S@tMax

Innovation Through Telematics

Executive Summary

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As personal mobility increases, people are spending more time in their vehicles. Furthermore, a large segment of today's workforce is part of a growing mobile service industry, creating an opportunity to increase productivity. Today's traveling time could be more efficiently used through the integration of mobile wireless communications services into vehicles.

The telematics market is emerging in the USA and offers enormous business potential. It is a new opportunity driven by a convergence of technology developments in a variety of areas including satellite technologies, wireless communications, semiconductors, intelligent vehicles, embedded computers, software and content, user interfaces and intelligent transportation systems. S@tMax defines telematics as mobile wireless information services that connect users in mobile vehicles on roads, to data, voice, entertainment, internet access, navigation and safety services.

S@tMax is developing mobile internet protocol (IP) connectivity and data solutions for vehicles on roads in urban areas, on highways and in remote areas. This will be achieved with a hybrid satellite-terrestrial wireless communications system.

The proposed S@tMax Corporation will become the telematics enabling market leader in the USA with an innovative business plan that has an excellent return on investment (ROI).

Executive Summary Contents

The executive summary covers the following subject areas:

Overview

The Need

S@tMax assessed the market to understand the customer needs. Mobility and efficient use of time are key parameters of today's life in the USA. Customers expectations were expressed as: "I want internet in my car", "I need to work while I'm on the road", "I want to be connected to my digital world", "I want my family to be safe", "I want accurate directions to my destination", "I want to know when my car needs maintenance", "I need to know how the vehicles perform on the road", and "I need to produce the best possible vehicles". All these needs refer to the brand new and fast growing telematics industry. The S@tMax envisioned corporation will address these customer needs by a unique services offering, a unique commercial approach and it will make use of an innovative, state-of-the-art, hybrid space based –terrestrial system architecture.

Definition of Telematics

S@tMax defines telematics as mobile wireless information services that connect users in mobile vehicles on roads to data, voice, entertainment, internet access, navigation and safety services.

Opportunity and Objectives

A profitable and sustainable business opportunity was identified in the telematics industry: offering mobile IP and data applications to vehicles in the contiguous USA (CONUS). S@tMax can empower mobile internet services by means of transparent IP data services integrated into automobiles. This will be accomplished by developing, deploying, operating and maintaining a hybrid space based architecture that is seamlessly integrated with existing and future terrestrial architectures using standards based interfaces and internet protocols for high data rate services.

S@tMax will provide high speed mobile data services (including Internet coverage) to vehicles on USA highways and low speed mobile data services to vehicles anywhere in the CONUS, opening the future for a new set of potential applications for vehicle telematics.

Vision

Market leader in developing mobile digital data solutions

Primary Objective:

Provide two way, Direct-to-Mobile-User wireless communications to vehicles on USA roads via a hybrid satellite system

Secondary Objectives:

- **Affordable, seamless, custom IP data services as soon as possible**
- **Develop a profitable and sustainable business**

The Products and Services

The extensive products and services portfolio has been designed to respond to the identified customer expectations. The modularity of the portfolio will easily support new possible customer needs following the market evolution.

S@tMax will turn today's car into tomorrow's mobile office. Business users will be able to access all the office services they are used to, including telephony, access to company files and servers, while on the road. With S@tMax Navigation, drivers will enjoy driver support services such as traffic analysis, live maps and advanced interactive navigation systems. S@tMax (in-vehicle) Safety & Security systems will become the standard to help and protect drivers and passengers on the road. With S@tMax Entertainment, families will be able to access the latest movies, satellite radio programs and various other entertainment services.

In addition to these user-centric business, security and entertainment systems, S@tMax will also provide vehicle manufacturers with services such as vehicle diagnostic and operational data, factory direct (vehicle) software updates, vehicle predictive maintenance, and post accident investigation analysis (black box) through S@tMax Diagnostics services.

Products will include a wireless communications receiver/transmitter electronics black box, an antenna system, and a data storage device that will be integrated (with sensors) into new vehicles in an active partnership with the automotive manufacturers.

Systems Engineering

S@tMax satellite systems engineering approach incorporates technical, financial and business engineering principles as additional design drivers, while traditional systems engineering seeks primarily to satisfy functional needs and stakeholder requirements. This optimized approach of system development applies classical systems engineering methods to arrive at a technical solution that is also a sound business concept. On Orbit Servicing (OOS) was investigated and included in the systems engineering process.

Business Engineering

To assess the commercial potential of newly emerging space-based business concepts, a generic and flexible business tool was developed. As a result of a detailed business engineering process, various business concepts were evaluated. The selected concept was optimized to maximize the business result. As part of this business engineering process, OOS was evaluated from a business point of view. Critical space issues as reliability, timeliness as well as cost-efficiency, business-related risks and real world factors were taken into account.

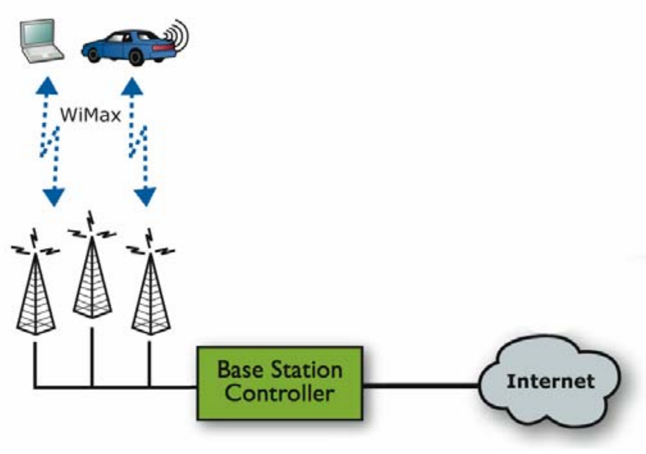
This document shows that the S@tMax business case is viable, profitable and sustainable. S@tMax is considered an important step toward providing roadway IP coverage for services based on a realistic case scenario that goes beyond traditional space project management planning.

The Solution

The S@tMax system will provide vehicles in the USA with direct, transparent communications to wireless data and the Internet. Transparency means that a given communications service (e.g. IP over WiMAX), can be supported by the same user device in both terrestrial and satellite modes in a manner that is transparent to the end user. The user can connect to S@tMax in three different ways, depending on the environment where the user wants to get connected and take advantage of the S@tMax products and services.

User in Urban Areas

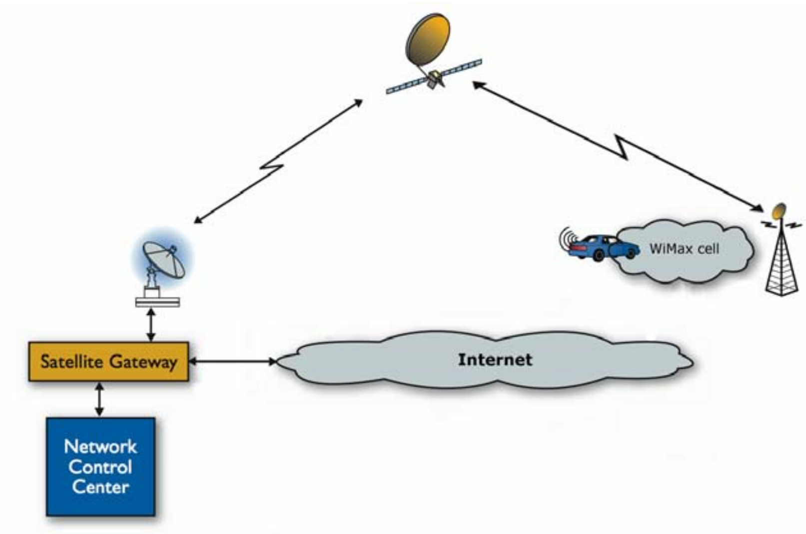
When in urban areas the user can access the Internet from his car computer by means of the WiMAX signal provided by the S@tMax operated fiber towers.



Since the car is equipped with a WiMAX transponder it can establish and maintain a connection with the WiMAX ground stations and provide content to the user by means of wireless coverage inside the car and other services. In this environment the user expects the best quality of service in terms of reliability and data rates.

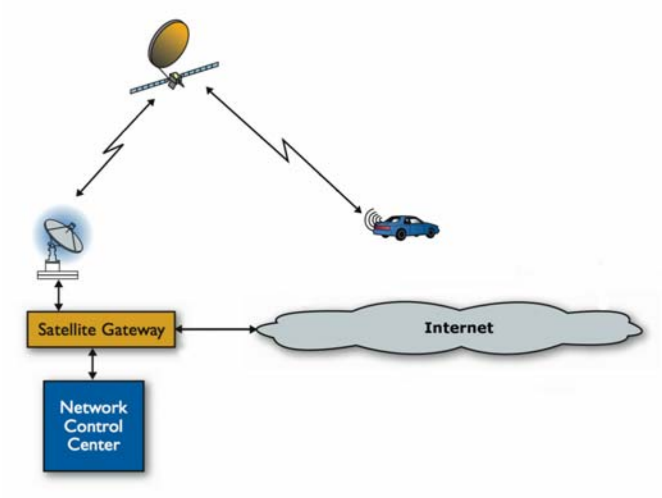
User on the Highways

When the car leaves the urban areas and moves to a highway it will leave the coverage area of the fiber towers and enter the coverage area of the relay towers. By means of standalone and fully automatic antenna relay stations linked to the S@tMax space segment (i.e. the relay towers), placed in proximity of the highways, the users in their vehicles can maintain connectivity in a transparent manner without loosing the connection. This concept is shown in the figure below.



User in Remote Areas

The services in urban areas and highways provide the best quality of service, but are limited to areas where WiMAX coverage is provided by a terrestrial network infrastructure. By means of the S@tMax satellite, even in remote areas the S@tMax customers can maintain their always-on connectivity with a reduced quality of service. This is achieved by using the direct to satellite link as shown in the picture below.



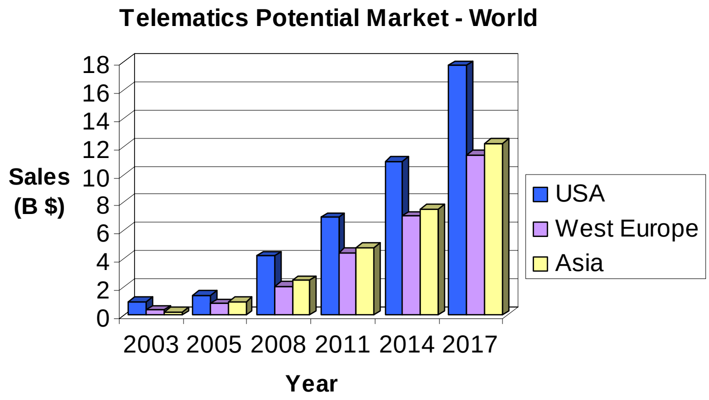
The ubiquitous and enhanced S@tMax IP based services are the key advantage of the S@tMax system which are achieved by means of the architecture available in urban areas, highways and remote areas.

The integration and availability of the 3 types of services are critical to the success of S@tMax and the transparency concept. The terrestrial and satellite components of the S@tMax hybrid network provide complementary coverage. The terrestrial component ensures service availability in major urban areas, where satellite-only systems suffer blockage from buildings. Likewise, the satellite component provides coverage to those areas that are impractical or uneconomical to serve terrestrially. The ubiquitous coverage enabled by hybrid networks substantially enhances the value proposition for safety and security applications in a variety of wireless segments, most importantly among public safety, consumer telematics, and fleet management.

