**Monday, January 18, 2016**

The Chair appointed Chittabrata Ghosh to be the Secretary for the January meeting

Agenda read and approved based on document 1520r2

Motion to approve the minutes:

Mover: Chittabrata Ghosh

Second: Michael Fischer

The minutes are approved

Request to change the order of contribution of contributions 22r0 and 22 r0 and the contribution 27r0 to the queue of presentations

**Usage Scenarios and Applications for Long Range WiFi - 0058r3 (Jianhan Liu - Mediatek)**

Q: How about coexistence when extending the range to 2km?

A: Not considered here; possibly, send legacy preamble in 20MHz before new preamble; beyond the 20MHz range, probably hard to control coexistence

Q: What is the existing technology in these use cases?

A: Narrow band and repetition of OFDM symbols, not back-compatible; shipping about 2M units, urgent requirement but do not care of coexistence

Q: Did you consider 11ah as an option?

A: it is possible with 11ah, problem being no worldwide frequency available;

Q: Smart home is potential for Wi-Fi and coverage is serious problem, need to resolve within LRLP; in Slide 3, propose 10-15dB improvement, how would you achieve it?

A: Assume same power consumption as in conventional Wi-Fi; low power for drone is not an important issue to consider

Q: Drone communication is potential for Wi-Fi application, but 2km may not be enough for drone coverage; do you think multi-BSS hand over is an option?

A: In Korea and China, they need drone within visibility; hence, 2km may be a possible range;

Q: Combine control and communications for drones; latency requirements?

A: Provide reliable link at MAC and PHY and latency is a fundamental difficulty for contention-based access; fast fading with Doppler fading needs to be thought through;

**At-home, IoT Use Case(s) for LRLP – 16r0 (Yaron Alpert – Intel Corporation)**

Q: Use cases almost covered by 11ah; the use cases are almost repeated from 11ah and overlapping with 11ah

A: The environment is more challenging compared to 11ah; foundational concept is to build on existing infrastructure and RF components; it is going to be remarkable that a 26 tone from 11ax could be used for LRLP and there is gap of satisfying the use cases and LRLP is to fill up that gap

Q: Appliances are long range, devices are powered and what is relevance with LRLP?

A: For low cost structure, there are many companies that do not support Wi-Fi for smart devices;

Comment: Interested in whole coverage at home; compared to BLE what would be advantage of LRLP over other competing technologies?

Comment: There is no single technology to solve all the use cases in Slide 12; may be the first step is to figure out devices in the TIG document that has requirements of LRLP and good to be included in the output document;

Response: Determine devices that use Wi-Fi technology and use other technologies and this could be included in the TIG document;

Comment: There can be a solution in the market, but none is using the technology;

Comment: There is synchronization mentioned and need clarification of time or frequency synchronization;

**Coexistence Problems – 26r0 (Minyoung Park – Intel Corporation)**

Q: Do you extend the 11ah operation for long range?

A: Just stated the fact of 11ah

Q: 1km is not easily achievable using 11ah with MCS 10; LRLP to support more than 1km as a requirement and then 1MHz bandwidth may be required and coexistence may be an issue

A: Narrow-band is used for extended range; legacy preamble has protection till 20MHz range so coexistence may be an issue;

Q: Propose to consider coexistence with legacy devices as LRLP requirements?

A: Yes; to maintain coexistence, you need legacy preamble to make legacy STAs to understand LRLP transmissions; in this presentation, just highlighting coexistence issues with narrow-band signaling;

Q: Coex issues was brought up in last meeting and you raise concern on the same issue;

A: In this presentation, provided some examples of coexistence issues;

Q: LRLP STAs assumed to operate in narrow-band?

A: LRLP STAs does not need to support 20MHz signal reception or transmission;

Q: How much interference on LRLP STAs in terms of throughput?

A: Probably come up with design before we simulate

**Long Range and Low Power and Coexistence – 22r0 (Shahrnaz Azizi – Intel Corporation)**

Q: What is the motivation of high priority for low power?

