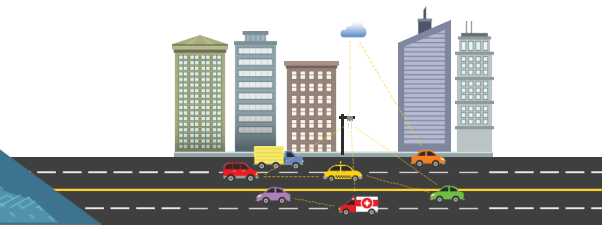
REDPINE SIGNALS®
DRIVING WIRELESS CONVERGENCE®

WaveCombo™



WaveCombo™ Solutions

Overview

WaveCombo in an integrated, multi-protocol wireless solution with ultra- low power and a low cost designed to drive the emergence of the connected car. It combines 802.11p. 802.11abgn, Bluetooth 4.0 Dual mode (classic and low energy) and 802.15.4/ZigBee into a single solution. It enables dedicated short-range communications (DSRC) as well as non-DSRC applications while also featuring low power consumption ideal for use in bicycles, helmets, smart phones, and any such non-vehicular applications for rider as well as pedestrian safety.

WaveCombo is a complete end to end V2X solution including the following:

- Chipset with 802.11p, 802.11abgn, Bluetooth 4.0 Dual Mode, 802.15.4
- Integrated module with all front end components and power amplifier
- IEEE 1609 Stack, ETSI ITS-G5 Stack*
- On-Board Unit* (OBU) for test deployments
- Road Side Unit* (RSU) for test deployments
- Software Development Kit for developing DSRC and non-DSRC applications (sample applications are provided with the kit)

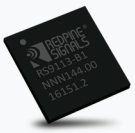
WaveCombo's unique wireless technology integration enables several applications and usage models such as emergency vehicle approaching warning (using 802.11p and BT), roadside alert (using 802.11p and BT), smart cone for worker safety (using 802.11p and 802.15.4) and passenger hot spot (802.11p in motion and 802.11n when parked) without the need for adding additional wireless modules.

WaveCombo Chipset and Module

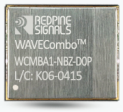
WaveCombo chipset (WCMBA1) provides a unique combination of 802.11p, 802.11abgn, Bluetooth 4.0 dual mode and 802.15.4 which reduces the time to market and cost of connected car applications. It also includes an embedded processor with rich set of peripherals offering minimal load on the host processor. Redpine also offers a module, WCMBA1-NBZ-D0P based on this chipset. The module includes the MAC Layer, PHY Layer, 2.4/5 GHz RF transceiver and a power amplifier. It can be used in either 802.11p mode or 802.11n/Bluetooth/802.15.4 mode with an application layer switching between the two modes. The module has a compact form factor (20mm x 23.9mm) and enables form-factor constrained applications. It can be used for Road Side Unit (RSU) as well On Board Unit (OBU).

Here are some salient features of the module:

- Operates in 802.11p or 802.11abgn/Bluetooth/802.15.4 modes of operation
- Supports SDIO and USB host interfaces
- Supports two antennae for antenna diversity
- Provides < 1ms switching time between Control Channels (CCH) and Service Channels (SCH)
- Configured to be used in RSU or OBU
- Output power of +23 dBm (+/-1 dBm) at 64 QAM with Class C Mask



WaveCombo Chip



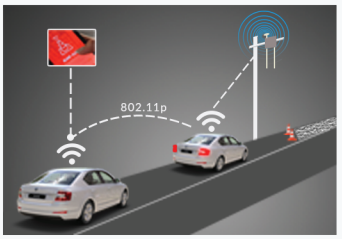
WaveCombo Module

IEEE 1609 Stack

OBU (On Board Unit)

RSU (Road Side Unit)

Emergency Electronic Brake Lights (802.11p + Bluetooth)



Road Side Alert (802.11p +Bluetooth)

Simultaneous Wi-Fi Acess Point and Client

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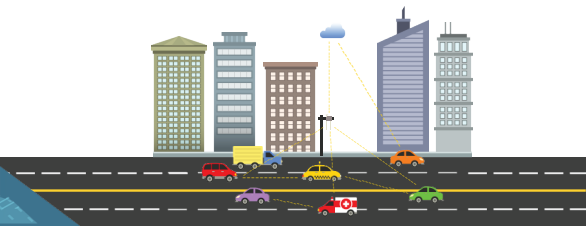


