The Role of S-UMTS in Future 3G Markets

a report by
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Introduction

Traditionally, satellite communication has been dedicated to long-distance intercontinental connectivity for national telephone and television operators. Narrowband, very small aperture terminal (VSAT) applications emerged in the mid 1980s but remained a niche market due to the cost of transponder and size/cost of terminals. There were fewer than half a million VSAT terminals worldwide by the end of 2000, thus only addressing the needs of wide-area enterprise networks.[1] It was the emergence of the direct-to-home television broadcasting business that led satellite industry growth in the 1990s. Nevertheless, the expectations for increase in the number of television transponders in the short/mid-term are moderate. Undoubtedly, the new driving force is the Internet and the trend for personal communications.

Most of the satellites to be launched up to 2010 (Intermediate Circular Orbit (ICO), Inmarsat-B and Inmarsat Broadband Global Area Network (B-GAN), etc.) are targeting Internet applications.[2] For a considerable number of isolated areas, satellite is the only means of connecting local Internet service providers (ISPs) remotely to the Internet backbone. However, the satellite industry is not anticipating sustained growth in the number of ISP connections as there will be increased competition from terrestrial operators rapidly deploying high-capacity fibre-optic infrastructures. On the other hand, satellites can be used for applications with significant broad/multicast traffic requirements. This comes as a direct consequence of their coverage properties, i.e. increased broad/multicast efficiency and cost sharing between numerous simultaneous users.

Considering that broad/multicast multimedia services will play a fundamental role in upcoming 3G mobile systems,[3] satellite becomes a competitive solution for one-way access applications, for example Internet Protocol (IP) traffic delivery based on low-cost digital video broadcasting for satellite systems (DVB-S) terminals. In addition, the emergence of new technologies introducing two-way access schemes, for example the European Telecommunications Standards Institute (ETSI) return channel over satellite (DVB-RCS) standard based on the DVB-S air interface for the forward link and on a multi-frequency Time Division Multiple Access (MF-TDMA) scheme for the return link,[2] or one-way hybrid (satellite forward plus terrestrial return channel), makes such systems even more attractive.

Problem Statement

Terrestrial interest groups have claimed that the mobile satellite services (MSS) industry has major financial difficulties and that MSS operators will probably not be able to make effective use of MSS spectrum allocations. Examples include pressure to designate the 2.5GHz band for terrestrial UMTS™ (T-UMTS) and European Conference of Postal and Telecommunications Administrations' (CEPT's) recent constraining of the available L-band spectrum for broadcast satellite service (sound) BSS(S)/ satellite-digital audio broadcasting (DAB) services.[4] Such proposals pose a serious threat to the satellite industry and, although interest in MSS remains intense, it is becoming established more than ever that to justify investments in satellites, much more than technology availability is required.

The principal question traditionally posed for satellite

1. *J Blineau, M Castellanet, P Cheval and D Verhulst, "Satellite Contribution to the Internet",* Alcatel Telecomm/s Review, *4th Quarter, 2001, pp. 243–248.*
2. *Advanced Satellite Mobile Systems Task Force, "Satellite Mobile System Architectures", Report of the R&D Group, October 2002.*
3. *R Keller, T Lohmar, R Tonjes and J Thielecke, "Convergence of Cellular and Broadcast Networks from a Multi-radio Perspective",* IEEE Personal Communications, *Vol. 8, No. 2, April 2001, pp. 51–56.*
4. *E D'Andria and C Quaglione, "Regulatory Framework for Advanced Satellite Mobile Systems", Proceedings of the 5th IEEE European Workshop on Mobile/Personal Satcoms (EMPS 2002), Baveno-Stresa, Italy, 25–26 September 2002, pp. 19–26.*

systems is whether they should address a mass/consumer market or target specific limited size niche markets. The satellite-specific niche market is already served by players such as Inmarsat and Eutelsat, i.e. there is high competition for satellite UMTS (S-UMTS) in entering such a market (currently estimated at about 500,000 users) with established players. The 'failure' of Iridium and, more generally, experience with 2G Satellite Personal Communications Network (S-PCN) systems (Globalstar, ICO) proved that satellite systems cannot capture the predominant voice market and, furthermore, acquire a position in the mass market as stand-alone systems. Therefore, the role of satellites within 3G integrated with T-UMTS aiming at this market becomes critical.

