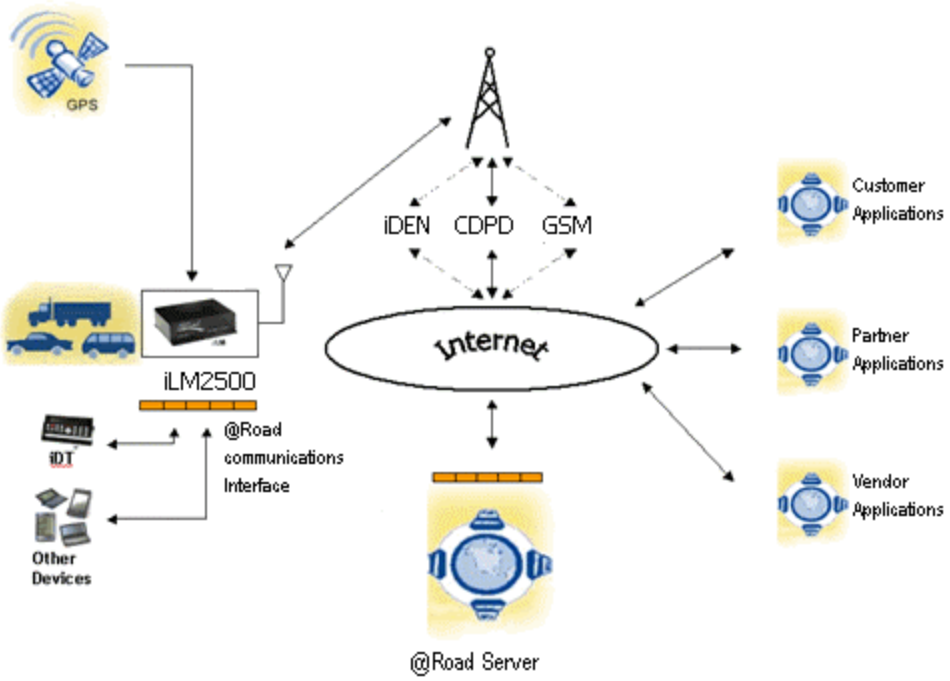
*i*LM 2500 Operational Description

The *i*LM 2500 Internet Location Modem combines GPS with a wireless data modem to provide vehicle location specific information. The intended use is to monitor location, speed and travel direction of vehicles. It is also designed to monitor PTO and activity based events such as ignition status, door open/close and tow lifts. It provides a serial interface for computers and peripheral devices like a printer, smart card reader, bar code scanner and temperature sensor.