Market

Market Potential

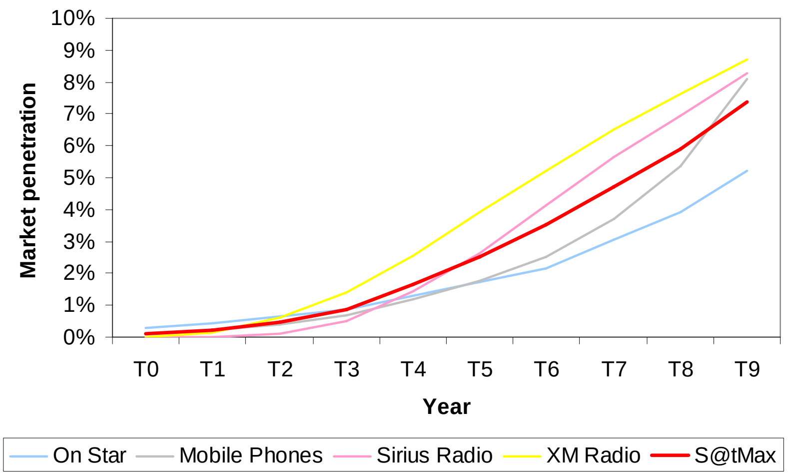
The telematics market in the USA offers enormous business potential. It is a new opportunity driven by a convergence of technology developments in a variety of areas including satellite technologies, semiconductors, intelligent vehicles, embedded computers, software and content, wireless communications, user interfaces and intelligent transportation systems. The market research revealed a predicted growth of about 22% a year between 2008 and 2011 and above 25% a year between 2011 and 2017. Consumer demand has been validated by a variety of sources including analogous businesses such as Global Positioning System (GPS) navigation systems, satellite radio, existing telematics and consumer surveys that indicate an 80% level of interest in telematics capabilities. The predicted telematics systems sales in the year 2017 amount to approximately $18 B dollars, as shown in the following figure:



Research conducted by an established industry source, the Telematics Research Group (TRG) indicated that by 2017, 90 to 100 million vehicles are expected to be equipped with telematics systems in the USA. S@tMax intends to become the market leader by providing integration of hybrid satellite systems wireless communications with products and services that fulfill consumer's needs in this emerging USA market.

Market Share

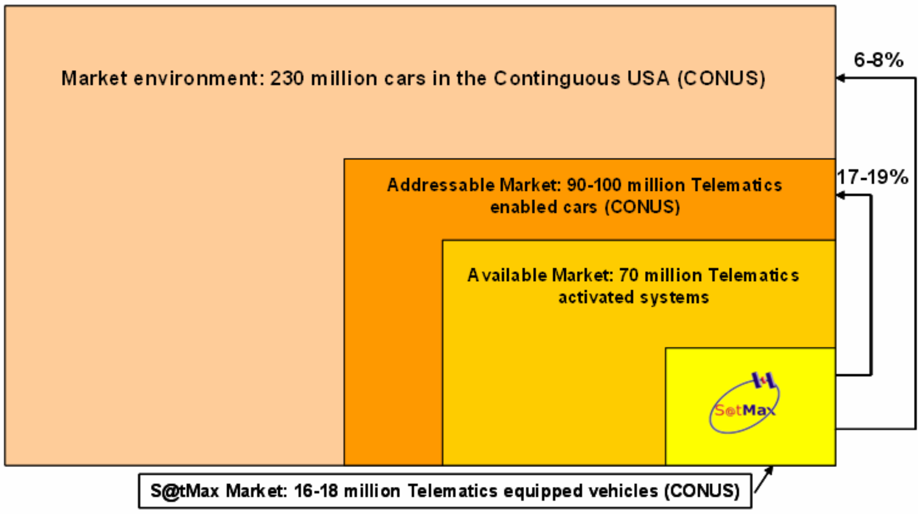
The revenue opportunity for S@tMax lies in the ability to capture a substantial part of the huge potential telematics market. The market penetration from industries acting on comparable markets was investigated. Market penetration curves show an analogous pattern and give good confidence in the expected market share of 6 to 8% of the total CONUS market by 2017 as shown below:



Considering a total, conservative assumed market of 230 million vehicles in the USA, this 6 to 8 % market share represents 16 to 18 million S@tMax users by 2017.

Market Sizing

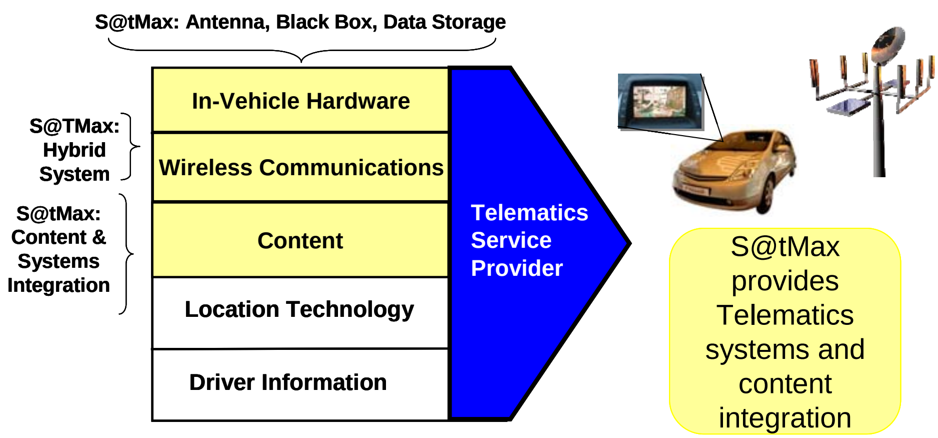
S@tMax has a total potential market of 230 million by 2017, which is the market environment. 90 to100 million vehicles will be telematics equipped by 2017, which is the addressable market. Industry sources (a vehicle manufacturer and a telematics service provider) confirmed a telematics subscription ratio of about 70%, which is the available market. The market share study showed that 16 to 18 million users will subscribe to S@tMax services by 2017. The following figure illustrates the market sizing.



S@tMax market share is 17-19% of the telematics equipped vehicle market and 6-8% of the total vehicle market in the USA.

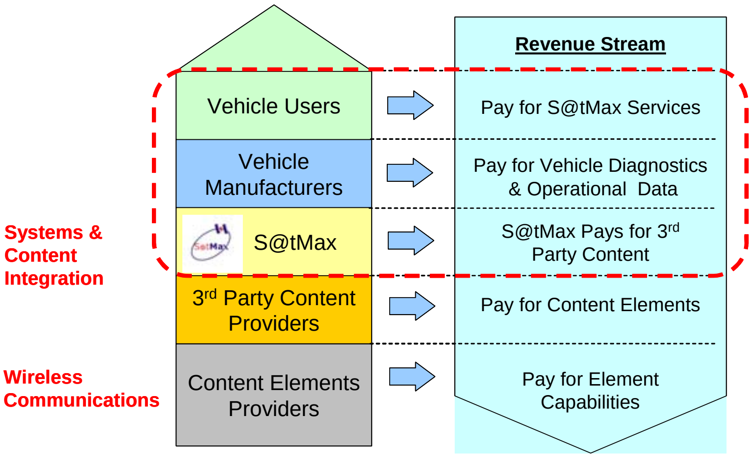
Elements of Telematics

In order to be a telematics service provider, five elements are necessary: in-vehicle hardware, wireless communications, location technology (GPS, Galileo), content and driver information. S@tMax will provide the in-vehicle hardware (antenna, receiver/transmitter and data storage device) as well as the wireless communications element. In addition, S@tMax will coordinate, acquire and integrate all telematics content in order to fulfill user needs. Integration of all systems and content will provide the user with a seamless data connectivity experience which will enhance utilization of all content. These elements and the total solution are shown in the figure below.



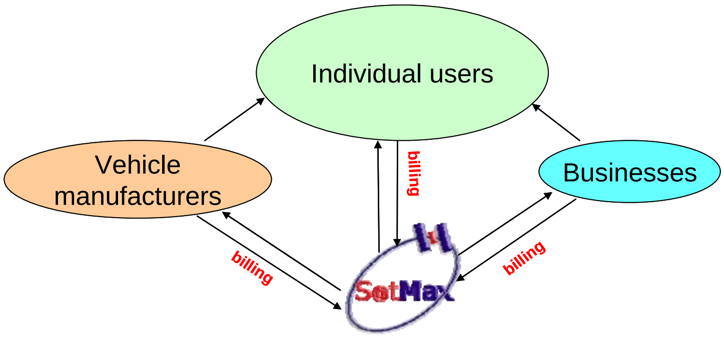
Value Chain

The value chain shows the hierarchy of the suppliers supporting the end customers: the vehicle users. It is desirable to be as high on the value chain as possible in order to maximize the value added contributions as well as profit margins. If S@tMax were to provide elements of telematics only (such as wireless communications), then the value added would not be maximized. By becoming systems and content integrators, S@tMax can elevate its position on the value chain, and achieve higher profits. This implies that S@tMax customers will be the vehicle manufacturers and the vehicle users (business and private). These relationships and associated revenue streams are shown in the figure below:



Customers

S@tMax will address three customer groups: the vehicle manufacturers, the businesses (flagship customers) and individuals (private and business users). S@tMax first focuses on businesses in order to minimize the customer acquisition cost. The vehicle manufacturers will be approached as strategic partners to gain access to the users or subscribers.

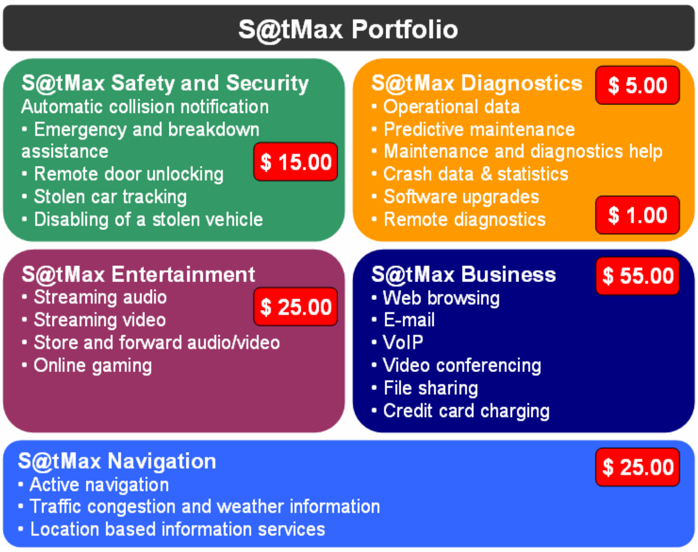


There are about 30 significant car manufacturers in the USA. From this group, S@tMax will approach the car manufactures that offer the highest technology on-board and whose customers are most likely to subscribe to telematics services. The Telematics Research Group, Inc. assessed the major brands in the USA through their Technology Index™, which measures the technology deployment across a vehicle brand. S@tMax primary customers are Mercedes, BMW, Audi, Acura (Honda), Lexus (Toyota), Infiniti (Nissan), Jaguar (Ford), Land Rover (BMW), Volkswagen, Volvo. Typical Businesses (flagship customers) to be approached by S@tMax are companies such as the American Automobile Association (AAA), and Hertz rental cars or Southern California Edison.

Products and Services

Overview

The S@tMax products and services satisfy a number of customer needs. Low data rate services such as Safety and Security, Vehicle Diagnostics and Navigation and high data rate services such as Business services and Entertainment are all in the S@tMax portfolio.



S@tMax Safety and Security

With more than 80% of USA car owners wanting some form of in-vehicle technology, safety and security services top the wish list. S@tMax Safety and Security targets businesses and individual drivers as customers. An automatic collision notification supports fast assistance and assistance can be requested by the driver in case of emergency or car breakdown as well. A popular remote door unlocking service is included for all the people that leave their keys in the car. Tracking stolen vehicles and disabling stolen vehicles are included services, both of which have increasing popularity trends. S@tMax has determined a competitive price of $ 15.00 per month for this service.

S@tMax Diagnostics

Vehicle diagnostics, a service recently launched by General Motor's OnStar subsidiary, is already a huge success with over a million subscribers in just six months. This service targets the individual driver that is able to see how his or her car is performing (or not performing!). The driver can look at his or her car's operational data at home and while driving a predictive maintenance service shows when parts of the car need maintenance. The driver can request breakdown assistance and the car can be remotely diagnosed. The individual customer can get S@tMax Diagnostics for only $ 5.00 per month. This technology can also be a breakthrough for vehicle manufacturers because it basically extends their test fleet to all vehicles on the road. Information about the cars operational data, crash data, and statistics can be of great value. Also the ability to send one-to-many software upgrades is very useful taking into account the increasing complexity of car electronics. For the vehicle manufacturer the price is $ 1.00 per vehicle per month.

S@tMax Navigation

Rapidly increasing sales of car navigation systems in the previous years indicates that this technology is popular. Active navigation is included in S@tMax Navigation targeting businesses and individual drivers. It is possible to download relevant navigation maps on demand that can be updated frequently.

Furthermore, S@tMax Navigation allows the addition of extra location based information, such as weather information, traffic congestion alerts, traffic routing information, and other location based services. The applications of this technology are endless, think of local fuel station information, personal billboard advertisement, highway restaurant menus, etc. The competitive price of S@tMax Navigation is $25.00 per month.

