INTERCAI MONDIALE

The Future of Mobile Satellite Services

Offering global telephony services, Mobile Satellite Systems seem to fulfil the dream of "communications anywhere". With global coverage, even the most remote areas of the earth are within voice and internet range – business can be conducted where the customer is, or where the businessman chooses to work. So have the dreams been fulfilled or will they turn to nightmares through the enormous capital expenditure and the inflexibility of the laws of physics?

Introduction

The ultimate goal of mobile service operators, or perhaps the ultimate requirement of their customers, is "any type of communication, anywhere". By anywhere, they mean, of course, anywhere on Earth, moving or stationary, outside or inside buildings.

Since the early 1980s there has been a growing community of people who have partially achieved this aim. Analogue cellular offered countrywide voice services. Digital cellular (GSM and later the American initiative – CDMA) at the start of the nineties provided the same service to more people, offered a simple data service, and introduced international compatibility. Third generation cellular should bring us extended international compatibility, and wide enough data bandwidth to see us through the first decade of the new millennium.

The global reach that these land based services offer, however, is limited for cost reasons to areas where substantial traffic is likely to be generated. They do not provide coverage even into the more remote parts of small countries like the UK, let alone the wide open areas of uninhabited land which make up a large percentage of the world land mass. While there is less demand for voice and data communication in these places, a true *service* would not be constrained to high traffic areas but would provide communication wherever it was needed. The Mobile Satellite Systems (MSS) aim to do just that through blanket coverage provided by constellations of orbiting transceivers.

While the terrestrial cellular businesses around the world have been extraordinarily successful, and have almost always grown faster than even the most optimistic estimates, the case for MSS is much harder to make. The untapped demand for global, outdoor coverage is tiny in comparison with the need for urban mobile communications, and at the same time, the costs of implementation and maintenance are much higher when constellations of satellites are involved.

While MSS can offer unparalleled geographic coverage, can they compete with the established terrestrial systems in terms of services and cost?

Current MSS capabilities and shortcomings

MSS are designed to operate with handsets similar in size to terrestrial cellular handsets, offering voice and low rate data services. These are low and medium earth orbit (LEO and MEO) systems and do not include the geostationary systems, which require dish antennas, such as Inmarsat, Intelsat or any of the VSAT (Very

SYSTEM	SATELLITES	TYPE
Iridium	66 active, 5 spare	LEO Low Earth Orbit - (150-250 km)
ICO	10 active, 2 spare	MEO Medium Earth Orbit - (450-800 km)
GlobalStar	48 active	LEO

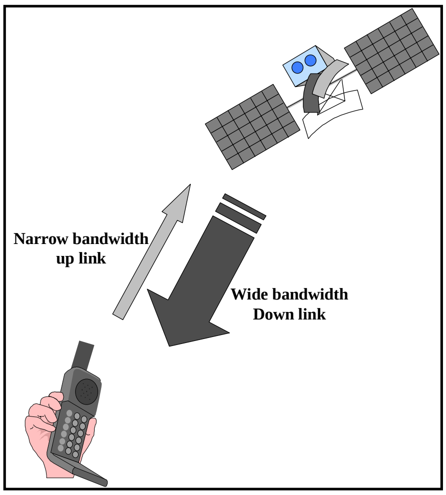
Small Aperture Terminal) systems. They also do not include the "Internet in the sky" data systems such as Teledesic or SkyBridge, which also require dishes. There are 3 commercial systems in, or nearing, operation. Iridium opened service in the last quarter of 1998 while ICO and Globalstar are expected to start service this year.

All the systems provide almost 100% global geographic coverage, but the services they offer today are somewhat less than terrestrial cellular:

- speech at a lower bit rate than digital cellular, potentially poorer quality especially in poor signal conditions
- data at 4.8kbps, half the rate of GSM which itself is considered far too slow for today's requirements (fixed wireline offers 33.6 to 56kbps depending upon the modem employed)
- direct satellite to handset communication is unavailable indoors: the antenna must be located with a clear line of sight to a fair proportion of the sky

In addition to this, satellite systems rely upon a very low power uplink, limiting the bandwidth that can be supported in this direction, despite having larger antennas than cellular handsets. The result will be that, as satellite systems improve functionality, it is likely that an uplink/downlink asymmetry will evolve.

This will permit the requesting and downloading of large files to an attached computer, or perhaps database contents for field workers. It would, however, preclude two-way video calls or the sending of video images from remote locations back to base which might otherwise be a useful application area.



Uplink limitations will affect MSS capability

These shortcomings do not affect all potential users to the same extent. In countries where expectations will be lower, e.g. third world countries with little or no fixed wire or cellular infrastructure, the immediate 100% coverage of a satellite based system, offers a massive improvement. It needn't be available only to the wealthy: community phones offer a whole village communication with the outside world, with installation costs subsidised by the operators, and call charges subsidised by the more far-sighted governments.