Automatic Vehicle Location (AVL) System Diagram



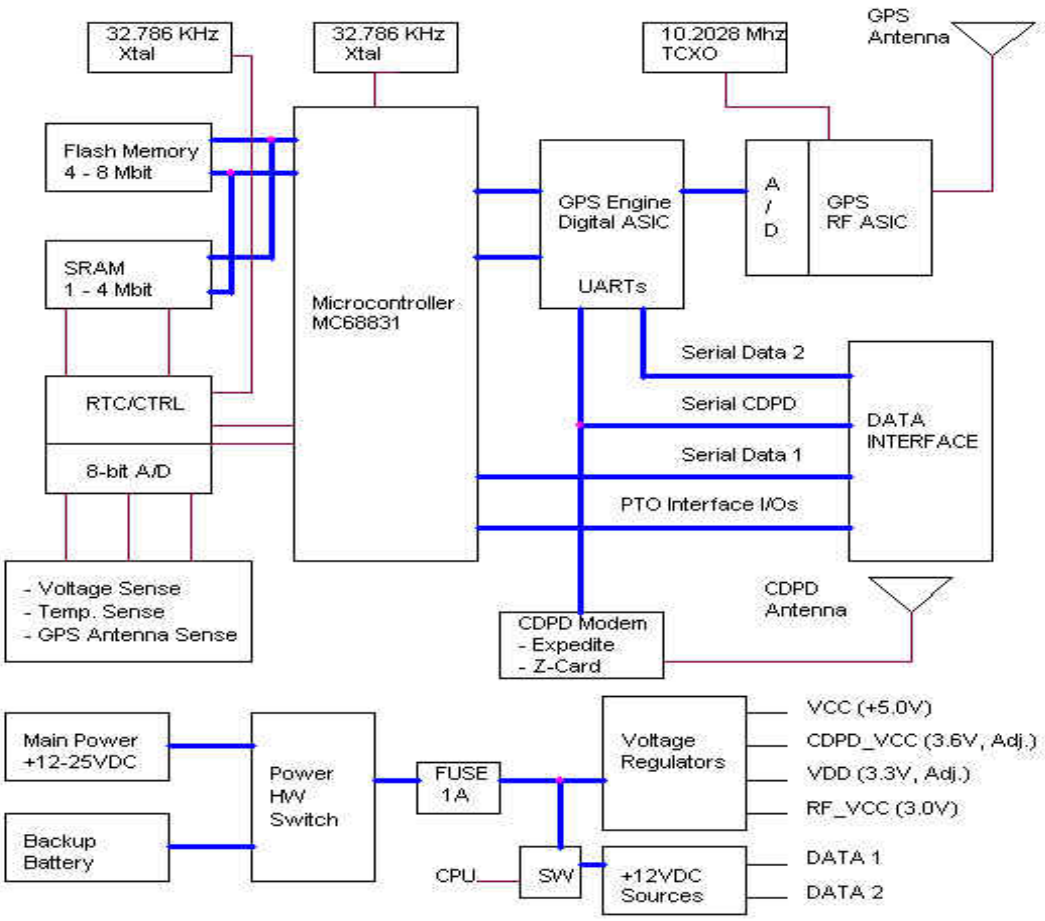
System Description

The iLM2500 has a GPS receiver, which receives location specific information from satellites. The GPS engine translates the receiving signal into data information and passes it on to the CPU. The CPU computes vehicle location, based on the information received. The location data is sent to the Rover Server/Database over the CDPD network. The information is retrieved via the Internet. The data is updated at intervals defined by the user.

Hardware Description

The Main components used in iLM2500 design include Motorola's MC68331 processor, Flash, SRAM, Vista™ chip set from @Road, RTC/System Controller, and various different 3rd party CDPD OEM modules. Power to the system is drawn from a vehicles +12VDC source. A few voltage regulators use this source to generate power and supply it to different areas on the PCB. The iLM2500 has a backup battery feature. The backup battery kicks in automatically when the main power falls below operating voltage or is absent. The power supplied to external devices via Data Port 1 and Data Port 2 can be switched ON/OFF by the CPU. This was added to enhance power management.

System Architecture



CPU

Motorola's MC68331 processor is used as the main controller of the system. It runs at 16Mhz, which is generated from an external 32.768Khz crystal. The CPU interfaces with flash memory, SRAM, GPS Asic and other I/Os in the system. An internal watchdog timer is used to generate the system reset.

Flash Memory

Flash ROM is used to store all the firmware and other information such as manufactures ID, user code, and other permanent codes. The board layout can be configured to use 4Mbit or 8Mbit Flash.

Flash Memory contains the following key components:

1. Boot block (OTAP capable in 96 and above firmware version)
2. Configuration data (IP addresses, device ID etc.)
3. GPS lookup tables.
4. Main program executable.

SRAM

SRAM is used to store all volatile and non-volatile data including PVT (Position, Velocity, Time) points and retain the data through use of a small battery.

Vista™ GPS Chipset

An @Road proprietary chipset comprised of two chips, GPS Signal Processing ASIC (VGP-12) and RF ASIC (VRF-12).

GPS Signal Processing ASIC

VGP-12 is the GPS Digital ASIC that combines twelve satellite correlator channels with other GPS system control peripherals. VGP-12 is designed to work with L1-CA dual bit down converter RF ASIC chip, VRF-12 by @Road.

VGP-12 is designed to process up to 4 VRF-12 down converted signals for applications requiring multiple antenna connections. Concurrent processing of multiple antenna signals:

a) Delta phase measurements between down converted signals.
b) Independently down converted signal processing,
c) Cross strapping for redundancy.

VGP-12 contains six types of functional blocks: A CPU interface, GPS clock controller, GPS correlator channels with their common control logic, receiver magnitude gain control, 8-bit parallel port and two serial ports (UART).

The VGP-12 device is packaged in 100-pin PQFP and operates from 2.7 to 3.7 volt supply.

RF ASIC

VRF-12 has an integrated dual conversion front end for a Global Positioning System (GPS) receiver application. The input is L1 (1575.42 Mhz) GPS signal. Output is a down converted, band pass 2-bit quantized signal, ready for digital processing.

VRF-12 is a dual conversion super-heterodyne receiver featuring an on-chip low noise amplifier (LNA), an image-reject front end, voltage-controlled-oscillator (VCO) with on-chip resonator, phase lock loop (PLL) synthesizer, automatic gain control (AGC), reference oscillator, 2-bit A/D and power control.