S@tMax Business

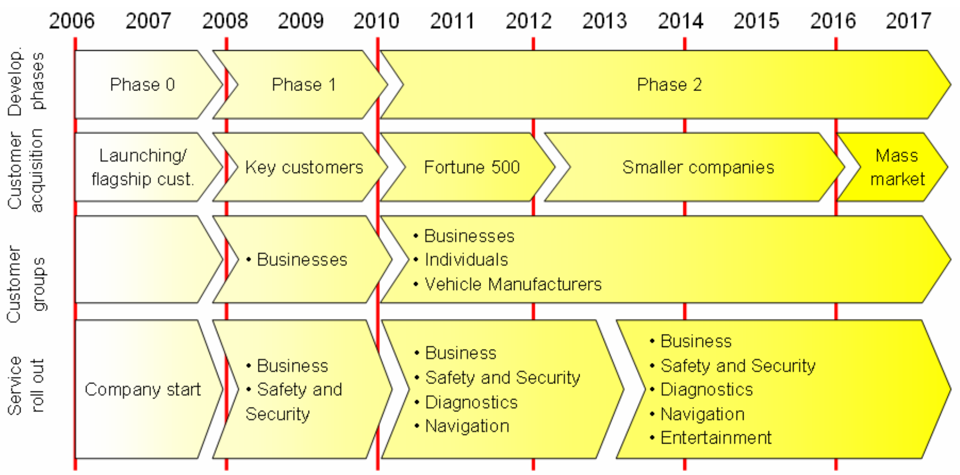
S@tMax Business enables user-centric connectivity to roaming workers in the USA. This can be either businesses or individual customers. Standard Internet services such as web browsing and checking e-mail and file sharing are included. Voice over IP (VoIP) and video conferencing are also offered as well as secure credit card charging. For $ 55.00 per month roaming workers can turn their car into tomorrow's office.

S@tMax Entertainment

Entertainment has always been an attractive business. In the last few years the rise of on-demand entertainment has opened up a new market. S@tMax Entertainment includes live streaming audio and video and online gaming. Many audio or video files can also be downloaded to the car using the store-and forward download service. S@tMax identifies individual drivers and businesses as the customer groups for a competitive price of $ 25.00 per month.

Service Implementation

The services are rolled out in phases. The first two years of the company, phase 0, is used to acquire a contract with one or more launching flagship customers, for instance; Southern California Edison.



In phase 1 this launching customer allows a regional implementation of S@tMax Business. S@tMax Safety and Security is already provided nationwide to individuals as well. Two years later in 2010, contracts with vehicle manufacturers allow the expansion of the S@tMax portfolio with S@tMax Diagnostics and S@tMax Navigation. The marketing effort is focused on big companies in the beginning and more and more mass market oriented in 2017. In 2013 S@tMax Entertainment will be introduced.

Marketing and Sales Strategy

The marketing mix is presented on the figure below, according to the theory of the four P's: product, price, promotion and place (distribution).

S@tMax Marketing Mix

PRODUCT
- S@tMax Safety and Security
- S@tMax Diagnostics
- S@tMax Navigation
- S@tMax Business
- S@tMax Entertainment

PRICE
- Price to market
- Packages prices
- Acquisition incentives
- Service bundling

PLACE
- Distribution channels
  - Vehicle manufacturers
  - Reseller network / dealers
  - E-commerce
- Phased implementation
  - Initial regional coverage
  - CONUS coverage

PROMOTION
- Strategic partnerships
- Website
- Advertisement
- Sales promotion
- Brand management
- Public relations

The substantial budget allocated to marketing will be used to ensure promotion of the services, to allow incentives for customer acquisition and offer unique bundling to increase customer retention, develop customer fidelity and sustain S@tMax competitive advantage and unique selling proposition. The vehicle manufacturers, as strategic partners to S@tMax are primary distributors of the S@tMax services and they will give access to the individual users. A prominent vehicle manufacturer in the USA explained that car manufacturers have no ambition to become telematics service providers. Sales support via Internet (web site, E-commerce) will be widely used.

Competitors Analysis

Telematics is at the crossroad of various technologies, each experiencing significant growth. Developments in semiconductors, intelligent vehicles, embedded computers, software and content, wireless communications, user interfaces and intelligent transportation systems cause a variety of industries being interested in telematics. S@tMax might thus expect competition from various angles as shown on the competition assessment table below. The fiercest competition can be expected from established telematics service providers (OnStar, ATX Group) and wireless terrestrial networks (Cingular, Sprint, Navini Networks).

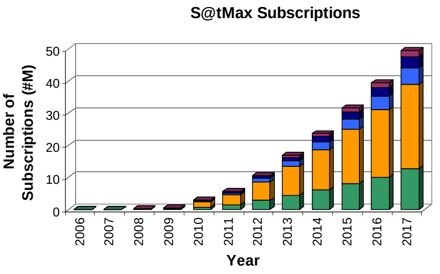
Companies / IP Services	Telematics Service Providers OnStar, ATX Group	Mobile Satellite Service Providers MSV, Terrestar, ICO	Wireless Terrestrial Networks Cingular, Sprint, Navini	Satellite Radio Providers XM, Sirius	Navigation Providers TomTom, Garmin, Navteq	S@tMax
Safety and security	✓					✓
Diagnostics and operational data	✓					✓
Active navigation	✓		✓		✓	✓
Location based services	✓		✓		✓	✓
Internet services (web browsing, e-mail, file sharing, credit card transfer)		✓	✓			✓
VoIP, video conferencing		✓	✓			✓
Streaming audio/video, online gaming	✓		✓	✓		✓

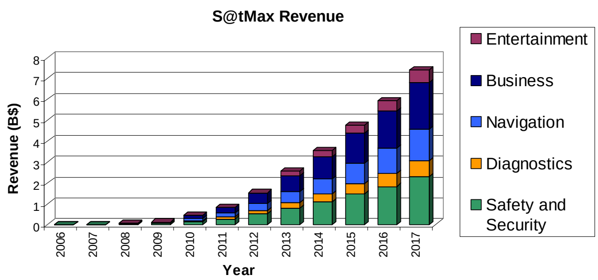
SWOT Analysis

A SWOT analysis was performed that revealed an interesting dynamic. The S@tMax primary strengths are new “in demand” services, 99% CONUS coverage and a hybrid space-terrestrial communications architecture. A focus on the automotive vehicular market will allow a niche market approach initially which will grow into a mass market. IP protocol is universal and transparent. By utilizing this, S@tMax will have quick access to the vast IP knowledge base and existing infrastructure. Threats are mainly caused by competition, which is described above. The large size of capital expenditures required for a satellite system deployment is also a weakness. There is a lot of uncertainty in the long term technological solutions and the market direction. These factors combine to form a complex and dynamic market that will require a large degree of flexibility and quick reaction by S@tMax.

Revenues

Based on surveys and competitor analysis, the number of subscriptions per service package was estimated. Some S@tMax users will buy only one service, others will buy more than one. The assumption is made that on average each user subscribes to one extra service. The total number of subscriptions sold is estimated to rise to 49 million in 2017. The large number of "S@tMax Diagnostics" subscriptions is due to the fact that this service will be sold to both the vehicle driver and the vehicle manufacturer. The S@tMax revenue is predicted to go up to $ 7.4 billion in 2017. These revenue numbers are in agreement with the estimated revenue for a hybrid wireless data communication system in the USA, according to a recent study from Telecom, Media and Finance.

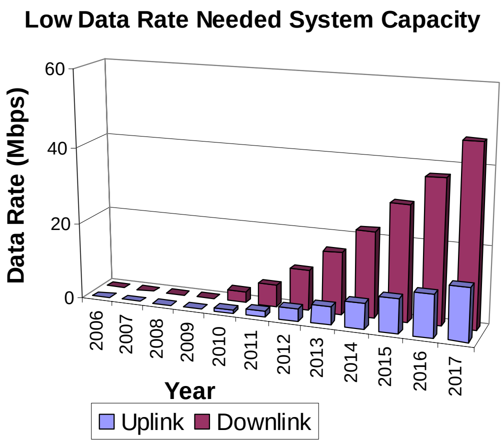


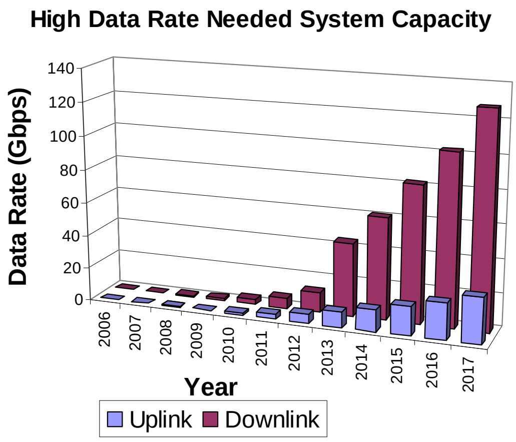


Needed System Capacity

The offered data traffic that flows through the S@tMax system is complex. Many different services are used by millions of users through diverse connections. The various services need different data rates and have different usage characteristics, each causing different loads on the system. By analyzing these characteristics and adding them for the complete system, the average needed system throughput can be calculated. Assuming that users start using the system at random moments, the data throughput of the system can be approximated by a Gaussian distribution. To cope with peak usage, the system is designed at 95 % of this distribution. This means that users have a 95 % chance of acquiring a connection with S@tMax. This is comparable to current cellular networks performance standards.

The resulting needed capacity is divided into low data rate services and high data rate services because the connection type is different. The needed capacity for low data rate services increases to 47 Mbps for the downlink and 14 Mbps for the uplink in 2017. For high data rate services the needed capacity goes up to 128 Gbps for the downlink and 27 Gbps for the uplink.

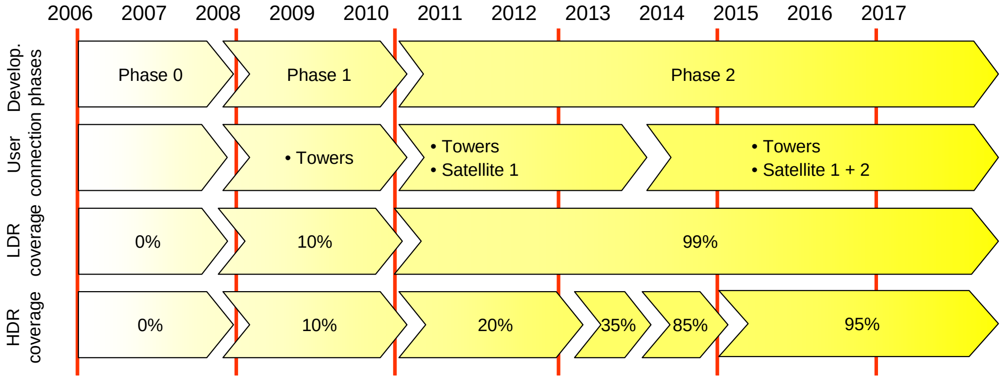




System Description

Phasing

S@tMax provides IP-services to users in the USA using a ground infrastructure and satellites. The system development is phased as shown below.



Phase 1: 2008 - 2010

- <u>Urban Areas</u>*:* High Data Rate (HDR) IP-services are provided through the terrestrial communications “fiber towers” connected to the fiber backbone.
- <u>Non-Urban Areas</u>: Low Data Rate (LDR) IP-services are provided using a direct satellite link to the car.

Phase 2: 2011 - onward

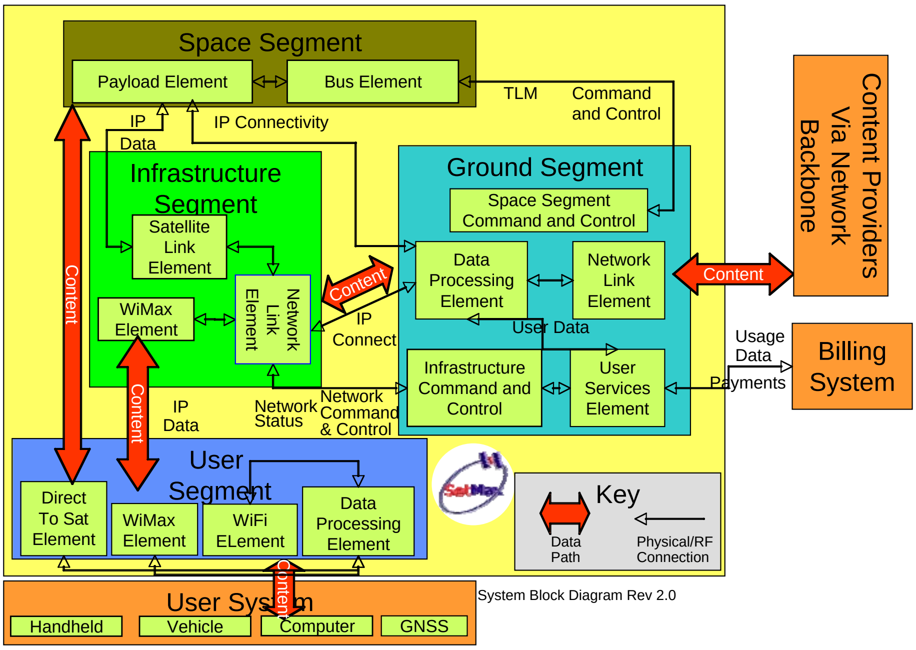
- <u>Highways</u>*:* HDR IP-services access is provided through a terrestrial network of “relay towers” placed next to the highways.

