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Bluetooth™ Wireless Protocol for Automotive Applications

RATIONALE

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Foreword—The Bluetooth specification is an open specification that is governed by the Bluetooth Special Interest Group (SIG). A Promoter Group leads this SIG and is comprised of nine companies¹. Total membership in the Bluetooth SIG, however, includes well over two thousand additional companies.

The Bluetooth specification supports wireless communications in the unlicensed ISM (Industrial Scientific Medicine) band at 2.4 GHz. Frequency hopping is utilized to reduce interference and fading. The standard operating range for a typical Bluetooth device is approximately 10 meters, (using class 3 transmit power of 1 mW).

The subject matter of this document covers some characteristic automotive applications utilizing Bluetooth wireless communications.

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- 1. Scope**—This SAE Information Report defines the functionality of typical Bluetooth applications used for remotely accessing in-vehicle automotive installations of electronic devices. Remote access may be achieved directly with on-board Bluetooth modules, or indirectly via a custom designed gateway that communicates with Bluetooth and non-Bluetooth modules alike.

Access to the vehicle, in the form of two-way communications, may be made via a single master port, or via multiple ports on the vehicle. The Bluetooth technology may also be used in conjunction with other types of off-board wireless technology.

This report recommends using a message strategy that is already defined in one or more of the documents listed in 2.1.1, 2.1.4, 2.1.5, and 2.1.6. Those strategies may be used for some of the typical remote communications with a vehicle. It is recognized, however, that there may be specific applications requiring a unique message strategy or structure.

This document depicts five different levels of security measures that may be required for the various types of communication.

The EMC test requirements for the implementation of this protocol are recommended.

This report makes no attempt to define all of the applications wherein the Bluetooth protocol may be utilized. A number of use cases are listed in Section B.1 of the appendix to serve as representative applications, e.g., credit card transactions, vehicle diagnostics, toll booth collection, flash reprogramming, etc.

2. References

- 2.1 Applicable Publications**—The following publications form a part of this document to the extent specified herein. Unless otherwise specified, the latest version of SAE publications shall apply.

- 2.1.1 SAE PUBLICATIONS**—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1979—E/E Diagnostic Test Modes

SAE J2190—Enhanced E/E Diagnostic Test Modes

SAEJ2178-1—Class B Data Communication Network Messages—Detailed Header Formats and Physical Address Assignments

SAEJ2178-2—Class B Data Communication Network Messages—Part 2: Data Parameter Definitions

SAEJ2178-3—Class B Data Communication Network Messages—Part 3: Frame IDs for Single-Byte Forms of Headers

SAEJ2178-4—Class B Data Communication Network Messages—Message Definitions for Three Byte Headers

- 2.1.2 REFERENCES APPEARING IN TEXT**—For more information refer to the Bluetooth web site www.bluetooth.com.

[1] "Specification of the Bluetooth System", Core, V1.1, Feb. 2001

[2] "Specification of the Bluetooth System", Profiles, V1.1, Feb. 2001

[3] "Bluetooth-based Wireless Connectivity in an Automobile Environment", Rene Nusser and Rodolfo Mann Pelz - Robert Bosch GmbH.

[4] "White paper on Bluetooth 1.1," AU-SYSTEM, Sweden, January 2000

- 2.1.3 CISPR TEST SPECIFICATION**—CISPR documents are available from American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036, Phone 212-642-4900, www.ansi.org.

CISPR 25 Ed. 1.0 b:1995 – Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles

- 2.1.4 IDB FORUM DOCUMENTS—Contact: Arlan Stehney, IDB Forum, 203 Spruce Drive, Suite 200 North, McMurray, PA 15317-3516, Phone 724-942-3636, www.idbforum.org.

IDB-0008-0F, FEB 00, ITS Data Bus Phone Application Messages

- 2.1.5 ISO DOCUMENT REFERENCE FOR FUTURE PUBLICATION—ISO documents are available from American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036, Phone 212-642-4900, www.ansi.org

The document listed as follows is currently a working draft of ISO TC33/SC 3/WG 1, Secretariat: FAKRA. When contacting ANSI regarding this publication, refer to document number N100.

ISO/WD 14229-1.6, (2001-02-22), Road vehicles – Diagnostic systems – Part 1: Diagnostic services

- 2.1.6 WEB SITES—www.bluetooth.com – for white papers, look under “Technical info” Bluetooth specifications are available from this web site, as well as background and general information about Bluetooth.