VRF-12 device is packaged in 48-pin TQFP and operates from 2.7 to 3.7 volt supply.

CDPD Modem

The CDPD modem is used to transmit location specific information from the iLM2500 to @Road's Server. The data is sent over periodic intervals defined by users and governed by different cost plans. The CDPD modem interface is through the UART from the Digital ASIC, VGP-12. The supply power to the modem can be turned ON/OFF via CPU control.

RTC and System Controller

A DS1670E IC from Dallas Semiconductor is used for real time clock and NVRAM control, including automatic battery backup. It also has three A/D inputs. The CPU uses an 8-bit A/D Converter to monitor supply voltage, temperature and GPS antenna.

External Interfaces

There are two external interface connectors available. One 26 pin for data and one 16 pin for power and high current I/O interface. The supported interfaces are Data Port1, Data Port2, PTO I/Os, Relay Drivers, Nextel Modem, and power I/Os. There are also two RF connectors for GPS and CDPD Modem antennas.

Data Port1

Data Port1 is solely used for the iDT, manufacturing, configuring, and debugging.

Data Port2

Data Port2 can be treated as the auxiliary data port. It interfaces with external devices such as a temperature sensor, smart card reader, printer, barcode scanner and magnetic stripe reader.

PTO I/Os
These I/Os allow a customer to monitor up to 4 contact-based switch events. The iLM can be programmed to transmit additional points when a switch transition occurs. Each time a switch transition, ON→OFF or OFF→ON occurs, an update is transmitted to the server.

Relay Drivers
There are two +12VDC relay drivers that can be used to turn ON/OFF the external relays.

Nextel Modem
Allows the user to interface an iLM2500 with an iDEN700 Nextel phone. The phone is data capable for communicating with the network server.

RF Connector
An SMA jack used for GPS antenna connection.

Power I/Os
+12VDC from the vehicle is the main input power source to the iLM2500. Another alternate source is the backup battery. With the backup battery installed, the iLM will continue to operate if main power is absent or the voltage level falls below +12VDC. The iLM uses the input power to provide two +12VDC supply lines. These supply lines provide power to external devices via RJ45 connector Data1 and Data 2. These lines can be switched ON/OFF by the CPU.

Power Consumption

Table 1: iLM2500 Current consumption in mA @ VDD = 3.3V

Mode of operation	Normal (MAX)	Standby
CPU	75	3
Digital ASIC	110	30
RF ASIC	43	4
Flash memory	7	0.0005
SRAM memory	40	0.0005
Peripherals	~20	~15
Total	295	52

Over the Air Programming Function (OTAP)

This unique feature enables us to reprogram an iLM with new firmware, via CDPD modem. It is designed for maximum flexibility and minimum code development on the network side. This is achieved by using the standardized TFTP (Trivial File Transfer Protocol).

Specifications:

Dimensions:
5.0” x 3.5” x 0.8” (127mm x 89mm x 20mm) (LWD)

Weight:

0.72 pounds (270 grams)

Electrical:

Input Voltage: 10 to 24V DC

Input Current: 340mA at 12V DC

Voltage Spikes: Up to 30V DC for 0.1 second

Current Consumption:

Standby: <1mA at 12V DC

Operating: 310mA

Memory:

4MB Flash (System firmware and user programming), upgrade to 8MB

128KB RAM (System and user data), upgrade to 4MB

Environmental:

Operating Temperature: -4° to 140° F (-20° to 60° C)

Storage Temperature: -40° to 221° F (-40° to 105° C)

Humidity: 0 to 95% RH, non-condensing

Shock/Vibration/Mechanical: Tested per SAE J1455 Aug 94, ASTM D-3580,

ASTM D-4728-95, ASTM D-5176

ESD: 4kv contact, 8kv air

Connectors and I/O:

Data Port 1, utilized by *i*DT only

Data Port 2, serial data port for external devices such as temperature sensor

PTO I/O, two ground sense and two +12V sense, interface for up to 4 contact-based switch events

External Modem, interface to iDEN700, Nextel phone

RF Connectors

SMA jack, GPS antenna

LED Indicators

GPS – Solid when operating normally, blinking when initializing

COMM – Solid when operating normally, blinking indicates antenna, coverage or connection issue

DATA – Solid when data is waiting to be transmitted, off when no data is in the buffer

ACTIVE – Blinking when operating normally, solid when insufficient power to *i*LM