System Architecture

The system architecture consists of four internal components:

- The Space Segment is a proprietary GEO communication spacecraft over the contiguous United States. By means of spot beams in Ka band the satellite communicates to the infrastructure relay cells. Ku-band and C-band wide area coverage provides a direct link to users.
- The Ground Segment is the heart of the system providing, command and control of the satellite and terrestrial towers, network maintenance, throughput management, content collection and Internet data processing.
- The Infrastructure Segment includes the terrestrial network of relay and fiber towers to provide high data rate, IP connectivity over the highways and in urban areas.
- The S@tMax system will link the end customer through the vehicle interface. The User Segment consists of a user terminal that is linked with the Space Segment and the Infrastructure Segment to distribute the IP data to the user inside the vehicle.

The overall S@tMax architecture is shown below.

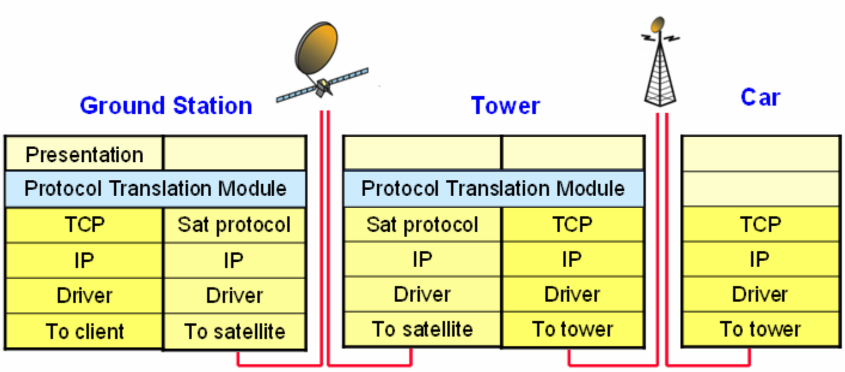


System Block Diagram Rev 2.0

The S@tMax system architecture provides a high capacity, expandable system with flexibility to provide high data rates to users in urban areas and on high traffic interstates while simultaneously providing a lower data rate connection to the entire contiguous USA. This flexible architecture supports the service plans desired by the end user enabling a strong, profitable business model. As the business grows the further deployment of infrastructure segment towers will allow for additional capacity and higher data rates.

Internet Protocol

The Internet Protocol (IP) is the linking pin between the actual application and the physical media used to transport the data, such as a telephone wire or a satellite link. A physical media that is compatible to IP is the door to a large variety of applications. In short, S@tMax compatibility with IP is a key to its success. In addition, IP provides S@tMax with the full advantage of the rapid developments in processing industry and third party developments on the Internet. To maintain compatibility with TCP/IP through the satellite link, the system uses gateways - located at the ground station, relay towers and in the car, as shown below.



Mobile WiMAX

The 806.12e standard is designed to enable mobile high data rate IP-connectivity. Mobile WiMAX can support handoffs within 50 ms of time and roaming with user terminals speeds up to 120 km/h. In addition Mobile WiMAX offers a better link margin, improved indoor coverage, flexible management of spectrum resources, and a wider range of terminal form factors. The results of these improvements are high data rate throughputs, scalable solutions and low cost deployment. In addition Mobile WiMAX end-to-end network architecture is based on an all-IP platform. This all-IP platform shows higher technology growth rates than standard telecom. The result is a lower cost, highly scalable, and rapidly deployable network.

Broad industry participation is expected ensuring large economies of scale that will help drive down the costs of subscription. In December 2005, the Institute of Electrical Engineers (IEEE) ratified the Mobile WiMAX and the first certified products are expected to be available in the first quarter of 2007. S@tMax will be on the cutting edge of WiMAX technology as a leader in the industry.

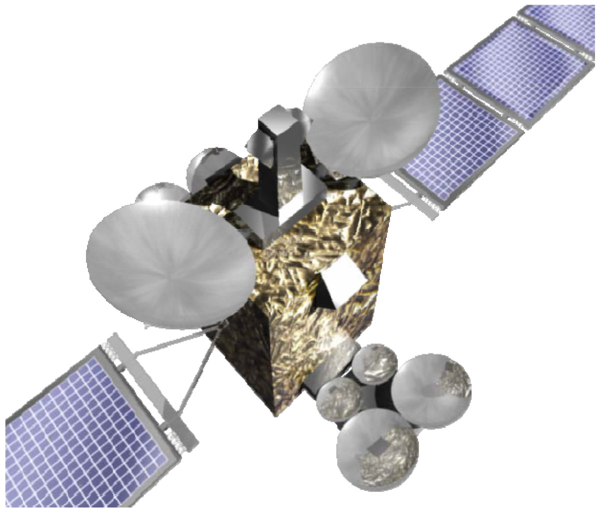
Mobility Management

While using S@tMax services, users can travel long distances: from crowded cities to small towns. The type of IP-connectivity depends on the user location. In cities it is provided through Mobile WiMAX tower directly connected to the Internet. On the USA interstates the IP-connectivity is established through mobile WiMAX relay towers that are connected to the Internet via a geostationary satellite link. On secondary roads and in non-urban areas in general, the IP-communication link is provided to a direct link with the geostationary satellite. S@tMax has developed a robust mobility management scheme for transparent IP-connectivity over the USA:

- From one Mobile WiMAX tower connection to the other
- From Mobile WiMAX relay tower to a direct to-satellite connection
- From one satellite spot beam to the other
- From urban areas to non-urban areas.

Space Segment

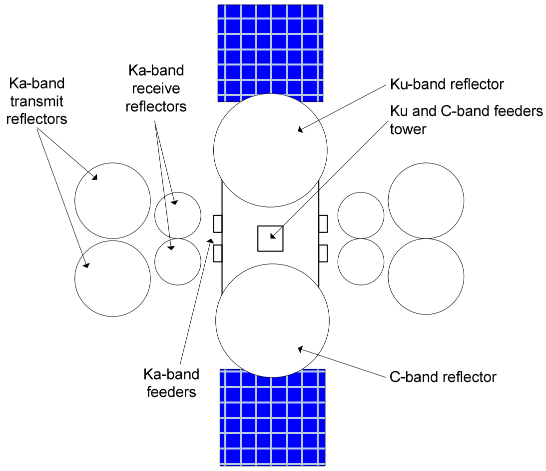
S@tMax will operate two geosynchronous satellites over the USA to provide the required IP capacity needed for both the relay cells of the Infrastructure Segment and the mobile users. The S@tMax satellite is a next-generation mobile satellite system; its unique capabilities will enable high-speed data networking, enable groundbreaking applications, and unlock a wealth of value-added IP based services over highways and remote areas over the USA. The space segment will consist of 2 satellites to be launched in 2010 and 2013 and located respectively in 85.5° W and 86.5° W. The satellites design is inherited from the Anik-F2 Boeing 702 platform and it has a lifetime of 15 years. A concept view of the folded and deployed configurations is shown below.



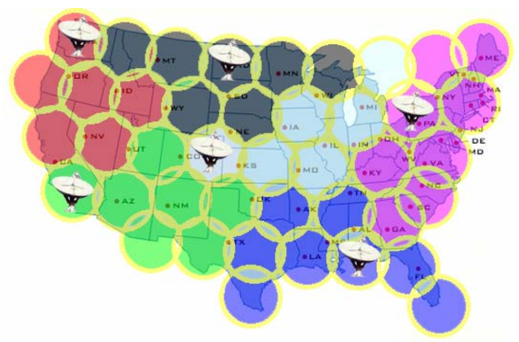
The total cost estimation for the first satellite is $430M, while the cost of the second unit is assumed to be $280M.

Communication Payload

Operating with 2 distinct communication payloads, each one of the S@tMax satellites will provide LDR services and HDR services to its users over the USA. The configuration of reflectors and feeders is shown in the picture below.



The S@tMax space segment employs high-performance, high capacity, bent pipe Ka-band spot-beam technology to offer a total capacity of 33.7 Gbps to the users of its High Data Rate services. The complete USA coverage is achieved with 41 active Ka-band spot beams of which 35 are dedicated to the link with the relay cells (user beams), 6 to the hub ground stations (service links) and 5 extra ones are spares. The picture below shows the layout of the Ka-band spot beams and the ground stations locations.



The Ka-band links rely on Advanced Coding and Modulation (ACM) techniques to improve the link availability between satellites and relay cell over all weather conditions.

The mobile communication payload consists of a set of Ku-band and C-band transmitters and receivers providing a total capacity of 32 Mbps and 21 Mbps, respectively for the downlink and uplink, over CONUS coverage footprint. The forward mobile link uses 32 Ku-band transmitters; each one with a bandwidth of 27 MHz achieves a capacity of 1 Mbps. The return link uses an unregulated spectrum of 150 MHz to transmit 1 W over 1313 channels of 16 kbps each.

Platform

The satellite platform is based on the design of the Anik-F2 Boeing 702 platform. The folded satellite configuration has side dimensions of 3.4 m x 3.2 m and a total body height of 5 m (7 m up to the antennas top). The primary load path is through the primary central structure, which collects all the loads and discharges them on the launcher interface. A secondary structure supports appendages and equipments. The North and South panels are thermal radiating panels and support the solar arrays. East and West panels support the large deployable Ka-band antennae. The nadir panel supports the C and Ku-band feeders and the corresponding large reflectors. The zenith panel has the launcher adapter interface and apogee kick motor nozzle. The total spacecraft wet mass at launch is 5994 kg without including the 70 kg of the launcher adapter.

The satellite is equipped with chemical and electric propulsion sub systems. The chemical propulsion subsystem is used to perform spacecraft orbit control, wheels dumping, station acquisition and E/W station keeping through the use of the Reaction Control System (RCS) and the apogee kick using the apogee main engine. The chemical propulsion is a conventional bipropellant propulsion subsystem using MMH as fuel and MON-3 as oxidizer fed to the 16 thrusters forming the RCS and the apogee kick engine by pressurized helium gas. The propulsion hardware is based on a single 410 N main engine and a set of 16 thrusters of 10 N each. The total chemical propellant mass is 2471 kg.

The Electric Propulsion Subsystem (EPS) is used for North/South station keeping. The main characteristics of the ion thrusters are the very high specific impulse and very low thrust levels, which allows a considerable mass saving. To operate the EPS requires a total electrical power of about 650 W. The xenon propellant mass is of 120 kg.

The power subsystem provides a nominal voltage of 42.5 V. Furthermore, the power subsystem provides protection and distribution capabilities to the spacecraft equipment, communication payloads, controls the battery charging during the sunlight, provides commands to the pyrotechnic devices and controls all the spacecraft heaters. Two deployable multi-junction Gallium Arsenide solar array wings for a total surface of 85.5 m^2 composed of 6 panels each provide the required Begin Of Life (BOL) power of 16.0 kW and an End Of Life (EOL) power of 14.5 kW. The solar arrays provide energy to rechargeable lithium-ion batteries.

By using flight proven passive means and electrical heater elements monitored with thermal sensors, the thermal control sub-system maintains the payload and platform units and components within their operational temperature limits allows the satellite to operate for a lifetime of 15 years. The North and South panels are used to mount the radiators. For all the other internal units a black coating is used to enhance thermal radiation exchange, contributing to the spacecraft internal temperature uniformity. In order to limit the spacecraft thermal excursions, all the S/C external surfaces are thermally isolated using Multi Layer Insulation (MLI).

