Extended Ephemeris improve Position Calculation

Nowadays when people talk about navigation, telematics, and other applications such as digital cameras they often mention assisted GPS. There are several different approaches to this technology, the most important of which are briefly presented and discussed in this article.

Assisted GPS, or A-GPS for short, is a bid to satisfy many applications' demand for a faster way of obtaining a first fix on a position. The earliest application served to calculate the positions of mobile phones, for example, to provide location-based services (LBS) such as directions to the nearest service station, movie theater, restaurant, or hotel. To do this, users must first be able to fix their locations. Other examples are emergency situations where users are often unable to pinpoint their positions accurately or at all. Position-fixing on a cellular basis can be wildly inaccurate, particularly in rural areas where just one mobile phone mast may be tasked to cover an area 20 km wide. GPS receivers also consume considerable power. To calculate a position quickly, it was necessary to frequently switch such receivers on. What's more, receivers take a very long time to get a position fix under unfavorable conditions such as in urban canyons.

A GPS receiver attempting to fix a position needs ephemeris data. Satellites send these unique orbital data every 30 seconds, whereby the amount of data is of course limited. Because positioning applications require very accurate orbital data, these ephemerides are valid for four hours only before the time out, after which the receiver must download new data [Figure 1]. This download is imperceptible to users if the receiver remains up and running. Satellites provide new ephemeris data two hours before old data expire. If the receiver is switched off in the evening, ephemerides must be downloaded again first thing in the morning when the device is powered back up.

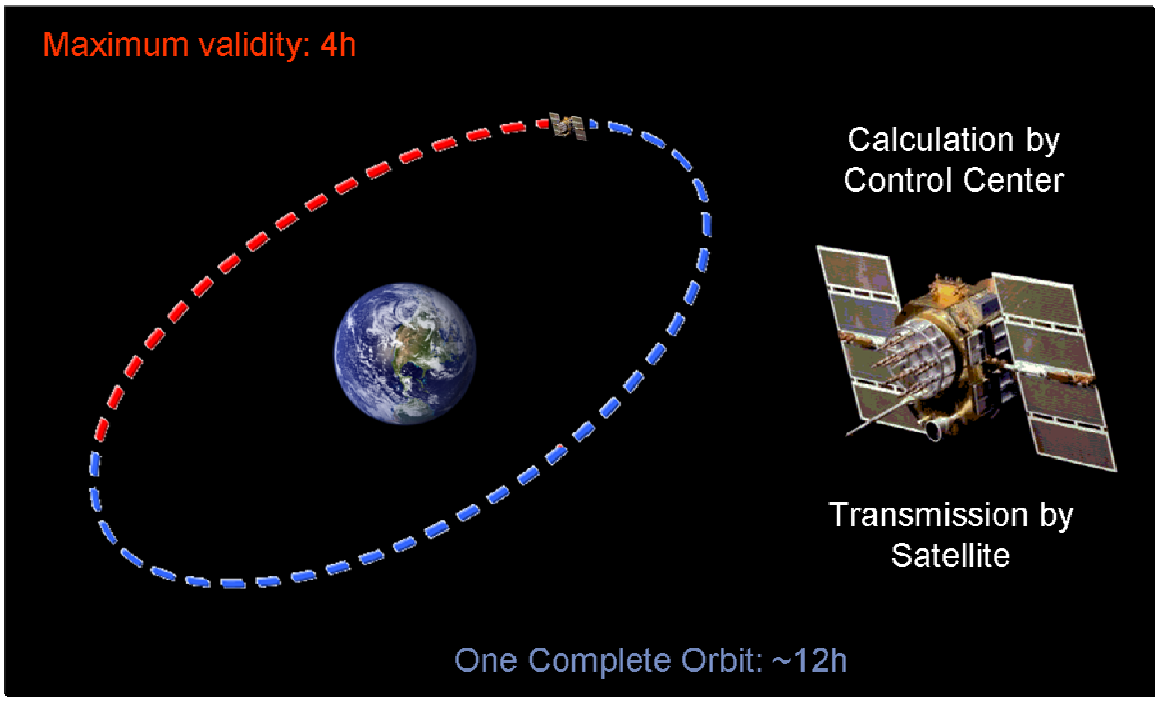

Figure 1: Ephemeris Data of a Satellite

There is another option for typical telematics applications such as fleet management, stolen vehicle recovery, and automotive diagnostics. It entails using a reference receiver that stays on