Business mobile users who travel extensively are likely to be interested in a system that offers communication coverage wherever they are, even if that communication is only speech and perhaps simple messaging, provided that they can get their usual services when closer to civilisation.

In other words "It's better than nothing."

Can MSS functionality be improved?

The main reason for the inherent low bandwidth of satellite communications is the distance between the terminal and the satellite (hundreds of kilometres) and the frequency of operation (around 2GHz). While it is possible to develop satellites with more powerful output amplifiers and possibly more sensitive receivers, the terminal will remain the weak link. Higher outputs from a handheld device will increase battery consumption and health risks, while better antenna efficiency, through such developments as electronically steerable beams (phased arrays), are still some years away.

MSS systems whose orbiting functionality is simple (i.e. so called "bent pipes"- which are just amplifiers in space with perhaps some signal shaping to lower the received bit error rate) are more likely to accommodate future developments. Evolution of the technology such as GPRS, the introduction of packet based services within GSM, could be added later because the functionality can be added in the ground based infrastructure without affecting the satellites. This would at least permit a moderate increase in bandwidth in both up and down links.

The basic problem of the line of sight requirement between the terminal and the satellite must be addressed. Perhaps the introduction of a separate antenna unit placed on a windowsill or somewhere with greater sky visibility, and a short-range radio link ("Blue Tooth" is a new standard that could provide this) to the terminal itself, would fulfil this role.

Even with these technology improvements however, a gap between terrestrial systems and satellite systems will still remain. It is unlikely in the foreseeable future that Mobile Satellite Systems will be able to offer functionality that can be considered comparable with terrestrial cellular.

Market size and commercial viability

There is a lack of published data relating to the potential market for satellite services, but it is important to put a stake in the ground to establish both the viability of the business, and provide a reference against which other factors and influences can be gauged.

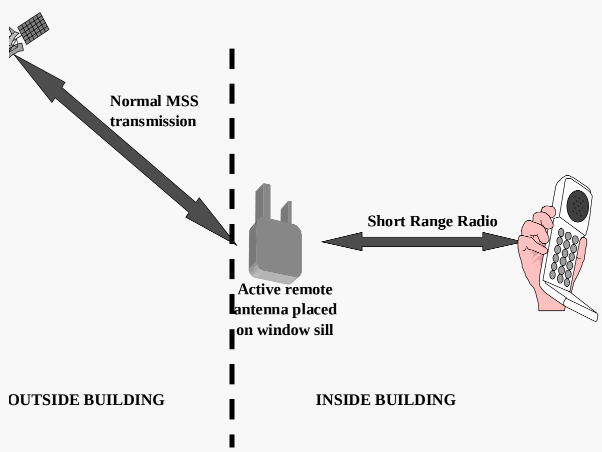
Several recent estimates have suggested that there are between 30 and 50 million potential MSS customers world wide (source: GlobalStar, ICO). Intercai analysis has shown that 30 million subscribers could generate a cumulative revenue of around $25bn in 10 years assuming a call charge not too dissimilar to cellular today and a $10 monthly standing charge. This would have to be shared amongst the operators and much of it would be used to maintain the networks, including replacing all the satellites at least once.

It is felt particularly important that call charges should fall to $1 a minute or less, as this is a serious psychological barrier, and that monthly standing charges should not be high relative to typical monthly call charges (this of course would be subject to bundling and other tariff considerations).

The analysis has not taken handset prices into

Overcoming the line of sight problem

One approach would be that the active antenna unit would normally form the top section of the handset (see diagram). For normal outdoor use, the handset would operate like any other cellular handset. When indoors however, the signal strength from a satellite is just too small (and the uplink signal is even more affected) so the active antenna would be unplugged from the top (activating the internal electronics) and placed in a location that has reasonable sky visibility. The detached unit would receive sufficient signal strength to interface with the satellite, while a second, short range, radio link would connect the unit to the main part of the handset. If the short range link were wireless (as opposed to infrared for example) then an in-building range of several tens of metres could easily be achieved. It should then be possible to operate in precisely the same way as when the handset is out of doors. A safety feature could be built in so that if the handset lost contact with the remote antenna it would alert the user. This would reduce the probability of leaving the building without reattaching the remote antenna.