The Attitude Control Subsystem (ACS) is responsible to maintain the satellite attitude 3-axis stabilized. ACS is composed of the sensors units: Gyroscopes, Sun Acquisition Sensor and Star Tracker. The sensors readings are sent to the on board computer. The attitude and orbit control algorithms are executed in the Command and Data Management Unit (CDMU), which sends via the on board bus, the commands to the actuators. The actuator units are the reaction wheels for attitude control and the chemical and electrical thrusters for the orbit control.

The Data Handling Subsystem (DHS) is responsible for the commands and telemetry functions, the on board time management and the overall platform management. The Attitude and Orbit Control Subsystem (ACS) is executed in the DHS together with the Thermal Control management software. The DHS is also responsible of the Fault Detection Isolation and Recovery (FDIR) functionality for the minimization of the system outages.

The ground station Telemetry Tracking and Commands (TT&C) communicates with the Ground Segment to provide telemetry information and receive commanding. This link is a continuous 2-way telecommunication link in S-band at 2 kbps uplink and 4 kbps downlink.

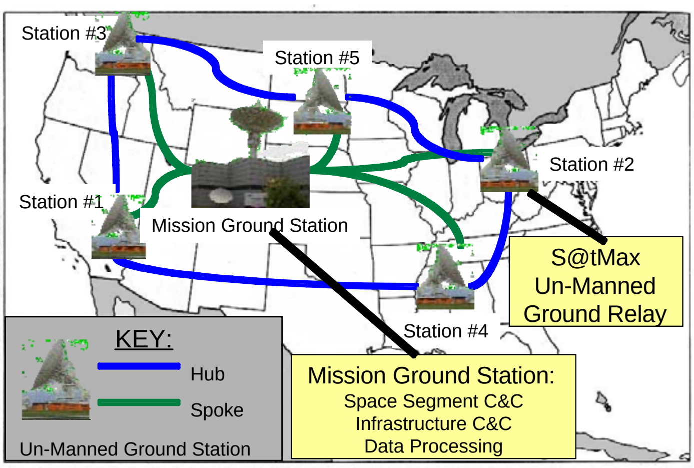
Launcher

S@tMax has identified the Sea Launch system that meets the requirements of reliability, availability, cost, target orbit as well as payload mass and volume. The launch performance to GTO is of 6066 kg and the launch cost has been assumed of about $80M. The Zenit-3SL launcher leaves the satellite in GTO parking orbit and it is the duty of the spacecraft apogee kick engine to circularize the orbit by means of a series of perigee rising maneuvers performed at apogee.

Ground Segment

The Ground Segment is the central nervous system of S@tMax, providing command and control of the space segment satellite, state of health monitoring, housekeeping of the infrastructure segment towers, data processing for payload data and routing of IP packets to the Internet. The Ground Segment is comprised of 6 ground terminals, one manned terminal, the Mission Ground Station (MGS) and five autonomous, unmanned, gateway terminals. The MGS houses all operational hardware, software and operators. Each gateway terminal has a 5.6 m antenna and output power of 1 kW, supporting an uplink of 9 Gbps and a downlink of 4.5 Gbps to link the two satellites. These terminals provide the network to the satellite and connect directly into the fiber backbone through the MGS. The MGS handles all data processing with total system throughput of 36 Gbps.

The MGS acts as the communications hub for the five gateway terminals, linking each terminal to the data from content providers, as well as user IP address information, user locations, satellite ephemeris and other critical operational data. The gateways act as hot backups for each other allowing for one station to be taken down for repairs while another picks up the traffic. The MGS coordinates all maintenance activities between terrestrial towers. Primary communications from the MGS to the gateway terminals through dedicated leased “spoke” fiber lines. These lines are leased from telecom providers by S@tMax with service entirely dedicated to daily operations of the system. The “hub” optical fibers link each of the ground stations together acting as spare fiber backups. If a spoke link goes down for repairs the hub links will be activated providing a redundant path.



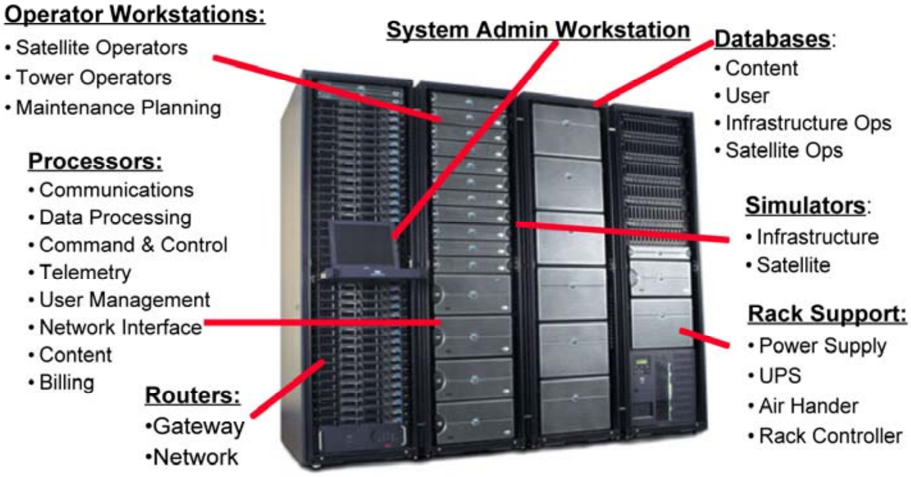
The Ground Segment is deployed in a phased implementation approach. The MGS will be on line with initial operational capabilities in 2008. These capabilities include initial operational infrastructure segment command and control as well as data processing for leased bandwidth services. The gateway terminals will then incrementally roll out to expand capacity from 2008 to 2013 when the Ground Segment achieves final operational capabilities with, 5 gateway terminals and a completely operational MGS with full functionality including satellite and tower operational controls.

The manned station is staffed 24 hours a day, seven days a week, with three shifts of 10 operator types responsible for satellite operations, network monitoring, data processing, and general system operations. The number of people staffing the 10 operator positions grows as the business grows and the complexity of system operations increases.

Ground Segment Hardware

To perform the necessary functions to operate and control the system, the Ground Segment has been divided into five elements. The Space Command and Control Element (SC&CE) provides daily operations of the satellite(s), telemetry monitoring and anomaly mitigation. Terrestrial tower operations, maintenance and usage planning is performed by the Infrastructure Command and Control Element (IC&CE). Linking the system to the Internet, including data protocol translation and content requests, are handled by the Network Link Element (NLE). The Data Processing Element (DPE) provides the functionality for all data handling and data processing. This includes data compression, content processing and protocol formatting. Finally, the User Services Element (USE) will manage and track all user information including login information, user password, account management, and billing information compilation. The combination of these five elements creates the entire functionality of the GS including satellite operations, terrestrial network operations, content collection and distribution, user account management, and data processing.

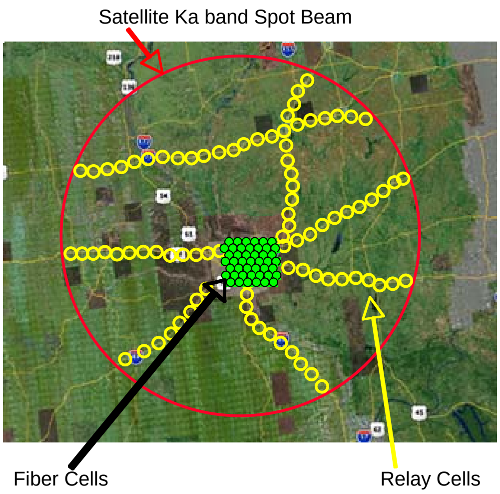
The Ground Segment Elements are comprised of software and hardware configuration items. The GS hardware is built with common components from commercial off the shelf (COTS) products in order to reduce development costs, ensure upgradeability/scalability, and reduce operational costs. This is a modular design with basic components that can be mixed and matched based on hardware needs for each element component. In addition, the use of compatible and swappable components improves availability by reducing the meantime to repair (MTTR). Each element contains multiple processors, operator workstations, servers, simulators, and storage RAIDS for databases. The nominal layout of hardware racks are depicted in the figure below.



As the system grows, these components can be modularly upgraded through the addition of new hardware expanding system capabilities. The Data Processor is responsible for; Encrypt/decrypt Packets, Route Packets, Mux/DeMux, Data Distribution (infrastructure/Space), Manage Content Distribution, Manage Content Requests. As the number of system users increases, the number of Data Processors increases. By 2017 the market analysis and throughput model shows a peak simultaneous number of users at 2 million. The Dell 2850 Advanced with the Dual Core 2.8 GHz Xeon with dual 2MB caches benchmarks at 38,688 transactions per second. To support 2 million simultaneous users, ~260 processors are required, a total investment of ~$2.8 Million. The Data Processor, Content Processor and the User Tracking Processors will handle a higher throughput as the user base grows.

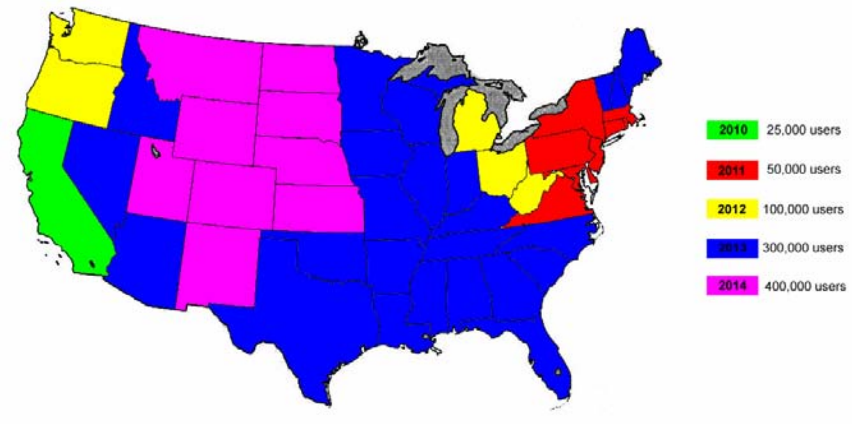
Infrastructure Segment

The infrastructure Segment provides a high data rate connection to the user vehicle through terrestrial Mobile WiMAX towers. In cities the IP-connection is established through Mobile WiMAX towers directly connected to the Internet. On the USA interstates the connection is provided through Mobile WiMAX towers that are connected to the Internet using a geostationary satellite link. The Mobile WiMAX tower is sized at 10 Mbps using a 10 MHz frequency channel and a cell range of 10 km. S@tMax delivers per spot beam a down-link and up-link data rate of respectively 642 Mbps and 321 Mbps. Assuming ~110 relay towers, with each 100 active users, are needed per spot beam to provide interstate coverage, the average data rates provided to S@tMax users is 60 kbps downlink and 30 kbps uplink. Under the same assumptions, e.g. 10 Mbps using a 10 MHz frequency channel, a cell-range of 10 km and 100 active users, the same data rates are provided through the fiber towers. The number of frequency channels deployed per tower enables higher data rates if needed to support the offered traffic. The deployment of these infrastructure cells is detailed in the figure below.



The deployment of the Mobile WiMAX towers is driven by user need, local business potential and S@tMax payment availability. Within this context, S@tMax strives to reach 95% coverage of USA interstates as soon as possible. The fiber towers and relay towers are rolled-out synchronously over the USA with the objective of providing transparent IP-connectivity when crossing a city while moving from one interstate to the other. In the cities the major roads connecting the USA interstates have Mobile WiMAX fiber towers deployed. In 2007 a government grant is used for a test case of Mobile WiMAX over fiber towers performed in California. In 2010 a test case is performed for Mobile WiMAX over relay towers. The role-out of the relay towers is presented next.

After 2014 the increase of total relay tower capacity is continued by the addition of frequency channels at the cost of $5,000 per channel. Additional relay towers can be easily upgraded to fiber towers and candidates can be selected on a case by case basis.



The relay tower is built from a VSAT antenna plus base station and a Mobile WiMAX antenna plus base station. The DVB-S2/ DVB-RCS VSAT is a 0.66 m to 1 m antenna, transmitting at 29.75 GHz and receiving at 19.95 GHz. The cost of the antenna is $390. The DVB-S2/ DVB- RCS base station has a capacity of 50 Mbps and can handle 200 active users at an estimated cost of $5,000. The Mobile WiMAX antenna, using smart antenna beam forming, achieves a capacity of 10 Mbps, with a 10 MHz frequency channel at a range of 10 km. The beam is a linear design to optimize road coverage. The operating frequency of the Mobile WiMAX can be either 2.5 GHz or 3.5 GHz. The Mobile WiMAX antenna cost is $6,000. The Mobile WiMAX base station has a throughput of 50 Mbps and handles 200 active users simultaneously at a cost of $5,000. If needed solar panels, batteries and charge controller can be attached to the relay tower to secure the power supply in remote areas. To limit tower construction cost, use of existing infrastructure such as telephone poles and billboards will be used as frequently as possible. The total cost of a fully deployed Mobile WiMAX relay tower is estimated at $25,000. The fiber tower contains a WiMAX antenna and base station. The total cost of a fiber tower is estimated at $20,000 assuming a simple connection to the Internet. The relay tower is easily refurbish-able to a fiber tower.

