|  |  |
| --- | --- |
| SparkLink mmWave | |
| Use Case Description Format & Version Management Proposal  Front page to be used from ver 0.0.0 till ver 1.0.0 | |
| Title / Number | Short Range Wireless Connectivity Solutions for harsh environments |
| UC introduced in meeting no. | 13th February 2025; Meeting no.3 Online meeting |
| Presenting Member/ individual Ver 0.0.0 | Vinod Kumar, WWRF representative |
| Sponsoring Members (Optional) | Huawei, Lenovo, Chipset Vendors, XR Vision Equipment Vendors |
| Intended Market Segments | Consumer, Medical, Automotive, IT Infrastructure, Industrial, Military |
| Ecosystems | Chipset, modules, device manufacturers  network operators involved (to be clarified) |

|  |  |  |  |
| --- | --- | --- | --- |
| Place Holder for managing the Use Case evolution in the TG Meetings | | | |
| TG Meeting No | Input version Ver 0.a.b | Output Version  Ver 0.c.d | Updates Introduced |
|  | Ver 0.0.0 | Ver 0.1.2 | * Some typos * Editing the “Dependcies” chapter for spectrum selection and Sparklink co-existence with other technologies in unlicensed band * Details on Xon/Xoff protocol in “Innovation" chapter |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

|  |  |
| --- | --- |
| Objective | Design of protocols and end node architecture for very low latency variable bit rate (raw) data transmission |
| Description | There is an identified requirement of end nodes capable of exchanging information bi-directionally at random intervals, and at symmetrical or un-symmetrical bit rates variable in time.  Very often such nodes shall be installed pairwise in confined but harsh (interference-wise) environments. Multiple node pairs may have to be installed in a same confined environment and/or in closely spaced separate confined environments. The case of one node of pair A talking “simultaneously” to multiple nodes of pairs B, C and D etc would also have to be foreseen.  The typical distance of separation between the two ends of a communicating pair would be in the range of a few centimeters to a few meters. The usually present LoS channel between a node pair in communication may sometimes be obstructed due to the physical distortion of the space between them.  Strict requirements of reliability and integrity of data are expected to apply. Additionally, quick node wake-up, very fast link establishment and very low latency of exchanged data would need to be respected. |
| Technical Specs related. | This use case would bring multiple technical challenges like   * Design of a quickly reacting XON/XOFF or RTS/CTS Protocols based on the exchange of short information packets * Design of error correction mechanisms for reliable transmission of short packets * Selection of suitable numerologies for short packets during initial link establishment and then for very high bit rate transmission after the initial link establishment. * Design of interference detection/evaluation mechanisms capable of driving the resource allocation for variable bit rate transmission in presence of a single one to one link, multiple one to one links and multiple one to many links. Ref remark about confined links above. * Identification of suitable channel models in view of the fact that the near field propagation mechanisms (applicable here) are totally different from the usual outdoor propagation mechanisms for mmWave frequencies * Design of node DRx/DTx and sleep mechanisms offering the best tradeoff between wake-up time, information latency, energy dissipation and information integrity. Remark: Side Clipping introduced by delayed wake-up results in information loss. * Checking the need and usefulness of a central controller for controlling resource allocation in case of multiple closely spaced node pairs. * …… |
| Technical Feasibility / Complexity – Critical path and any Roadblocks | If this can be demonstrated to be feasible and if there are some methods already available – Hopefully only a few bullet points |
| Dependencies | In the first step, it is suggested that a “focussed” piece of ISM spectrum be considered for the design of mechanism mentioned above. The following text reproduced from the XR Use case seems to be relevant for this use case as well. It will have to be adapted to fit the requirements and technical challenges listed above for the present use case.  The available spectrum in unlicensed band is listed in the table below      The availability of this spectrum is usually under strict government control. At the first instance, it is suggested that the 61 to 61.5 GHz spectrum band be considered for the implementation of the present use. The IEEE 802.11ad is largely deployed in the 60 GHz band and substantial amount of information related to channel models and path loss models for different deployment environments is available in the reports of WiFi Alliance. (Ref. xxx)  It is true that the co-existence of networks using existing and upcoming technologies like WiGig and 5G NR can be source of interference for Sparklink use case. Multiple studies on co-existence of such networks and dealing with the design of interference avoidance mechanisms like LBT are available. (Ref yyy).  In view of the relatively stringent specifications on transmission reliability and latency the situations of Primary and Secondary Users should be avoided for this particular use case. |
| Innovation | Design of Xon and Xoff or RTS/CTS protocols for the “initial handshake” in wireless links is very challenging.  Multiple considerations for high importance need attention namely   * time and frequency synchronization between the Tx and Rx and interaction with the native synch mechanisms for the air interface, * node energy dissipation wrt the selection between “always on” and use of DTx/DRx. * Inclusion of channel quality parameters in protocol header format useful for the Adaptive Bit Rate transmission. The channel coherence time in implementations of this use case would be more a function of the inter-system interference rather than on the relative Tx/Rx mobility. * Inclusion of parameters related to the native air interface – e.g in case of OFDM symbols at the beginning of each slot can be reserved for the exchange of handshake messages. * ….. |
| Justification and benefits | Why market needs this, what will be the benefits for that market and what problems the use case will solve. |
| Priority | Defined by the SparkLink Alliance |