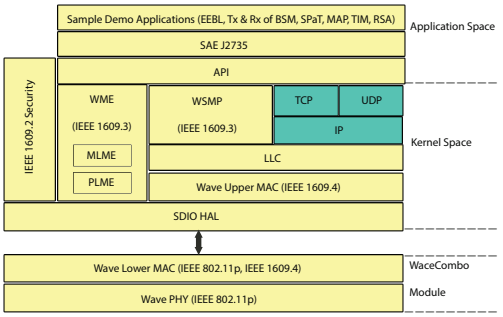
WaveCombo™ Solutions

IEEE 1609 Stack

Redpine provides a complete IEEE 1609.x stack to work with its WaveCombo chipset and module. It is provided in binary format along with APIs as part of the Software Development Kit. Source code can be licensed separately from Redpine.

Here are some salient features of the module:

- Supports IEEE 1609.2 2013/ IEEE 1609.2 2016, IEEE 1609.3 2010/IEEE 1609.3 2014 and IEEE 1609.4 2010/IEEE 1609.4 2014.
- Supports the following SAE J2735 messages: BSM, TIM, Map, SPaT, RSA (other messages to be supported in future)
- Sample applications for all the supported SAE J2735 messages
- Sample end-to-end applications for Emergency Electronic Brake Light (EEBL) and Road Side Alert (RSA)
- Comes with complete Linux image, stack binary and the necessary APIs for developing applications



WaveCombo Software Development Kit (SDK)

WaveCombo Software Development Kit (SDK) enables users to develop dedicated short range communications (DSRC) applications along with non-DSRC applications based on integrated 802.11p, 802.11abgn, Bluetooth Classic, Bluetooth Low Energy and 802.15.4/ZigBee.

This SDK contains all the necessary software and hardware needed for hardware evaluation and development of applications. The kit contains a Freescale i.MX6 processor, WaveCombo module, GPS receiver, dual band antennae with DSRC support, power supply adapters, embedded software (binarycode), WaveCombo software configuration management system, and device drivers.

Source code is available for licensing separately. Two sets of hardware boards are provided with the SDK to do a complete end to end development and testing.

The SDK can be used for the following activities:

- Evaluation of performance of the radio
- Execution of a set of pre-defined applications (such and Emergency Electronic Brake Lights and Road Side Alert) in field as well as laboratory
- Development of DSRC and non-DSRC applications based on 802.11p. 802.11n, Bluetooth, 802.15.4/ZigBee
- End-to-end testing of the applications (each of the boards can be configured as an OBU or RSU)

Here are some salient features of the SDK:

- Comes with all the necessary hardware, software and sample applications for developing the DSRC and non-DSRC applications
- Supports Ethernet with PoE, USB 20 OTH, USB 2.0 Host, HDMI, Serial Console, CAN, Digital I/Os, BroadR Reach automotive Ethernet*
- Supports GNSS (GPS, GLONASS, QZSS) with PPS for timing synchronization; <1m accuracy
- Supports Bluetooth for interfacing with Smart Phone and CAN bus
- Supports Control Channel (CCH) and Service Channel (SCH) Coordination; <1ms channel switching time between CCH and SCH; 50ms channel dwell time in CCH and SCH
- Supports IEEE 1609 stack, ETSI ITS-G5 stack*
- Supports Linux operating system (Automotive grade Linux, Android and QNX are planned in roadmap)
- Supports the following SAE J2735 messages: BSM, TIM, Map, SPaT, RSA
- Comes with the following sample applications:
  - TX and RX of supported SAE J2735 messages
  - Emergency Electronic Brake Light (EEBL) with Bluetooth message output (audio and data)
  - Road Side Alert (RSA) with Bluetooth message output (audio and data)

SDK Contents

- Two hardware boards which can configured as OBU as well as RSU
- Necessary antennae and power adaptors
- Linux based tool chain (with integrated drivers and stacks)
- IEEE 1609 API Library
- Wi-Fi API Library
- Bluetooth API Library
- 802.15.4/ZigBee API Library
- FlexCAN/J1939 API Library
- Sample Applications
- SDK User Guide
- SDK Quick Start Guide
- SAE J2735 ASN Library

*Under development, Please contact Redpine sales at sales@redpinesignals.com for further details.

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