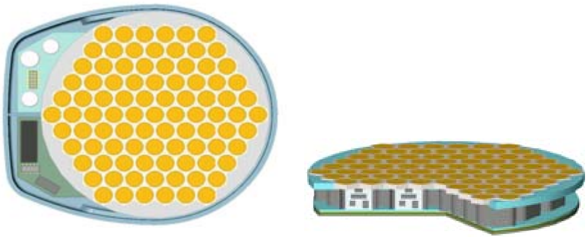
User Segment

The S@tMax user accesses S@tMax using a standard device operating on IPv4 or IPv6. This standard device interfaces with S@tMax system using Wi-Fi, Mobile WiMAX or USB-port. The device is readily integrated into the vehicle or a later-on installable portable item.

The S@tMax user equipment supports all three link types described: the direct-to-satellite link, the Mobile WiMAX relay tower link and the Mobile WiMAX fiber tower link. The user equipment contains two user components: one component to secure the direct-to-satellite IP-connectivity and one component to secure Mobile WiMAX IP-connectivity. The cost of each user component is ~$100. The user terminal is readily integrated into the vehicles as OEM or can be purchased aftermarket as portable electronics. Depending on specific user needs, the user can mix and match the two components.

The user component providing Mobile WiMAX IP-connectivity has a maximum throughput of 10 Mbps using a 10 MHz channel and an operating range of 10 km. The operating frequency is either 2.5GHz or 3.5 GHz and is based on Time Division Duplexing (TDD). The Mobile WiMAX user terminal comes in a standard version and a Memory Card International Association (PCMCIA)-card respectively shown below:

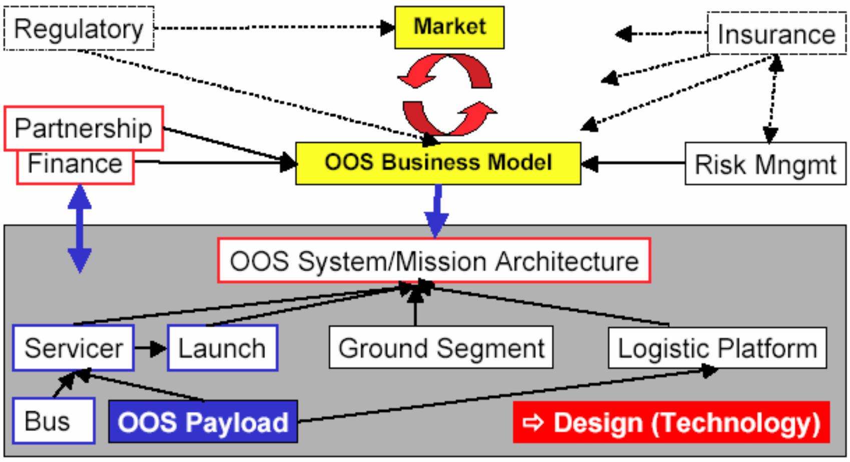
The user component providing direct-to-satellite IP-connectivity consists of an indoor and outdoor element. The outdoor element is a flat dual band patched antenna using Ku-band uplink and C-band downlink as shown below. Based on present state of the art of mobile Ku-antenna's, the size of the S@tMax direct-to-satellite antenna is set to be a diameter of 15 cm and thickness of 1 cm. The downlink will be based on the Digital Video Broadcasting (DVB)-technology. The antenna is integrated into the roof of the car to ensure good coverage of the sky. The transmitted power is limited to 1 W to meet FCC regulations. The total down-link and up-link capacity of the S@tMax direct-to-satellite link is respectively 1 Mbps and 21 Mbps. The antenna is shown below.



On-Orbit Servicing

Introduction

On-Orbit Servicing (OOS) is an emerging field of space technologies and operations which provide opportunities for new ways of implementing satellite systems designs and which also can increase flexibility and efficiency of systems architectures and associated business plans. Satellite problems can be fixed on orbit, systems can be upgraded, mission flexibility can be increased and entirely new missions may be enabled. An associated field is On Orbit Assembly (OOA) which can be used in conjunction with OOS to allow innovative solutions outside the traditional boundaries of the space industry. The various elements that tie together in the technical and business systems have been summarized in the diagram below:



For the purposes of this business plan it was assumed that all OOS services are commercially available in order to trade off the business case with OOS against the business case without OOS.

Applicability

OOS was examined in three contexts: the business plan, the systems architecture and OOS technologies. An initial value assessment of the case for OOS resulted in the following table:

Service class	*Kind of service*	*Value*	*Cost ($M)*
Motion	**Rescue / re-orbiting**	**High**	**50**
	De-orbiting	Low	25
	Salvage	Low	50
	Maintenance	**High**	**75**
	Repair	Med	100
Manipulation	**Retrofit / upgrades**	**High**	**75**
	Docked inspection	Low	10-25
	Satellite life extension	**High**	**75**
	Remote visual inspection	Med	1-5
Observation	Non destructive evaluation	Low	5-10

The most promising areas of OOS are highlighted in yellow in the table. The associated costs are also listed and were accounted for in the S@tMax Business Engineering trades.

Implementation Trade

A system engineering analysis was performed of the system and the S@tMax team established an OOS baseline or point of departure scenario. As a result of the concept evaluation process, the following OOS concepts were recommended for further study to the systems design and Business engineering sub-teams:

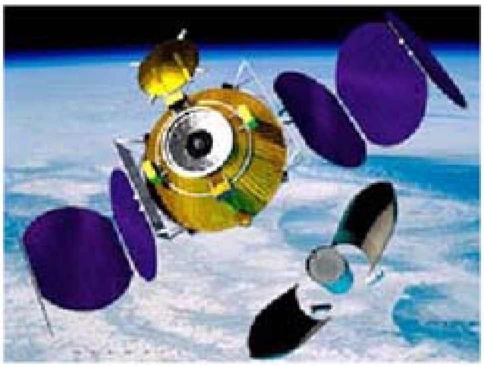
Concept # 1 Orbital Rescue/ Insurance Mitigation

Concept # 3 Modular Incremental Satellite

Concept # 6 End of Life Extension

Concept #6, End of Life Extension with a GEO tug satellite (such as the Orbital Recovery Corporation Orbital Life Extension Vehicle (OLEV)), is technically feasible as the OLEV can grapple the S@tMax satellite nozzle and take over station keeping, thereby providing an extra 8 years of life. The net cost savings will amount to $228 M. In addition there will be additional revenues being generated by the extended life satellites. All satellite parts must be designed for a 23 year life and the solar panels must be changed out on orbit after the 15 year end of life period. With this rationale, End of Life extension was base lined for the S@tMax system.

The S@tMax business team concluded that insurance was not desirable in this business plan. If a satellite failure occurs then the business case will be delayed while the replacement satellite is launched at a cost of $280 M. However OOS Concept #1 has the potential to eliminate the launch of a replacement satellite if the cause of system failure is due to a wrong orbital insertion. In this one case, then the S@tMax satellite can be rescued and placed in the proper orbit by a space tug OOS servicer. The cost of such a service is $50 M therefore resulting in a cost savings of $230 M and a schedule savings of approximately 2 years, since the fabrication and launch of an extra satellite are avoided. Clearly in this case OOS is desirable, and the orbital rescue OOS option was also baselined for the S@tMax business plan as a contingency option. Insurance was assumed to cost 20% of the satellite cost or $142M. Since the cost of OOS rescue, if possible, is less than half at $50 M, both timeliness and cost savings dictate that OOS rescue shall be used as a contingency function in the S@tMax system. The Orbital Recovery Corporation rescue /re-orbit vehicle is shown below.



Concept #3 was also evaluated and traded off against the business and technical plans. As a result, the business case analysis showed that two large investments of $430 M and $280 M were hard to absorb at the beginning of life of the business. This led to a trade study, where a modular capability was analyzed. The modular satellite can then be deployed in smaller investment increments, therefore spreading the cost of the satellite over more time. The satellites could be co-located in the same orbital slot, or they could dock and then share power and station keeping functionality. The transponder capacity could be re-directed between several satellites to match the area of highest bandwidth demand.

In order to substitute a modular system, then 6 satellites must be launched to meet the capability of the Boeing 702 platform. This implies a total cost of $1,644 M vs. a cost of $710 M for the larger birds. This means that the modular system is by definition more expensive than the single GEO satellite. In order to make up for the higher cost, then there must be a significant time phasing advantage where the deployment of the satellites can be spread out over time in order to reduce the discrete investment magnitudes and provide a better business model. In order to achieve the S@tMax system, then 4 satellites must be launched per year, from Year 1 (2010) through Year 3 (2013) when the full capability is activated. Since there is risk associated with every launch and docking, the cumulative risk of 12 launches is 64% whereas the cumulative risk of 2 launches is 92%. Since the mission risk is much higher for the multiple satellite scenarios and the business case advantages are not significant, then it is judged that it is preferable to launch 2 large BSS-702 satellites.

Conclusion

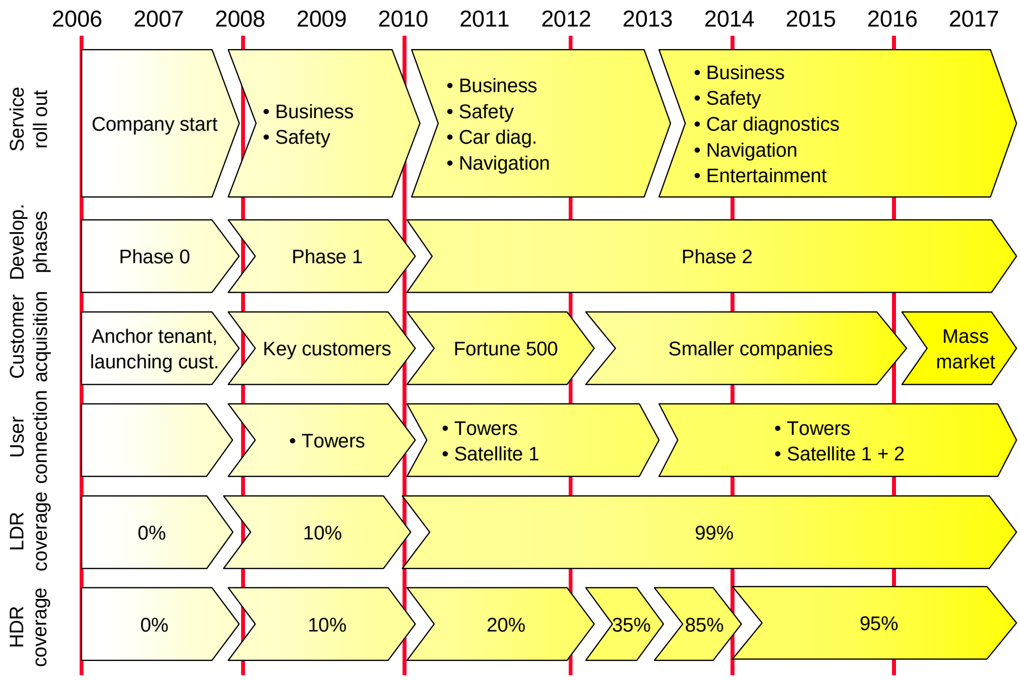
The conclusion of the OOS trade study is that end of life extension OOS is desirable, thereby increasing the life of each satellite form 15 to 23 years with an associated cost savings of $228 M, if the state of the satellite and the technology progression allows it. This implies that the satellite should have components selected for a 23 year life. A secondary conclusion is that orbital recovery is a desirable OOS option as an insurance mitigation strategy with a potential contingency cost savings of $230M.

The use of a modular satellite system is not recommended since 12 satellites must be launched to replace a system of 2 satellites and the associated risk is judged to be too high in relation to the cost and business case advantages of spreading out the discrete investment amounts.

Business

Business Implementation

The following figure shows the high level S@tMax implementation model.