A: To restrict Tx power and maintain the range; if we keep the extended range, then we sought out solutions for coexistence;

Q: Wi-Fi with extended range could be a differentiator over BLE, is that the goal?

A: Provide an answer right now;

Q: Power savings with restrictive bandwidth has been suggested; where is the asymmetry?

A: LRLP devices operate in narrow band;

Q: What is the main differentiation point from 11ax?

A: 11ax PAR has more about power efficiency but did not have metrics to compare or estimate;

Clarification on difference between power efficiency and low power (in terms of average power consumption and peak current consumption)

SP:

* **Do you support that the first priority of the technical development of LRLP should be on enabling a low-power capability?**

Comments: Propose to divide into two different PARs?

Response: Not an intention; once we operate in narrow band, automatically increases the range; clarify the focus of this group

Deferred to Tuesday AM 1 session;

**Tuesday AM 1**

**Considerations on LRLP Transmissions – 62r0 (Yakun Sun – Marvell)**

Q: What is the FFT size?

A: 64 tone FFT

Q: Whole framework is OFDM, otherwise SC?

A: No specific design, is SC is used, reduced PAPR;

Q: Do you consider OFDMA?

A: In DL side, depends on the effort we make in LRLP project; synchronization may not be efficient, so it may be hard to make OFDMA work; for DL it can work, but for UL, it may be hard

Q: Sounding is mentioned with implicit feedback

A: Main issue is synchronization

Q: Coverage is 300-400m, legacy preamble protection may not be enough

A: If STAs out of AP’s coverage, additional mechanism is needed to make it work;

Q: In Slide 8, the diagram depicts that the legacy preamble protects the first 2 frames, but issues with unprotected LRLP preamble and data
A: Best balance between coexistence and cost; unprotected LRLP preamble and data could be protected with legacy preamble in UL for protection against legacy devices

Q: Can this be done under the 11ax project?

A: For better focus,

Clause 25 in 11ax Draft 0.1 needs to support range of MCS 0-7 and low power devices need not implement all these complex hardware from legacy specification;

Q: Drawbacks of SC-FDMA?

A: They have to spread out in larger FFTs, study the tone plan, guard tones; outdoor channel would be frequency selective, need to define the tone structure

Q: 10dB required in home Wi-Fi use cases; what would be the changes to achieve this additional power?

A: To compensate link budget, lower coding rate of current MCS 0 and SC transmission may better use transmission power; for UL beamforming, cost needs to be considered and there may be 2 classes of devices (one with beamforming in UL and the other class with no beamforming);

Q: In Slide 8, anticipated that LRLP devices operating in narrow-band, no protection;

A: Only perform ED, may be Trigger frame-based transmissions; minimize collisions among other LRLP devices;

Q: Unscheduled UL transmissions may be an issue without protection; one LRLP device in one narrow-band channel may not hear another LRLP transmission in another narrow-band channel;

A: This is almost like UL OFDMA and the assumption needs to be worked out;

Q: Assumption for modulation level for SC-FDMA?

A: BPSK and for higher order modulation, PAPR may be increased;

Q: What is the extension range to be expected in second bullet of Slide 3?

A: Drones may be used in low populated areas in the drone use case; from a list of range from proposed use cases, the value might be defined finally in the LRLP output report;

**LP-WUR (Low-Power Wake-Up Receiver): Enabling Low-Power and Low-Latency Capability for 802.11** – **27r0 (Minyoung Park – Intel Corporation)**

Q: What is delay between wake-up signal and following PPDU transmission?

A: Take around 10ms from Deep sleep to active state;

Q: Does the AP poll the LRLP STA to wake up?

A: There can be different flavors of the wake-up mechanism; piggyback the data with the wake-up signal

Q: What is the reliability of wake-up?

A: Receiver sensitivity similar to current Wi-Fi;

Q: With wake-up receiver, the device could go to sleep

A: Targeting low power with 100us, probably not possible with current Wi-Fi

Q: Assumption for the data traffic in Slide 15?

A: Compared the schedule in Slide 12

Q: Why not integrated with LRLP?

