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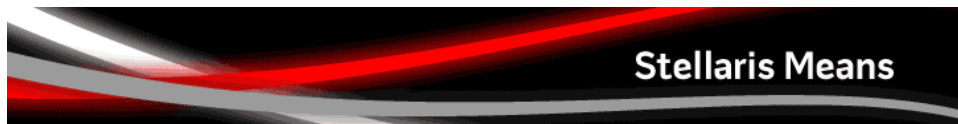
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The challenges of GPS in telematics

By Hans Wiedemann

People expect nothing less than precise locations from more and more modern positioning applications. Whereas just 15 years ago the first navigation systems were a special feature of premium-class vehicles, nowadays everyone is familiar with practical portable navigation devices. A luxury item has become a commodity.

What's more, the GPS has made inroads into many recreational applications, including devices for everything from mountain bikes to digital cameras and mobile phones. Certainly the most common commercial application is telematics, and the market is growing fast. Ten years ago truck dispatching was the main application, and SMS was the preferred means of communication. Today more data can be sent far faster and at much lower cost via GPRS, and the number of applications has clearly increased.

More and more systems providers are offering solutions that do anything from simply locating stolen vehicles to supporting insurance applications and providing sophisticated diagnostic data. It would appear that the GPS has advanced to the point where it can readily be used everywhere. However, the devil is in the details, and some remaining challenges merit consideration. This article discusses those challenges arising in telematics applications.

The term telematics is generally taken to mean the linking of information and telecommunication. In vehicles, this technology is used in combination with the GPS "that is, the system providing information on location, speed, direction, and time. The added requirements determine how complex a box will be. Is it a matter of reading outputs or setting inputs? Is it necessary to access vehicle information (frequently via CANbus)? Are there interfaces to other sensors? Is there a need to display information? Does it require driver interaction? Telematics applications are also making branching out into other fields, for example, personal and asset tracking applications that trace and find people and goods. All these systems have two characteristics in common: They come with a GSM/GPRS unit (and often also CDMA, rarely a satellite communication unit, and sometimes both) and are GPS-enabled.

Once a manufacturer of such telematics boxes has made the buy-or-build decision, he has to determine whether to use a GPS chipset or a module for his proprietary design. It takes quite a few unit numbers "250,000 is the typical figure" for a chipset to pay off. Using a module, in turn, entails investing considerable effort.

After all, it takes special components to provide optimum support for the chipset - first and foremost, a precision temperature-compensated crystal oscillator (TCXO). And it requires an LNA (low noise amplifier), a SAW filter (a band-pass filter with a narrow bandwidth) and an exceedingly clean voltage supply. The attendant clock quartz is a somewhat simpler matter.

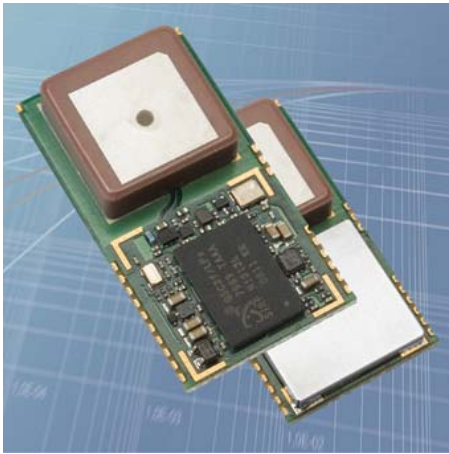
All these components must be precision-tuned to match the chipset and connected using a well-designed PCB track. Of course, chipset manufacturers devote most of their design support to applications with high unit numbers. This allows a module manufacturer to get the best performance from the chipset and enable fastest integration into a telematics box. In the simplest-case scenario, the effort is limited to providing power, a serial interface, and of course a clean antenna connection.

And there are other obvious advantages to using a module: While the manufacturer has to buy just one component when opting for a module, a proprietary design requires contacting, negotiating, and nurturing a relationship with a specialized manufacturer or distributor. Furthermore, using a module shortens the design cycle for the overall product so it can go into production that much sooner.

Another issue is the antenna and a tidy antenna connection. One should always bear in mind that signals sent out by the GPS are very weak "they actually "hide" among the natural background noise. The better the antenna (that is, the higher the signal amplification), the lower the noise figure, and the better the link connecting the antenna and GPS module, the better the GPS receiver's performance will be. Or, in other words, there is no way of regaining the loss caused by an inferior antenna or sub-standard antenna-to-satellite alignment.