Figure 1: Indirect Access – Collective Configuration (Remote Islands)

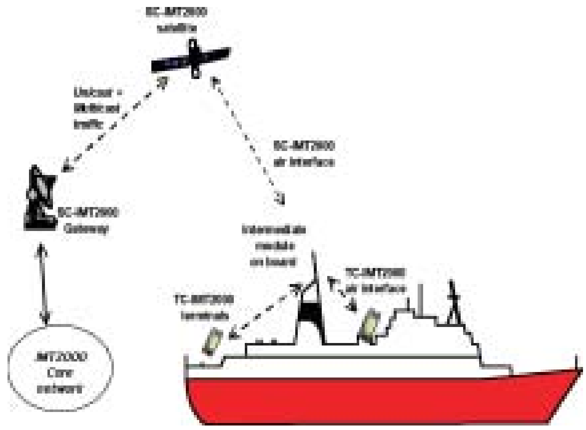
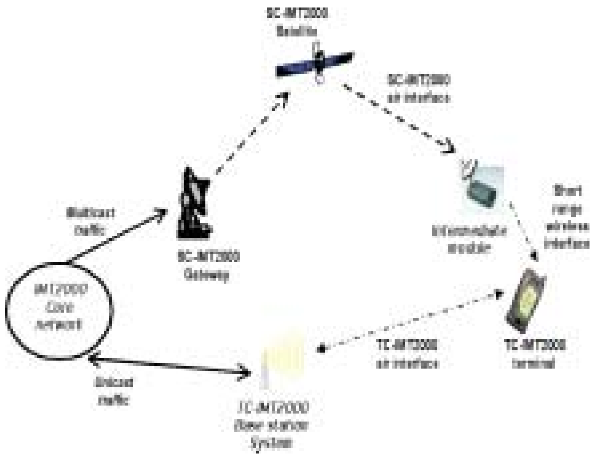


Figure 2: Indirect Access – Use of Intermediate Module Repeaters and Terrestrial Return Channel



S-UMTS/T-UMTS Service Integration and Delivery Scenarios

There are different levels and granularities of integration between T-UMTS and S-UMTS having a direct impact on the system and terminal cost. These include terminal, network and service-level interoperability. At the service level, and irrespective of network-level integration, the following two approaches are identified for S-UMTS.

- Geographical complement/early service proposition – in this approach, S-UMTS expands the reach of T-UMTS services in areas not covered adequately by T-UMTS. These include coverage extension (physically isolated regions), coverage completion (gaps in T-UMTS network coverage), disaster-proof availability (areas where telecoms permanently, or temporarily, collapse due to disaster or conflict), dynamic traffic management (absorption of excessive traffic while optimising the dimensioning of terrestrial infrastructure) and rapid service deployment in areas where there is no infrastructure yet to test the potential of an emerging market for new service propositions.

  During the transitory phase from 2G to 3G, satellites may offer day-one global roaming solutions, whereas T-UMTS is more likely to be deployed initially over limited 'islands' of coverage. Outside T-UMTS coverage, S-UMTS offers the same set of services as T-UMTS.

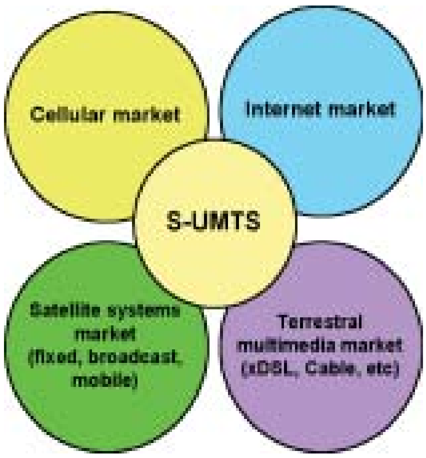
- Service complement/close co-operative approach – so far, the lack of inexpensive and efficient point-to-multipoint transfer mechanisms and the traffic costs of pure point-to-point solutions have restricted the wide use of mobile multimedia (MM) services. However, the increasing demand for such services is likely to favour the dominance of multi/broadcast services in the near future. Thus, the vision for S-UMTS is not to attempt to offer voice or interactive services, being less efficient compared with the terrestrial networks, but to focus on multi/broadcast, where it is inherently more cost-efficient.

  This approach implies a maximum level of integration and co-operation with T-UMTS, with potential advantages for the end-users enjoying innovative services at a low cost, as well as for operators of both satellite and terrestrial networks in terms of shared infrastructure investment.

The two approaches identified here may be further refined into service delivery scenarios based on the introduction of two differentiation factors:[5] direct (integrated terminal) versus indirect (distributed terminal) access to the satellite, and individual (e.g. vehicular) versus collective (e.g. 'remote' islands) access configurations. *Figure 1* (geographical complement-based) and *Figure 2* (service complement-based) depict two of the most appealing service paradigms.

