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Dash7: Performance

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Abstract : *A new wireless sensor networking technology, DASH7 uses the ISO/IEC 18000-7 standard for active RFID. It operates in the 433 MHz unlicensed spectrum. DASH7 provides many advantages over other wireless technologies such as multi-year battery life, dynamic range of up to 2 Km (potentially farther) etc.DASH7 is the name of the technology promoted by the non-profit consortium called the DASH7 Alliance. DASH7 follows the ISO/IEC 18000-7 open standard for the license-free 433 MHzISM band air interface for wireless communications. 433 MHz was first reserved for military purpose but is now available for use worldwide. DASH7 networking technology was originally created for military use and is now being re-purposed for many commercial applications in place of wireless protocols like ZigBee or IEEE 802.15.4.*

Keywords*–433 MHz, DASH7, RFID, Zigbee, ISO/IEC 18000-7*

I. INTRODUCTION

The wireless technology, DASH7 complies with the ISO/IEC 18000-7 open standard for the license-free 433 MHzISM band air-interface for wireless communications. 433 MHz was initially licensed for military application, but is now available for use worldwide. The wireless networking technology was originally created for military use and has been re-purposed for mainly commercial applications in place of proprietary protocols like ZigBee or Z-Wave. DASH7 networks serves applications in which low power usage is essential, and data transmission is typically much slower In January 2009, the United States Department of Defense (DOD) declare the largest RFID award in history worth $429 million contract for DASH7 devices to three hardware vendors. They were Savi Technology, Evigia Systems, and Identec Solutions.

In March 2009, a non-profit industry consortium, DASH7 Alliance, to promote interoperability among DASH7-compliant devices, was announced and as of July 2010 has more than 50 participants in 23 countries. Similar to what the WiFi Alliance does for IEEE 802.11, the DASH7 Alliance is doing for the ISO 18000-7 standard for wireless sensor networking.

II. TECHNICAL SUMMARY

2.1. Tag-to-Tag Communications

DASH7 supports tag-to-tag communications which, unlike most active RFID technologies, combined with the long range and signal propagation benefits of 433 MHz, makes it an easy substitute for most wireless "mesh" sensor networking technologies. DASH7 also supports sensors, encryption, IPv6, and various other features.

2.2. Frequency Spectrum

433.92 MHz is ideal for wireless sensor networking applications since it penetrates concrete and water. It also has the ability to transmit/receive over very long ranges without requiring a large power draw on a battery.

DASH7 utilizes the 433.92 MHz frequency, which is globally available and license-free.

The low input current of typical tag configurations may allow battery powering on coin cell or thin film batteries for up to 10 years.

2.3. BLAST networking technology

DASH7 networks serves applications in which low power usage is essential, and data transmission is typically much slower and/or sporadic, like basic telemetry.

Networks based on DASH7 differ from typical wire-line and wireless networks that operate with a "session". So instead of replicating a wire-line "session", DASH7 was designed with the concept of BLAST:

1. Bursty

Data transfer is abrupt and does not include content such as video, audio, or other isochronous forms of data.

2. Light

For most applications, packet sizes are limited to 256 bytes. Transmission of multiple, consecutive packets may occur but is generally avoided if possible.

3. Asynchronous

DASH7's main method of communication is by command-response, which by design requires no periodic network "hand-shaking" or synchronization between devices.

4. Transitive

A DASH7 system of devices is inherently mobile or transitional. Unlike other wireless technologies DASH7 is upload-centric, not download-centric, so devices do not have to be managed extensively by fixed infrastructure (i.e. base stations).

III. Interoperability

Use a single global frequency in DASH7 devices simplifies deployment and maintenance decisions relative to specifications using multiple frequencies. A neutral, third party testing authority also conducts conformance and interoperability testing under the DASH7 Certified program.

IV. RANGE

DASH7 devices today advertise read ranges of 1.5 kilometer or more, however ranges of up to 10 km have been tested by Savi Technology and are easily achievable especially in the European Union where governmental regulations are less constrained than in the USA.

Dependence of range is shown in fig. 1 for free space transmission.

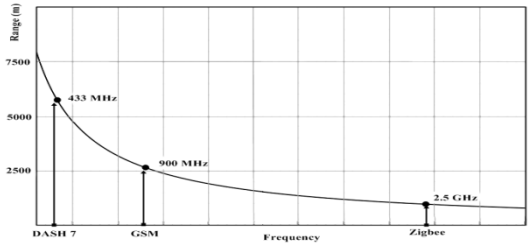

Figure1: Range dependence on frequency

V. Spectrum Usage And Modulation

DASH7 uses a special wideband modulation in a narrow, 150 KHz Band. Therefore DASH7 signals are affected by only $1/20^{th}$ to $1/60^{th}$ the noise of other technologies like Bluetooth and Zigbee.