Investment Opportunity

S@tMax has an excellent investment opportunity on offer. There are three investment possibilities: in 2008 and 2009 $33 M of S@tMax shares are offered. This is complemented by a share offering of $130 M in 2010. The first offering is intended for a strategic investor such as a car manufacturer like Mercedes and Toyota. The second offering of $33 M is intended for a telematics service provider like OnStar. The third offering is intended for a financial investor.

In 2012 a buy out is foreseen by the second strategic investor, the service provider. S@tMax will start paying dividend in 2014 of 50% of the net income.

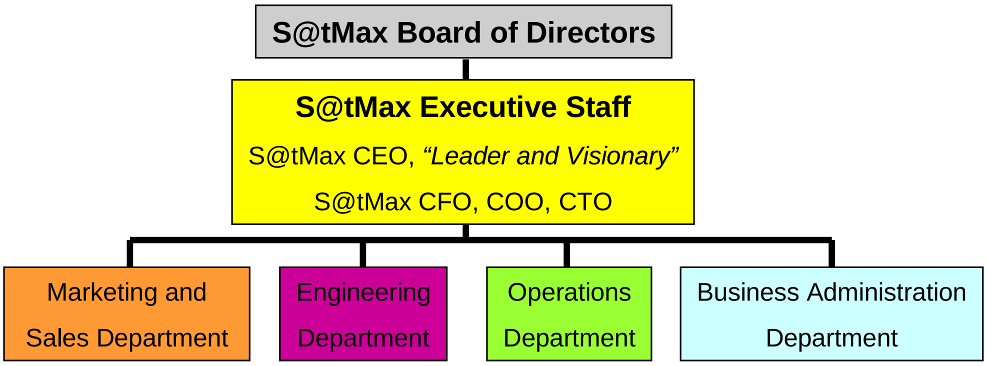
Investor	***Investment (M$)***	***Divestment (M$)***	***Years***	***Capital gain (M$)***	***Multiple***	***IRR (%)***
Founders	4	214	6	210	53.54	94.14%
Strategic 1	33	124	4	91	3.76	39.23%
Strategic 2	33	-533	3	-566	-16.16	8.13%
Financial	130	195	2	65	1.50	22.47%

The returns on the investments are excellent as can be seen in the table above. In 2017 strategic investor 2 shall not only have achieved an IRR of 8%, but will also own a company that is valued at $6.4 B.

The valuation of the company is based on the Price/Earnings method. The P/E of comparable sectors like auto dealerships, business services, Security and protection services are used. A discount of 30-40% is taken into account. More details about this are given in the financial section of this document.

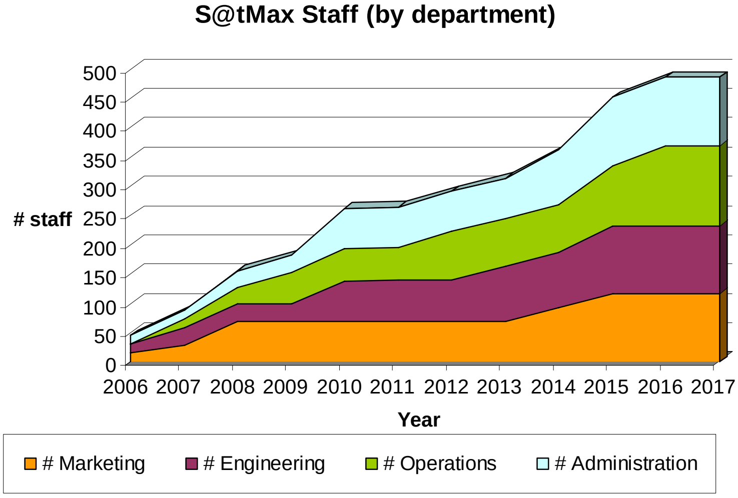
Management and Organization

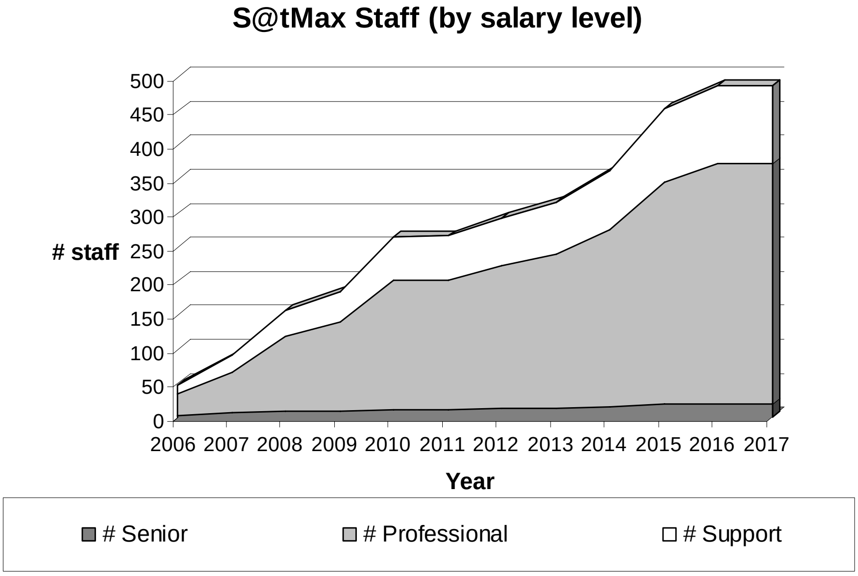
The S@tMax proposal envisions a small company which grows steadily, but realistically, throughout the life cycle according to the time-phased resources required to meet all major corporate milestones. The Chief Executive Officer (CEO) is the visionary leader who will define S@tMax and continually influence progress toward meeting all corporate milestones, both technical and financial. Additional executives who will support the CEO are as follows: Chief Financial Officer (CFO), Chief Operations Officer (COO), and Chief Technical Officer (CTO). The corporation itself is divided naturally into four departments as shown below.



The "Marketing and Sales Department" is responsible for promoting the S@tMax products and services through strategies that include raising customer awareness through education, enabling customers via S@tMax, and securing the market for S@tMax through proactive partnerships and exclusive agreements. This department has accelerated staffing growth early in the life cycle to begin promotion activities and remains strong throughout the life cycle in order to sustain market penetration and promote new services. The "Engineering Department" is responsible for the technical development and integration of all system elements required to deliver S@tMax products and services. This department also has accelerated staffing growth early in the life cycle in order to begin production/procurement of long-lead items. The "Operations Department" is responsible for all day-to-day and strategic activities associated with operating and maintaining a hybrid space-based and terrestrial architecture. This department will lag in staffing growth due to the later, time-phased nature of supporting operational requirements. The "Business Administrative Department" is responsible for all day-to-day and strategic activities associated with operating and maintaining a healthy corporation. This department will lag in staffing growth due to the later, time-phased nature of supporting operational requirements.

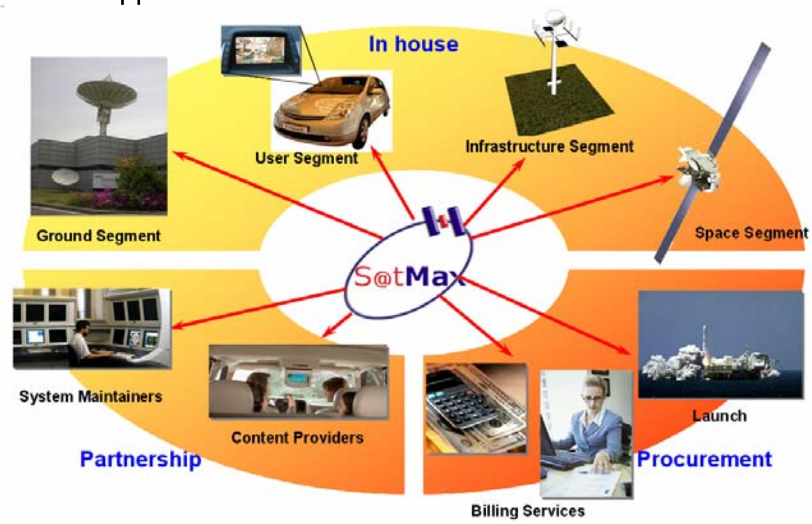
From a salary level perspective, S@tMax is composed of four levels of salaries: executives at $250K/year, senior management at $150K/year, professionals at $80K/year, and administrative Staff at $50K/year. It is important to note that these salaries are shown and used as the costs to S@tMax per employee, not the salary each employee can expect to take home. It includes estimates of per employee for benefits, etc. that S@tMax must pay in support of each employee. It was assumed that each manager had approximately the same number of professionals and approximately the same number of administrative staff to maintain a healthy balanced employee ration. In specific organizational areas during specific time periods this ratio was augmented due to specialized supporting rationale. The figures below showcase both the time-phased staffing profiles per department and the time-phased staffing profiles per salary level.





Partnerships

The S@tMax system relies on external knowledge. The following figure depicts the procurement approach for various elements.



Financial

Main Assumptions

For the financial plan, the following assumptions were made (for the year 2017):

- Revenue
  - Service: $7.4 B
  - Revenue per user equipment sold: $20
  - User equipment: $1.2 B
  - Total revenue: $ 8.6 B
- Investments
  - Satellite 1 (incl. launch): $430 M
  - Satellite 2 (incl. launch): $280 M
  - Ground segment: $50 M
  - Infrastructure segment: $207 M
- Cost of Goods Sold (COGS)
  - Strategic partner cost: 75% of service revenue
  - Customer acquisition cost per new user : $180
  - Cost of user equipment per new user: $180
- Operating expenses
  - Cost of personnel: $38 M (493 people)
  - Marketing and sales: $381 M
- Other
  - Depreciation: 15 years
  - Interest Rate: 7.5%

Financing Plan

The S@tMax financing model assumes three types of investors: the founders of the company, strategic investors with an industrial motivation that are thus willing to accept more risk than the third type of investor, the financial investor, which sole purpose is to generate superior returns. Apart from equity, S@tMax needs loans to finance the investments. Debt financing is obtained from banks.

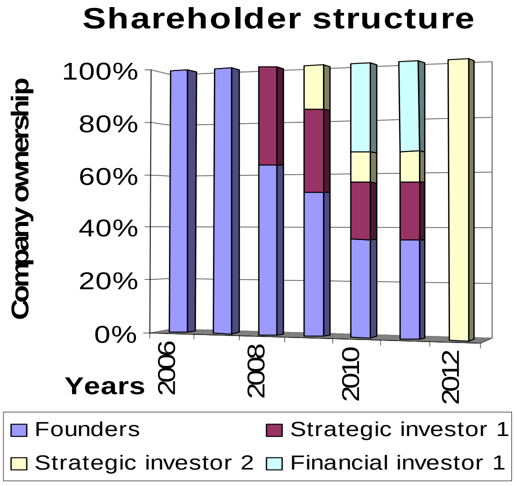
Year	*Type*	*Identity*	*Equity (M$)*	*Debt (M$)*	*Total (M$)*
2006	Founders	Company founders	4	-	4
2008	Strategic investor 1	Car manufacturers	33	-	33
2009	Strategic investor 2	Service provider	33	-	33
2010	Financial investor	Venture capital	130	-	130
2010	Bank		-	400	400
2011	Bank		-	16	16
2012	Bank		-	0	0
2013	Bank		-	105	105
		Total	200	521	721

The investment plan for S@tMax is shown in the table above. Strategic investor 1 could be a car manufacturer like Mercedes, Fort or Toyota. Helping to start the S@tMax business will allow them to expand services to their customers and sell more cars at a better price. Strategic investor 2 could be a service provider like OnStar. OnStar could expand its services with the S@tMax communications system. A total of $200M will be raised in 8 years.

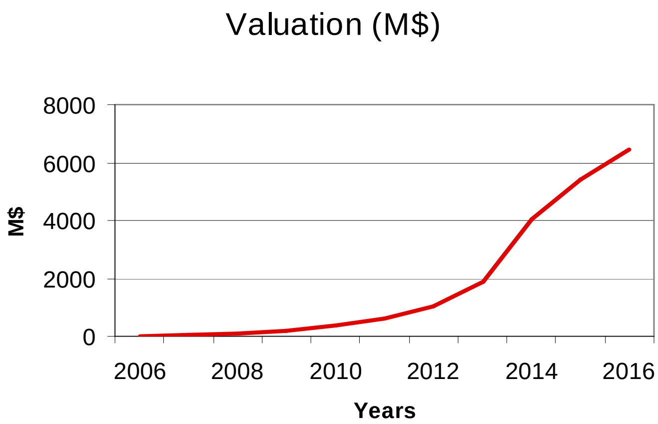
Strategic investor 2 has an interest in acquiring the full company when it is fully up and running. The exit strategy for the other investors will therefore be a buy out trade sale to strategic investor 2 in 2013; this is shown in the following table.