5. *IST-2000-25030 SATIN Project, 'S-UMTS IP-Specific Service Requirements' Deliverable No. 2, April 2002.*

Figure 3: UMTS Market – The Macro Environment



Source: UMTS Forum

Overall, analysis has indicated that there is not a single configuration that can fulfil simultaneously all of the conditions securing the presence of S-UMTS in all (or most) of the environments with a real market potential. To promote chances for mass-market penetration and faster deployment of 3G services, S-UMTS should be based on an indirect configuration, allowing end-users to receive the promised services with any standard (single/multiple-mode T-UMTS) terminal of their choice, in both indoors and outdoors environments. On the other hand, direct configurations (based on dual-mode terminals with built-in satellite receivers and return link through terrestrial networks) seem better suited for penetrating the traditional (vertical) satellite communications markets.

A broadcast-oriented scenario allowing terminals to be operated indoors (via intermediate repeaters) is essential to address requirements from low mobility end-users of 2G+/3G services primarily interested in a cost-efficient alternative to wired access. This group of users seems to be key for mass-market penetration. On the other hand, a coverage-oriented scenario featuring a collective configuration is best placed to facilitate terrestrial fill-in and selective expansion of T-UMTS in rural areas or to gain the very important cruiser/ferry maritime and aeronautical market segment.

S-UMTS Addressable Market Assessment

Having defined the scope of integration at service level, as well as the different delivery options, the next step is to assess the anticipated markets for S-UMTS. These include:

- traditional niche market segments comprising maritime (merchant/fishing fleet, cruise/ferry market), land mobile (peace-keeping/aid organisations, government agencies, press and media, transportation and commercial vehicles, oil/gas/mining companies and other industries) and aviation (commercial aircraft) segments; and
- emerging market segments comprising small and medium-sized enterprise intranets and extranets (IP-based connectivity), 2/2.5/3G terrestrial extensions (mobile network users) and fixed/semi-fixed satellite users (terrestrial/satellite broadband users).

S-UMTS is therefore positioned as a potential player in a very wide market[6] (see *Figure 3*), addressing segments that are traditionally covered by terrestrial broadband systems like xDSL, cable or existing VSATs, or targeted by the forthcoming broadband fixed-satellite services systems (Teledesic and SES Global, etc.), as well as those segments served by existing mobile satellite systems (Inmarsat), personal communications systems (Globalstar) or targeted by the forthcoming advanced mobile systems (such as B-GAN). However, the actual size of the S-UMTS market is only subject to wide speculation as mobile markets have proved difficult to forecast. After considering a number of studies, three hypotheses were identified:[7–9]

- Average – none of the highly sensitive issues (terminal cost, technical feasibility, mass-market awareness of MM) experiences remarkable evolution.
- Pessimistic – 3G is delayed due to consistent regulatory and standardisation problems. Operators are reluctant/unable to produce low-cost MM handsets, and value-added services are not sufficiently developed. S-UMTS, no longer correlated with market demands, suffers a major setback.
- Optimistic – fast Internet/intranet evolution, appropriate regulatory framework and proliferation of new well-marketed services make satellite MM commercially attractive. New small handsets now

6. *"Enabling UMTS/Third Generation Services and Applications", UMTS Forum, Report No. 11, October 2000.*
7. *"The Future Mobile Market – Global Trends and Developments with a Focus on Western Europe", UMTS Forum, Report No. 8, March 1999.*
8. *"Final Report S-UMTS – Preparation of Next-generation Universal Mobile Satellite Telecommunications Systems", ESTEC-13694/99/NL/US, ESA S-UMTS Study, 29 November 2000.*
9. *"S-UMTS Final Report", ALENIA Spazio, ESA Contract 13695/99/NL/4S, 04-10-2000.*

benefit from evolved display capabilities, user-friendly interfaces and robust satellite reception.

Spectrum calculations added a precious 'piece' to the S-UMTS market assessment puzzle.[5] The conclusion was that the spectrum currently allocated to MSS, i.e. 2*30MHz overall, is enough to support the subscribers forecast for 2005 and 2010 according to a pessimistic hypothesis. However, for the numbers predicted in the average and optimistic hypotheses, the allocated MSS spectrum may prove inadequate to support the expected subscribers. Therefore, it becomes of vital importance for the satellite world to at least secure the existing spectrum allocations and investigate solutions to support the average and optimistic scenarios to guarantee the long-term viability of the 3G satellite business. Although an obvious solution would be the allocation of additional spectra (unlikely, given the current trends), a more attractive alternative would be to secure a total number of 1–2 million broad/multicast users, which can be served with the current spectrum allocations.