DASH7 occupies less bandwidth than Zigbee when compared to noise.

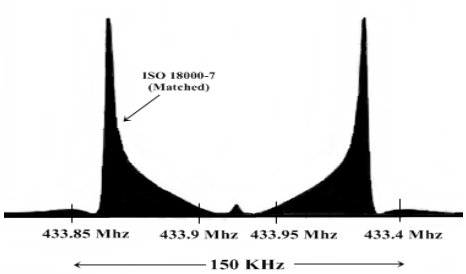

Figure1: Range dependence on frequency

VI. Multiplexing

Multiplexing is performed by collision arbitration [ISO4T] in broadcast message, point-to-point message are synchronous (collision may happen with another network only) and collision are seen as a damaged package.The interrogator (or master) asks the tags (slaves) to collect their TAG's IDs by broadcast and it sets a window size (WS) in number of slots. Each slot of the window lasts a predetermined period of time and tags must transmit just during these slots, the slot during which to transmit is chosen randomly by the tag. In case of collision between tags, they choose another random slot to transmit (Slotted Aloha Method).

After Window Size (WS) slots the interrogator sends a sleep signal to the tags who answered the first collection round, and then it starts again another collection round until there is no more answer.

VII. Network Topology

The network is based on master-slave mode, also called interrogator and tag.

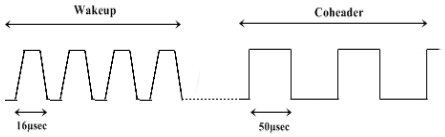

Figure 2: Wakeup signal of DASH7

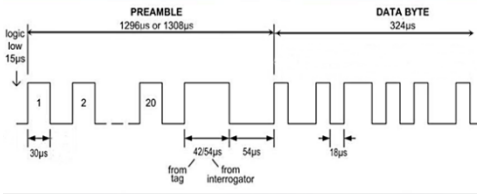

Figure 3: Preamble and data

DASH7 mode 2 is event-driven and an event cantrigger a tag-initiated communication or a tag-to-tag communication which is not possible in DASH7 mode1.
Event-drivenness brings better battery use compared to mode1 where the network polls in the background.
The interrogator can set the owner ID for each tag to separate network groups.

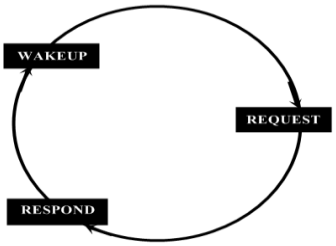

Figure 4: ISO 18000 Handshaking in DASH7

VIII. Layers Definition

The ISO 18000-7:2004 defines physical and data link layers [ISO 4D]. The physical layer defines the modulation used in air communications and band frequencies.

The data link layer defines the communications protocol, data header, commands, data, collision treatment, broadcast communication and point-to-point communication.

Between commands, the interrogator can ask by broadcast for each tag's owner ID by point-to-point communication, verify a tag's battery status and set a connection password.

IX. Security

The interrogator can encrypt the connection between the tag by setting a password. To allow a new password, the tag must be unlocked first with the old password. Tags are unlocked by default.
Locked tags answer a point-to-point communication only if the message is encrypted with this password, but broadcast message are not affected by locked or unlocked status.
DASH7 mode 2 can use AES (Advanced Encryption Standard) public key.

X. CONCLUSION

This paper discusses the basic details of DASH7 technology. As work is in progress on this new technology many transmission protocols are yet to be defined and many existing protocols are to be revised.
DASH7 has very high chances of acceptance all over the world because of its various advantages over many other existing technologies. This will bring uniformity in transmission systems.

DASH7 is a technology based on 433MHz frequency spectrum which is license free in almost all parts of the world, hence there is more opportunity for DASH7 application to flourish.
Specification and research related to DASH7 is currently being undertaken by DASH7 alliance which constitutes many public and private firms from across the globe. Currently more than 50 companies and organization are involved in the expansion of DASH7.

Various aspects in DASH7 technology such as low device cost, long range, interoperability etc. provide greater favour to DASH7 over other existing technology.
But as this is a newer technology it will surely require ample amount of time to evolve and remain as a better option among the existing transmission technology.

XI. ACKNOWLEDGEMENT

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