulations that SparkLink mmWave need to be considered.
* Noted.

**9 - Contribution 0009r0**

* Technical introduction about SLB-mmW plans to do.
* New proposals/amendments/adjustments/… are welcome.
* Noted.

**10 - Contribution 00010r0**

* Establish a group for administration (TR/TS numbering, copyright, template, IPR rules, whether to include author names and companies etc.)
* **Skeleton updated online (r1) and approved**. It does not prevent us from further updates. The scope will also be discussed later.
* TR and Spec Development procedures: **0001r1 approved.**
* The template needs to be sure. To follow ETSI (such as) or use Chinese version as the EDSG. Copyright / Publicity need to be very clear. Based on what kinds of Charter.
* The information about copyright and IPR needs to be clear in every deliverable so that everybody who gets the document knows what are the rules applicable to its content.

**11 - Contribution 00011r0 Summary**

* ad hoc groups / tasks [TENTATIVE]
  + AHG1: Use cases (template from \*Vinod\*, Li Xu, Juan Carlos, Lenovo)
  + AHG2: Implementation issues (\*Micky\*, Youssef, LiXu, Michele, Wan Lei)
    - Power consumption, complexity, channel measurements, RF, analog, ADC/DAC interface
  + T1: Spectrum study (\*Theodoros\*, Tommi, Lorenzo, Youssef)
  + T2: Survey Competing Standards and SparkLink SWOT-analysis
* Based on above
  + Requirements including output from use cases and implementation
  + Spatial design (antenna array, beamforming, MIMO, etc.)
  + Technical aspects
* Deliverables
  + Draft meeting minutes to be delivered after the meeting (by 25th Nov).
  + Approve 001r1 and 002
  + Approve ad hoc groups, task coordinators, editor
* Next meetings
  + Group calls invited by the group leader/coordinator
  + Next Plenary conference call 5 December 10 – 12 CET. Shen YAN may help with the online organization.
  + Face to face meeting week 3/2025 (the week from 13 to 17 January 2025.