NOTE— Work is currently underway by the Automotive Experts Group (AEG) of the Bluetooth SIG to investigate applications of Bluetooth for the vehicle. For more information contact the web site listed previously.

Information regarding membership, as well as the necessary documents for early adopter/associate membership applications, are available by sending an e-mail to: bluetooth@opengroup.org, or by contacting:

Bluetooth SIG
C/O The Open Group
Apex Plaza, Foxbury Road
Reading, Berkshire RG1 1AX
U. K.

www.motorola.com/bluetooth – Motorola is a Bluetooth promoter company.

3. Definitions

- 3.1 **Active Slaves**—A given multiple number of slaves (up to 7) that are capable of communicating with a Bluetooth master.
- 3.2 **Bluetooth Master**—A given master that is uniquely addressed and capable of communicating with a multiple number (up to 7) of active slaves.
- 3.3 **Connected State**—The state where devices can exchange data under the control of the master.
- 3.4 **Inquiry Operation**—A given device obtains information about the identity of other devices in its vicinity; these other devices must be in an inquiry scan state to listen for and subsequently respond to inquiries.
- 3.5 **Inquiry Scan State**—A given device is in the condition to listen and respond to a page.
- 3.6 **Parked Slaves**—A given multiple number of slaves (up to 255) that are directly addressed to communicate with a Bluetooth master, but are inactive at this point in time.
- 3.7 **Page State**—A given device explicitly invites another device to join a network whose master is the inviting device; the other device must be in the condition to listen for and subsequently respond.

- 3.8 Piconet²**—A network where a given master communicates with one or more slaves (up to 7 active slaves and up to 255 parked slaves are possible).
- 3.9 Scatternet**—A condition when two or more communicating networks overlap, at least partially, in time and space.
- 3.10 Standby State**—A given device is in the default operational condition, and typically idles only its native clock in this low-power mode.

4. Acronyms

BD_ADDR—Bluetooth Device Address
CRC—Cyclic Redundancy Check
CVSD—Continuous Variable Slope Delta Modulation
FEC—Forward Error Correction
FHS—Frequency Hopping Sequence
FHSS—Frequency Hopping Spread Spectrum
GFSK—Gaussian shaped binary Frequency Shift Keying
IP—Internet Protocol
ISM—Industrial Scientific Medicine
OBEX—Object Exchange Protocol
RFCOMM—Serial Cable Emulation Protocol
TCP—Transmission Control Protocol
TCS—Telephony Control Specification - Binary
TDD—Time Division Duplex
UDP—User Datagram Protocol
WAE—Wireless Application Environment
WAP—Wireless Application Protocol

- 5. Functional Operation**—Bluetooth is a short-range radio link intended to replace the cable(s) connecting portable and/or fixed electronic devices. Key features are robustness, low power, and low cost. [1]

The Bluetooth system consists of a radio unit, a link control unit, and a support unit for link management and host terminal interface functions (see Figure 1). The Bluetooth link controller carries out the baseband protocols and other asynchronous low-level link routines.

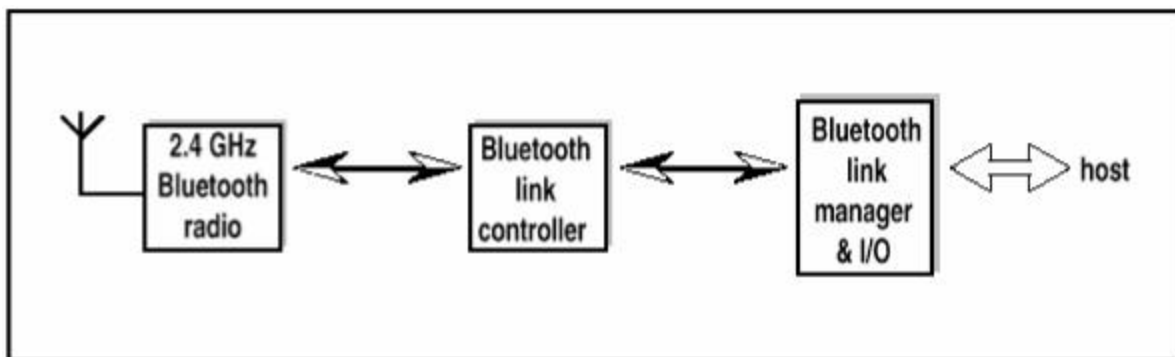


FIGURE 1—BLUETOOTH FUNCTIONAL DIAGRAM [1]

2. Trademark of Ericsson