A: Feasibility to achieve low power;

Q: Comparing with other technologies would have been relevant; is this an additional component apart from LRLP

A: Comparing with BLE is a valid comment; wake-up is one aspect, any other usage scenario could be coupled with the WUR

Q: How do you see this WUR: is it going to replace BLE or complement with BLE

A: The WUR does not have the transmission capability, so there is no intention of replacing the BLE

Suggestion time: We need to identify the requirements or metrics in the output report to capture the WUR mechanism within the LRLP project

**LRLP potential technologies – 118r0 (Tianyu Wu - Mediatek)**

Q: How could you achieve 10dB gain with 8x duplication?

A: One duplication brings 3dB; Channel D (n-LOS) was used to propose 8 time duplication to achieve 10dB additional gain

**Potential Coexistence Approach – 129r0 (Tim Godfrey – EPRI)**

Q: Can you clarify the extended range definition?

A: There is a 20MHz preamble protection region and the range beyond the preamble protection

Q: Making LRLP devices receive 20MHz preamble may help, but there are ranges within extended range that may not be covered totally;

A: Agreed

Q: Why is coexistence problem discussed in longer range area?

A: In low power region, the lower transmission power over narrow-band could be used to coexist when compared to extended range applications;

Q: Comment on device types, one capable of 20MHz preamble capable and other without 20MHz preamble capability

A: We do not need to have different classes defined now;

*Announced that PM1 on Thursday would be in PM1 in Centennial I*

**Thursday PM 1 session**

The Chair presented 1520r4 to recap the motivation of LRLP

Comments: Clarification requested on the sentence with “deployment scenarios of both devices and infrastructure are not the primary candidate for LRLP.” What would be the primary candidate for LRLP?

Response: Standardized broad market of, say 11ax, devices can have LRLP capability;

Comment: The point in the first bullet is unclear

Response: Reasonable to expect with APs having LRLP capabilities with close to zero cost on APs for such support

Comment: There will be additional cost to the inclusion of a new technology and requests for modification in the first bullet;

Response: The sentence was put together in haste and can be modified;

Comment: Request to withdraw the slide 9 from the contribution 1520r4

Response: Agreed to withdraw the slide and have a separate contribution if needed

**0022r0 – Shahrnaz Azizi**

SP:

* **Do you support that the first priority of the technical development of LRLP should be on enabling a low-power capability?**

Q: How do you define low power in the SP?

A: The home entertainment use case may not need to be low powered since devices may be powered;

Q: Some of the new use cases may be excluded in the Study Group?

A: In the Study Group, the use cases may be re-defined that need low power; majority of the use cases have been proposed and low power seems to be important pointing to the need of a new amendment

Q: It may be too early to decide whether the amendment needs to be focused on low power or long range?

Comment: Need to understand the low power and coexistence?

Response: Agreed

A: Some use cases need extended coverage, but there are techniques to solve the issue; however, majority of use cases are focused on low power and enable devices to bring to market through this amendment; in Slide 6, we include extended range with asymmetric link;

Q: What do you mean by “first priority” in the SP, is it that the standard handles 2 classes of devices?

A: The priority is low power and if we design Wi-Fi to transmit 0dBm to close the link, the extended range is gained automatically

Comment: “Yes” would mean “low power is the priority,” “No” means “long range has same or high priority than low power” and Abstain to mean “no opinion or too soon to decide”

**Straw Poll results**: Y: 18; N: 25; A: 52

The LRLP document 1446r5 was reviewed by Chittabrata Ghosh and Michael Fischer

Q: The coexistence requirements appears to be at the AP;

A: Since the 20MHz preamble

Q: Understanding of the reason for the illustrious LRLP report

A: Preparatory work of scope, use cases, and requirements document; accelerate the process of the Study Group formation as was suggested and directed by the Working Group Chair;

The Chair reviewed the teleconference times of February 17th and February 18th at 8 am PST

Comments: Do we need to decide on low power or long range in March meeting?

Response: It may be done in Study Group and not in the TIG