Indoors

Knowing where one is inside an office, shopping centre or other giant building, and how to get to where one wants to be, is key for fire fighters, medical personnel and other rescuers in a crisis situation. When a building is on fire rescuers don't have time to study floor plans by entrance or elevators, and the receptionist will have fled to save her own life. Mobile GIS handhelds, equipped with GNSS, might provide a solution. However, on entering a building a GNSS receiver will fail to maintain tracking position. It is not the wavelength that foils GNSS signal take-up, but signal strength, which is too weak to pass through concrete or canopy. The power of a GPS signal falls from 27W leaving the satellite 20,200km above the Earth, to 100 billionth, billionth of a Watt on arrival at Earth surface. Indoor attenuation is a factor of 100 to 1,000 compared to outdoors.

GPS signal wavelengths are L1: 19cm; L2: 24.5 cm and L5: 25.5cm; those of Galileo are similar, while Glonass L1 and L2 bands are comparable to GPS L1 and L2. Were their strength high, such microwave signals could easily pass glass and walls. Two obvious remedies: the first, design more sensitive receivers, which manufacturers are doing, but indoor positioning is not always guaranteed and thus not 100% reliable. Another cure is to augment the energy level of outgoing signal; one main difference between GPS and coming Galileo is that the power of the latter will be greater by a factor of two. Another solution is to mount pseudolites, which transmit GNSS-like signals, on walls and ceilings, but their coverage is limited to a specific building, so no overarching solution for an entire modern city.

When, way back in the '90s, mobile phones became ubiquitous, many people thought they were in direct contact with a satellite. Now we all know that signals are transmitted via ground-based stations. Global Systems for Mobile Communication (GSM) signal wavelength varies from around one metre to 20cm, and such strong signals can easily pass through glass and concrete. Early '90s telecom providers were locked in aggressive competition and rushed to mount base-stations on towers and high-rise buildings to guarantee their market position. They focused on telephony, not on positioning. But their base-stations network also serves precise positioning.

The infrastructure and technology are in place. To supplement satellite positioning with ground based position is a matter of the willingness of telecom providers to let their networks talk to each other, so that people know where they are indoors.