Of course, today's receivers are extremely sensitive, but the installation site (e.g. in the vehicle's interior) and the vehicle's whereabouts (e.g. in a multi-storey car park) may weaken signals. Factor in a poor antenna and a bad connection and even the most sensitive receiver may be unable to determine any position at all.

Often the issue is whether to use passive or active antennas, the latter usually being equipped with a SAW filter and an LNA. First it is necessary to determine what type of antennas the receiver is designed for. An external active antenna's cable dampens signals. A typical attenuation value is 1 dB per meter, so three meters of cable halve the signal level. It is best to avoid using plug-in connectors, or to ensure they match



Vincotech A1035-H GPS antenna module built around the SiRF GSC3 chip set with a sensitivity of -159dBm and power consumption down to 86mW .

the GPS frequency (1575 MHz). Datasheets usually provide valuable info on this. Also, the actual signal circuit's impedance should be 50 ohms. The cable ought to be straight and as short as possible.

There are three very important things to watch for when using internal - and usually passive - antennas: the antenna must be tuned to its surroundings, requires a matching ground plane, and its environment should be free of potential sources of interference. In view of the growing demand for ever more compact telematics boxes, the latter two points are often difficult to realize.

Also, to select the best possible antenna position, it is important to know upfront where the box will be installed. This begs the question whether or not this position will always remain the same. Different mounting locations can influence the choice of antenna type. If the installation position is unknown, the antenna must be able to receive signals from all directions - so an omnidirectional solution is the only option.

Low power consumption is an increasingly important consideration for a telematics box. Big truck batteries provided a steady supply of power for early applications, even when the ignition was off. Today's vehicles, however, are equipped with so many electricity consuming devices that lowest consumption is a top priority. This demand is even more pressing for applications with their own power supply, preferably a small and light battery.

So, another criterion for selecting a module is that it consumes the lowest possible power (currently, standard values for tracking satellites are around 20mA). Many modules support power saving modes. They may be triggered via software commands. In some cases, it takes an additional hardware signal to wake the receiver up again. (An example of this is push-to-fix, where the receiver runs autonomously on the lowest possible power. It is briefly activated by a hardware signal only when it has to calculate a position).

Another aspect to consider is the receiver's sensitivity when pinpointing an initial position. The stronger the signals, the easier it is for the receiver to find a location (see the preceding paragraph). It can then quickly calculate a position and be switched off again. The receiver needs a description of satellite orbits called ephemerides to figure out the position. Reception takes 18 seconds under optimum conditions with a good signal level; 27 seconds are typical. If the receiver is switched off for a while, these ephemerides must be reloaded because their data are already outdated. This will take the typical 27 seconds; in certain circumstances weak signals may even prevent their decryption altogether. This means the receiver stays on longer and consumes more power.

Extended ephemeris data can solve this problem. They can be loaded from a server into the telematics box and fed into the receiver, where they remain valid for several days. This is a major stride towards further power savings.

Future chipsets are sure to bring further improvements in sensitivity and power consumption. Extended ephemeris will become commonplace, either delivered from an external server or calculated in the actual chipset. Another trend is to continuously track at least one satellite, with lowest power consumption. This means the receiver spends less time awake and can sooner be sent back to sleep.

A previously neglected aspect is the jamming of GPS signals; that is, interference caused by sending a signal in the same frequency range. For safety reasons, engineers are seeking and are likely to find new solutions that address this problem for many telematics applications. Vincotech's modules will incorporate these advances, thereby making them much easier to integrate into new solutions and improving their performance.

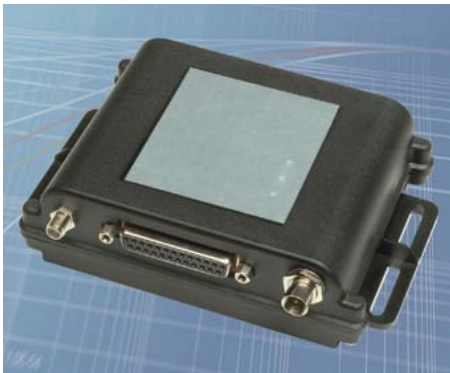
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The A1084 modules of SiRFstarIII-based GPS receivers which supports both passive and active antennas.



The EV1084 GPS receiver evaluation module.



The A1074 telematics platform includes a SiRFstarIII GPS receiver, a quad band GSM/GPRS modem and an ARM microcontroller.



The EV1070-A telematics evaluation platform.

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