line and is always able to provide valid ephemerides, though these are sent by means other than the satellite link. Typically, they are transmitted to the telematics unit via GPRS and then loaded to the GPS receiver. The benefits of this method are that it is a little faster - data transfer takes just a few seconds rather than the 30 for the download – and the receiver is more sensitive. While decoding requires a signal-to-noise ratio of 28dB/Hz, a receiver that already has ephemerides can process much weaker signals to fix a position. Ephemeris data's limited shelf life remains an issue. These are real ephemerides, so renewed downloading is necessary every four hours at the latest. But an activated unit draws current, which contradicts another common requirement – that these devices consume as little power as possible.

Another approach is to address the problem of ephemeris data's limited validity. The aforementioned problems concerning satellite's orbital fluctuations and the narrow bandwidth available for data transfer can be solved by using more precise models and alternative transmission methods. Given these models and enough computing power, it is possible to calculate ephemeris data several days in advance, thereby obtaining extended ephemeris data. [Figure 2]

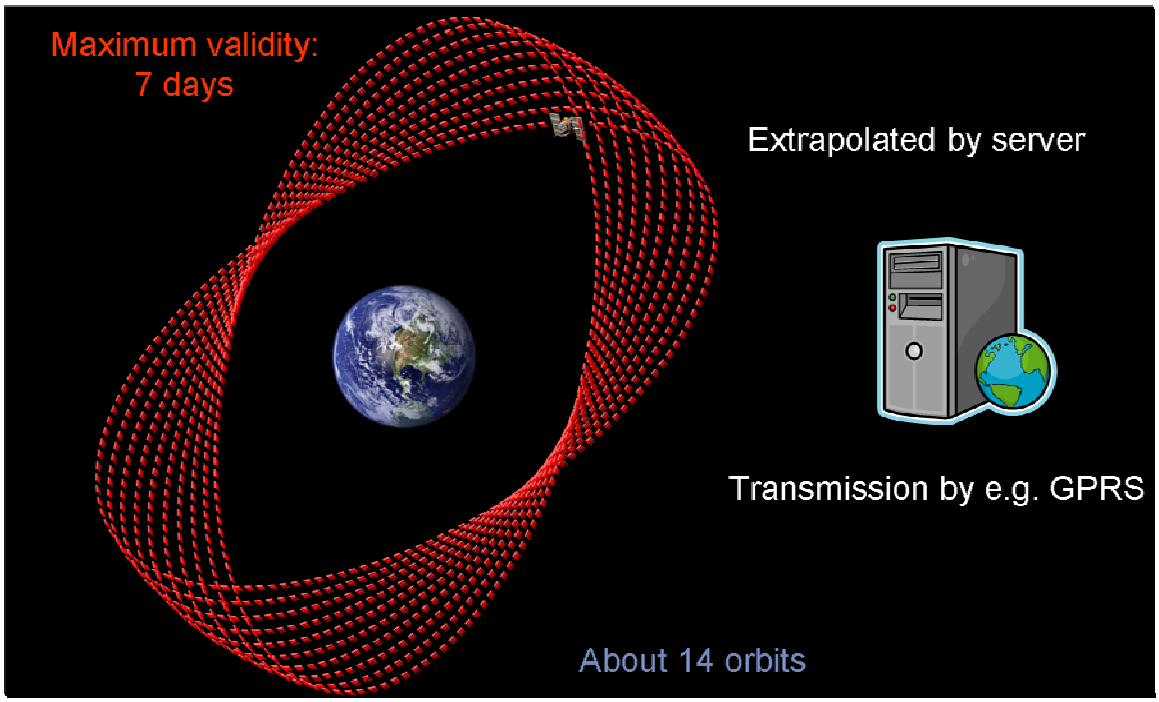

Figure 2: Extended Ephemeris Data of a Satellite

The alternative transmission path discussed above can serve to send a file containing extended ephemeris data to the telematics unit. These data are stored there, and a simple command sequence forwards it to the actual GPS module. The receiver now has several days' worth of ephemeris data for reference. As soon as it is awakened and has detected satellites, it is immediately ready to begin calculating its position. A download is no longer necessary, thereby saving time and conserving power. The GSM modem, which otherwise had to be switched on to obtain up-to-date ephemeris for every transmission, can remain off until it is actually needed. This puts another new twist on A-GPS.