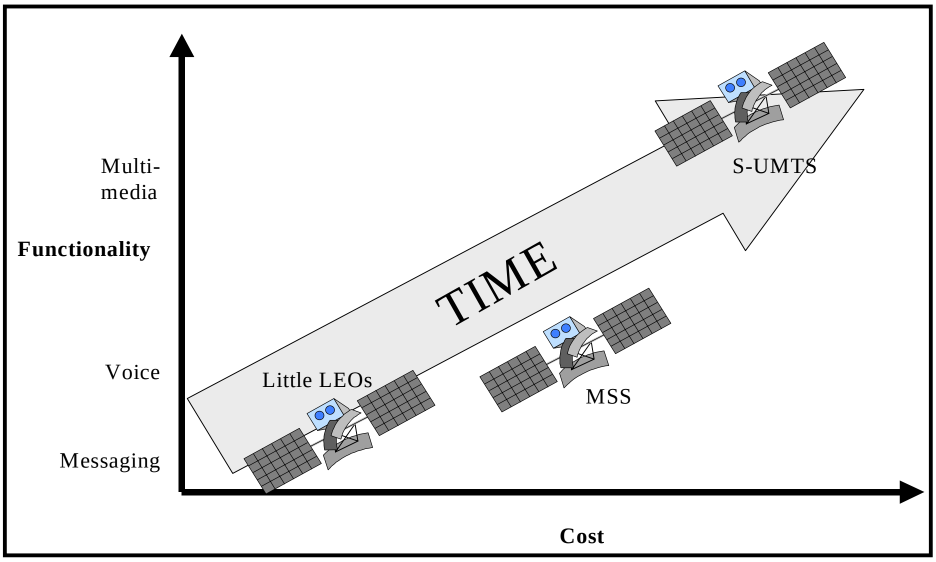
account. To stimulate demand the traditional approach would be to heavily subsidise the handset, and clearly at $1,000+ today, the price of handsets is a serious stumbling block. Subsidising the cost may improve customer ontake, but it would significantly increase the costs to the operators. The period in the business that subsidies are really needed is at the beginning and this is of course when handset prices are at their highest.

It is expected that volume efficiencies and the sharing of silicon with other technologies (such as GSM) will cause handset prices to fall over the next ten years to around $100 which will at this point not be a barrier to subscriber ontake. With the published figures for capital that has been raised to start-up the MSS businesses at around $3-4B each, it is clear that while one or two operators might succeed, it is unlikely that the market can support three.

Where does S-UMTS fit in to the picture?

UMTS is the next generation (3G) of cellular services, specified to deliver up to 2Mbps of packet based communications to an individual user, anywhere within the coverage of the network. It is a truly international standard and will form part of a global initiative providing 3G services anywhere on Earth.

S-UMTS (the satellite part of UMTS) is the next generation of MSS designed to complement T-UMTS (the terrestrial part of UMTS). S-UMTS will aim to provide speech and greater data bandwidth than existing MSS, combined with mobility, to fill more effectively the gap between the terrestrial based services around populated areas of the Earth, and everywhere else. The diagram below illustrates that although costs inevitably go up, the delivered functionality increases at a greater rate.



There are other players in the market to consider too. Little LEOs (systems of small constellation size Low Earth Orbit satellites) offer low data rate and messaging services, and Teledesic and SkyBridge offer wide bandwidth data geared towards Internet access, all further reducing the market size for data and voice (once Voice over IP becomes the norm). While this may provide a greater choice for the customer, it may prevent the rapid integration of satellite services and may even reduce the market size sufficiently to eliminate one of the MSS operators.

The shortcomings of the existing MSS and the reasons for these shortcomings will be, if anything, exaggerated in S-UMTS. The terrestrial systems will have extended the potential services available by a large degree, but the restricting laws of physics will apply equally to S-UMTS as they do today with MSS. There will therefore be a perceived widening of the gap between terrestrial system capabilities and the space borne equivalents.

Over the expected lifetime of UMTS and S-UMTS (probably 15 to 20 years), technological improvements and innovations will narrow the gap. However the market may still only support one operator if the costs and services do not match the terrestrial equivalents. With MSS only just coming on line, it will be some years before we see sufficient technological improvement to make S-UMTS viable.

Conclusions

The introduction of UMTS will change the structure of the industry. There is no “killer application” identified for the wide bandwidth system, as was voice for today's systems.

Intercai's analysis has suggested that the case for even one S-UMTS operator is difficult to make. It will be a platform investment with returns spread over many services with content becoming the important element and content providers the driving force behind the new services. This will change the balance of power in the industry.

We suggest, therefore, that a positive way forward would be to set up a collaborative arrangement involving operators and even governments who share the responsibility and expense of providing such a truly ubiquitous satellite service. This would be a network that all operators could use. Many would be partners in the venture, accessing the same network but doing their own location and mobility management - that means providing their own so-called "home location registers” (HLR's).

Other operators may be limited to making roaming arrangements with the partners. All operators would benefit because UMTS would be seen to be the universal service it set out to be. Furthermore costs to the customer would be lower (by virtue of only one constellation having to be implemented and maintained) and this should further increase demand.

It would seem that, despite the undoubted benefits that competition has brought about, there may remain some frontiers where international and commercial collaboration is the only effective way forward.

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