Satin S-UMTS Business Case

A business case was built, focusing on a sensitivity analysis of the financial aspects for the deployment of a global S-UMTS system.[10] The overall target was to indicate the conditions in terms of number/type of users, way of using the system and average revenue per user (ARPU) under which an investment in S-UMTS produces a positive net present value (NPV), and to extract conclusions on the potential mix of services and T/S-UMTS synergy approach required to attract the volume of users that are essential for a viable investment.

System and Operating Costs

A number of – as realistic as possible – assumptions were taken for both physical (hardware) and non-physical (software, engineering) investments as follows:

- Space segment – the system was based on a geo-synchronous (GEO) constellation providing global coverage and comprising five basic plus two spare GEO satellites of 15 years life-expectancy.

- Ground segment – up to 20 gateways, control centres, billing functionality, hardware to route traffic to UMTS core/Internet, fixed assets, etc.

Figure 4: S-UMTS Operator Structure

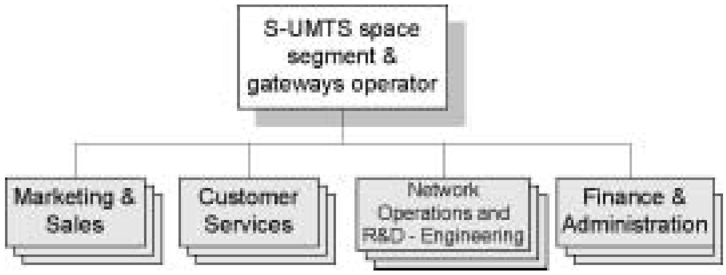
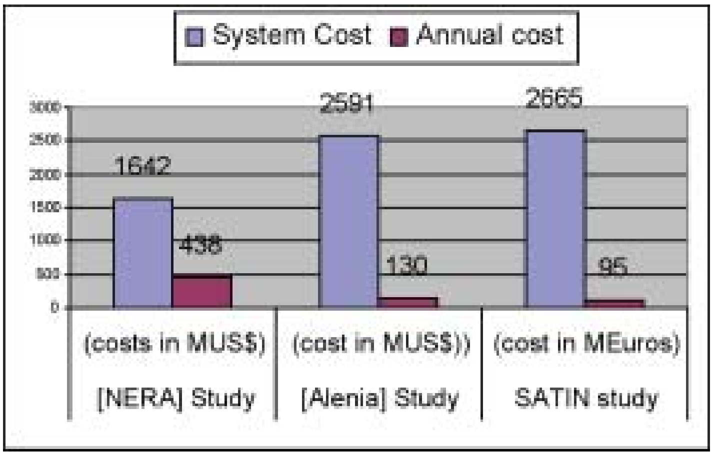


Figure 5: S-UMTS System and Operating Costs



- System development – engineering and research and development.

- Working capital – invested or leveraged required for covering pre-operational expenses such as salaries or interest expenses up to launch.

Regarding operating costs, a breakdown of the organisation structure – employing 800 people in the post pre-operational period – is depicted in *Figure 4*. It should be noted that sales/marketing and financial operations are partly undertaken by terrestrial value chain partners assuming the close co-operative approach. *Figure 5* depicts an estimation of the anticipated operating costs per annum and the accumulated system costs, as compared with European Space Agency (ESA) similar studies conducted by Nera and Alenia.[8,9]

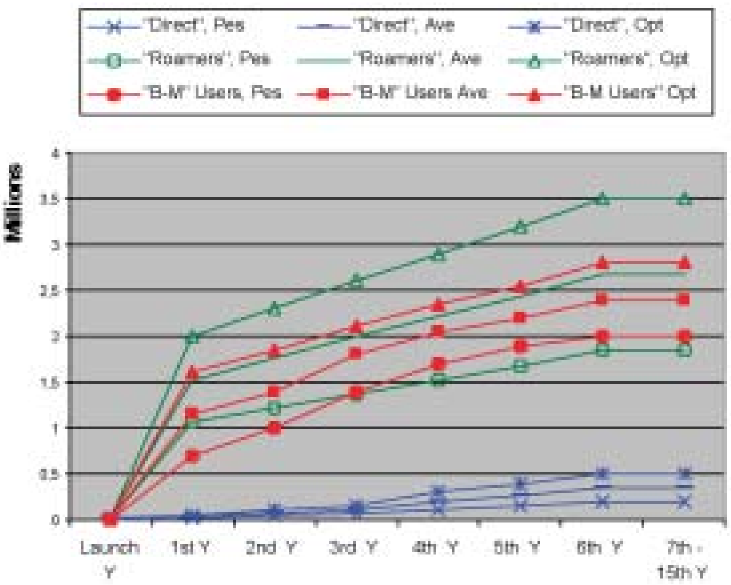
Type, Number and ARPU of Users

For the sake of the financial analysis, potential S-UMTS users were categorised into three groups:

- Direct, i.e. users that have no other terrestrial alternative – in principal, subscribers of the S-UMTS network that may (occasionally) roam

10. *P Philippopoulos, N Panagiotarakis, I Mertzanis and I Andrikopoulos, "A Business Case for S-UMTS", Proceedings of the 5th IEEE European Workshop on Mobile/Personal Satcoms (EMPS 2002), Baveno-Stresa, Italy, 25–26 September 2002, pp. 19–26.*

Figure 6: S-UMTS Subscriber Base Evolution



in a terrestrial network. These users belong to traditional niche market segments;

- Roamers – in principal, subscribers of T-UMTS or 2G, 2G+ networks and only occasionally use S-UMTS when out of coverage of their home network and belong basically to emerging niche segments. The anticipated revenue for the S-UMTS operator comes from roaming charges only.

- B-M users, i.e. users of broad/multicast services – will normally use the S-UMTS network, even though they move in areas where T-UMTS or 2G(+) networks are available. These users can be T-UMTS and/or S-UMTS subscribers.

Our hypothesis is that the S-UMTS operator will probably operate in co-operation with terrestrial UMTS operators, but in competition with other aeronautical MSS systems (such as B-GAN) or other regional/global systems offering a similar set of services (DVB/DVB-RCS). In view of this complex and highly competitive market landscape, our assumption is that the share to be obtained by S-UMTS is 33% to 62% of the addressable global market, i.e. wide enough to encompass all reasonable error margins and unpredicted fluctuations. *Figure 6* depicts the assumed evolution of the subscriber base time-wise.[11]

With regard to ARPU, although studies from UMTS-F and major operators (France Télécom, BT and Deutsche Telekom AG) provide estimations in the area of €1,000 to €3,000, we are assuming significantly moderate figures, mainly because in a co-operative approach, tariffs will be highly influenced by the terrestrial markets. Direct users' ARPUs are assumed to be in the range of €1,400 to €1,450, with a low cost of revenue (ACRPU) between 10% and 20%.

Roamers' and B-M users' ARPUs are significantly lower (€400 to €600 average), but with a high ACRPU (40% to 60%). The B-M user generates revenue from airtime subscription, advertising and transactions while using their home network, whereas roamers will normally generate revenues from airtime when visiting S-UMTS. The average projected difference in revenues between these two categories is in the order of €340 (second year of operation) to €240 (sixth year of operation), i.e. a range of €28 to €20 per month. This amount is considered a realistic difference that users would be willing to pay for receiving added value to their standard 3G services.

Sensitivity Analysis and Conclusions

Analysis was conducted on the basis of the discounted cash flow method (at a compound discount rate of 14%). Thirteen different scenarios were evaluated based on different hypotheses on the number of users and type of system use. The overall study period was 18 years from investment decision, while the first satellite is launched in the third year. In this respect, financial analysis covers 15 complete years of commercial operation. Furthermore, it is assumed that the number of users and ARPUs remains constant at the levels achieved in the tenth year from investment decision. Summing up financial projections, the following conclusions can be drawn:

- An S-UMTS venture is not viable assuming only direct users.

- An approach focusing only on roamers produces financially healthy results if their number will exceed two million from the very beginning, which is highly unlikely. If the portfolio of services includes B-M services, the investment is viable if the operator attracts a number of users in the area of 1.15 million. This appears to be feasible, considering that B-M users are normally urban/suburban inhabitants wanting S-UMTS as a cost-efficient alternative to T-UMTS.

- The analysis further suggests that, to achieve high profitability, S-UMTS should address a mixed population of users with varying needs (see *Figure 7*). Broad/multicast services should be the basis of the potential services portfolio to minimise spectrum implications and secure higher ARPUs.

11. The first satellite launch year is placed between 2004 and 2005.

- All of the scenarios producing positive NPVs assume a considerable population of users (in the order of millions) from the very beginning of commercial operation. This imposes a very close co-operative approach for deploying the system, with terrestrial operators ensuring that the initial user population of S-UMTS will be sought among their home (numerous) users and not the occasional roamers. ■

Acknowledgments

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Figure 7: Break-even Point and Projected Gross Earning Expectations for Scenarios with Positive Cash Flows