Other applications beyond telematics are sure to benefit from the advantages of extended ephemeris data. And A-GPS will continue to evolve. Powerful processors in special navigation modules are already able to calculate extended ephemeris data on their own. This is a big help,

for example, on the way to work every morning. On the downside, they can only calculate those ephemerides that actually have available. And six hours later, the satellite constellation has changed markedly. Also, power consumption is not such a big issue for navigation in connection with motor vehicles.

As of this fall, Vincotech's customers will be able to use extended ephemeris for the services they provide. And an important aspect of this is that the current GPS A1084-A/B modules as well as the latest GPS A1035-H antenna module will be supported. Data may be downloaded once daily from the Vincotech server. [Figure 3]

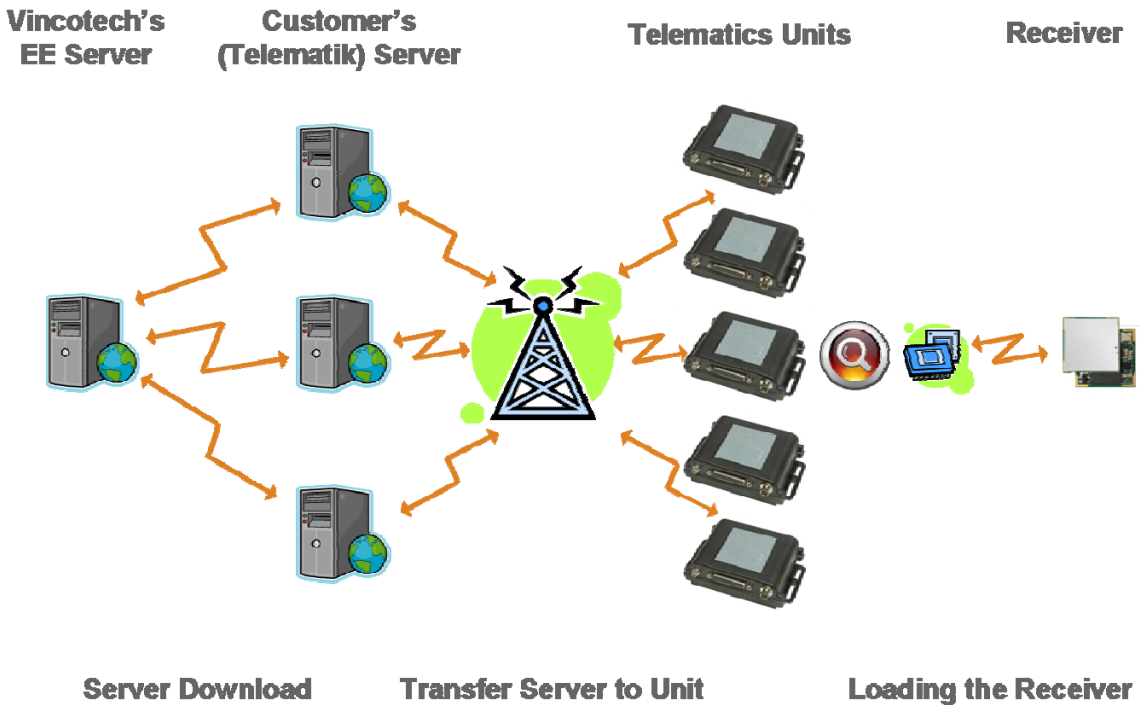

Figure 3: The Path of Extended Ephemeris Data

Author: Hans Wiedemann, Vincotech GmbH

www.vincotech.com