Investor	***Trade sale***
Founders	100%
Venture capitalist	100%
Strategic investor 1	100%
Strategic investor 2	0%
Financial investor	100%

Before the buy out, a trade sale of shares will be accepted. Whenever new shares are sold, the other shares will dilute. This dilution is shown in the following figure.



The amount of dilution strongly depends on the valuation of the company. The valuation of S@tMax is based on the average price, earnings ratio (P/E) of comparable industries applying a discount of 30-40%. This P/E is applied over the average net income of five years. This method can only be applied in the profitable years of the company. Therefore it is implemented from 2012 onward. For the years before the company reaches profitability, the valuation is based on an extrapolation of the P/E justified valuation, raised equity, established customer base, available infrastructure, strategic partnerships etc. The valuation of S@tMax is shown in the next figure.

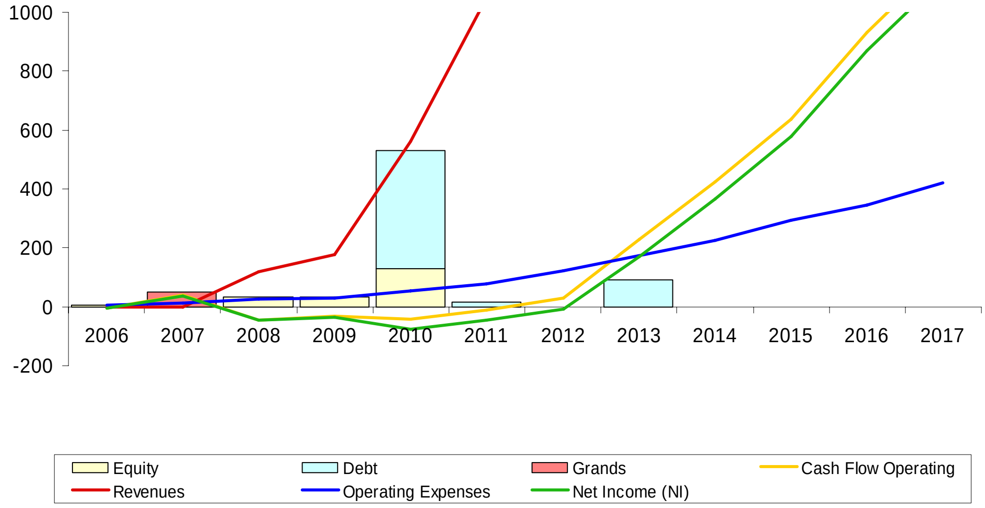


The expected gain on investment of the various investors over the invested years is shown in the table below. As can be seen the capital gained as relative to the made investments and the number of invested years is excellent. S@tMax will start paying dividends of 50% of the net income in 2014.

Investor	***Investment (M$)***	***Divestment (M$)***	***Years***	***Capital gain (M$)***	***Multiple***	***IRR (%)***
Founders	4	214	6	210	53.54	94.14%
Strategic investor 1	33	124	4	91	3.76	39.23%
Strategic investor 2	33	-533	3	-566	-16.16	8.07%
Financial investor	130	195	2	65	1.50	22.47%

Finance

The implementation plan leads to a financial result. This result is given in the profit and loss account summarized in the figures below.



As can be seen in the figures above, the J-curve of the net income reaches a positive number in 2012, which is rather late. This can be explained by the conservative market penetration curve assumptions and by the high investment needs of the company. However, from an investor point of view, this can be overcome by the fact that the equity is also raised late in the business development, so that the invested years are not so many, and by the potentially excellent return on investment.

Performance

Some of the performance indices for S@tMax are given in the table below.

Year	***2008***	***2013***	***2015***	***2017***
COGS (%)	117.4%	85.9%	83.1%	81.5%
Operating Expenses (%)	20.4%	5.6%	5.2%	4.9%
Personnel (%)	10.8%	0.8%	0.6%	0.4%
Depreciation (%)	1.4%	1.9%	1.1%	0.7%
Profit on Revenues (%)	-39.2%	5.5%	8.0%	9.2%
Return on Capital Employed (%)	-127.7%	84.9%	226.5%	396.0%

Since the costs of the strategic partners are 75% of the service revenue, these indices give a some what slanted representation of the company. The following table shows the indices where the revenue is corrected for the high service cost.

Year	***2008***	***2013***	***2015***	***2017***
COGS (%) *	81.4%	32.6%	28.2%	25.6%
Operating Expenses (%) *	31.9%	11.9%	11.5%	11.0%
Personnel (%) *	55.4%	2.8%	2.1%	1.5%
Depreciation (%) *	2.2%	4.0%	2.4%	1.6%
Profit on Revenues (%) *	-61.4%	11.7%	17.8%	20.7%
Revenue per Capita (M$) *	40.7%	386.5%	470.3%	658.3%

*: Corrected for service partner cost.

These indices show that the business is profitable, strong and sustainable. The business engineering analysis shows that this business plan has a high potential return on investment (ROI) and is a good investment opportunity.

Risk Management

Overview

Risk Management is a "living" process that acts as an ever-vigilant watchdog throughout the life cycle of any project. Typically, risks are assessed in terms of two components: likelihood and consequences. If the current risk ranking is of sufficient concern, then proactive risk mitigation activities are developed to either reduce the likelihood or consequences to an acceptable level. It is important to note that some risks may only require monitoring until better risk definition can be developed. Understanding risks upfront and proactively managing them is critical for assuring a consciously selected risk posture, complete with the proper safeguards. For the S@tMax proposal, a customized, configuration-managed Risk Management Tool (RMT) was used and separated into the following two categories: S@tMax Corporation Risks and S@tMax Design Risks. Risks were monitored approximately bimonthly basis to incorporate any newly identified risks, modify existing risks based on more current data, and/or retire old risks where possible.

S@tMax Corporation Risks

S@tMax Corporation risks are associated with overarching corporate success. Several substantial negative events can occur during the lifecycle of any commercial space program which could kill or at the least severely disable the corporation. The table below contains the final snapshot of this section of the RMT and highlights the risks of most concern.

Risk/Event	Likelihood (1 <=> 5) 5 = likely	Consequence (1 <=> 5) 5 = severe	"5X5" ranking
Launch Failure	2	4	8
On-orbit Space Segment Failure	1	4	4
Ground disaster	1	4	4
Loss of key personnel	1	3	3
Potential liability & customer lawsuits	2	4	8
Business Case Risk	3	4	12

The "business case risk" is the standout area of concern. While the selection of the innovative S@tMax products and services was the result of several months of marketing research, significant uncertainty still exists with respect to robustness of the overall baseline business case against deviations. To better understand this risk, the business sub-team performed a sensitivity assessment (shown next). The sensitivity assessment showcased business case robustness against several negative scenarios, but also showcased heightened sensitivity to revenue predictions. Mitigation strategies exist to deal with this scenario real-time should early warning indicators trigger concern.

Risk/Event	Sensitivity Result
Development cost growth, excess of 10%	No appreciable affect, potential investment strategy mod
Time to market delay, schedule slip of 6 months	No appreciable affect, extend/expand leased bandwidth
Launch/space-segment failure, total loss of first satellite	No appreciable affect, extend leased bandwidth
Operating cost growth, 30% higher than prediction	Significant reduction in profitability if growth remains
Market share not achieved, 30% lower than prediction	Significant reduction in profitability, customers/revenues are critical, investment strategy mod
Price reduction required, 30% price reduction	Significant reduction in profitability, customers/revenues are critical, investment strategy mod

Insurance

Launch failure risk and on-orbit failure risk is also of interest. While the likelihood of such an event is somewhat low, the negative consequences are intuitively high. This difficult likelihood and consequences combination, coupled with the possibility of purchasing insurance as mitigation, establishes an interesting risk versus cost trade space. The S@tMax proposal establishes a phased approach to spiraling up the products and services. In the early stages, satellite bandwidth will be leased from existing satellites to build a customer base and establish a sustainable business. Later, S@tMax will launch its own satellite and only continue leasing bandwidth as needed. Furthermore, procurement of a second satellite to enhance system capability or act as a spare is planned to be available a few years after the first satellite. This approach would mean that a failure of the first satellite (during launch or while on-orbit) would result in the loss of that asset and an unscheduled "pause" in the spiraling up of the business plan, but not necessarily a deathblow to the S@tMax system or corporation. Finally, whether or not insurance was purchased, the system and corporation must be robust enough to continue after incurring asset loss or merely receive the financial compensation and liquidate the business, which was not a favorable option to the team. So, after considering this trade, the strategy is to not purchase insurance for the first satellite and evaluate the outcome. Pending the outcome of the first satellite, a decision would be made concerning the second satellite.

S@tMax Design Risks

S@tMax design risks are associated with successful development of the hybrid satellite/terrestrial network. Several complex and competing challenges exist both in the system architecture development and in the real-time orchestration of the fully operational system. These trade spaces were iteratively evaluated per systems engineering processes. During the functional view and physical view definition process, the team identified the major system architectural risks (see table below). The final snapshot of this section of the RMT highlights the risks of most concern.

Risk/Event	Likelihood (1 <=> 5) 5 = likely	Consequence (1 <=> 5) 5 = severe	"5X5" ranking
SE1) Satellite coverage, bandwidth and latency issues	2	4	8
SE2) Complexity of space segment, ground segment, and infrastructure design	4	3	12
SE3) Frequency allocation and link budget issues	3	4	12
SE4) Infrastructure command and control complexity	4	3	12
SE5) Content provider integration	4	3	12
SE6) Competing technologies	2	4	8

In order to cope with the above major system architectural risks, the following four architectural guidelines were identified for the S@tMax system: Upgradeability, Modularity, High Quality of Service, and Security.

Legal and Regulatory Risks

Also of interest are the risks associated with frequency allocations, orbital slot allocations and other general legal/regulatory issues. This category is quite extensive and requires breadth of understanding for proper risk assessment and mitigation planning.

The Federal Communications Commission (FCC) shares spectrum management responsibilities with the National Telecommunications and Information Administration (NTIA). The situation becomes complicated as radio spectrum is a limited resource and decisions by one agency often affect the other. Furthermore, the rapid evolution of wireless technology coupled with a constantly changing market demand, make it difficult for spectrum regulators to forecast what services will be available or which frequency range will be efficient for a given service. The challenge of the regulatory agency becomes the challenge of the spectrum requester to “compete” for this limited resource and secure all of the appropriate commitments in a timely manner. Complicating the situation further, radio waves transcend national borders and there are an increasing number of global services making international coordination of spectrum and GEO orbital slot allocations critical. Conferences of the International Telecommunication Union (ITU) are the principal mechanism for international spectrum allocation. Several complaints have been filed against the FCC and ITU by recent spectrum requesters sighting schedule backlogs of almost 2 years. There are many other legal and regulatory aspects to the S@tMax system with respect to broadcasting frequencies, operating satellites, operating ground stations, portable transmitting wireless devices, etc. To help mitigate this risk, the team has intentionally proposed a system that utilizes standard commercial frequencies, stays below transmission power level thresholds of concern, and basically stays well within the realm of “typical” and “available.” No “show-stoppers” to date have been discovered with the current S@tMax proposal from a legal and regulatory perspective, however this aspect of the proposal requires special attention by experienced professionals of this discipline as there are significant technical, cost and political considerations. To that end, the current risk management strategy is to bring, at the appropriate time, expert guidance onto the S@tMax Corporation team strictly to deal with these issues (early enough to mitigate unacceptable risks with sufficient lead time).

Finally, there are concerns over potential future safety regulations that could affect the usage and, therefore, sales of mobile services. Many of our products and services are meant to be active and supportive to the vehicle operator and passengers, while at the same time, not distracting to the vehicle operator. Several studies have been conducted which offer vague and sometimes contradictory assessments of the dangers of driving while using a cell phone, especially a hands-free cell phone, but only fairly recently have debates raged about regulations aimed at limiting usage in the name of safety. Clearly, from a regulatory standpoint, the USA tends to be reactionary and slow when attempting to pass legislation to impose usage limits on the public. This historical trend could be seen as a positive for S@tMax in that it could mean years of regulation-free existence. However, there also exists significant uncertainty as to how a potentially changing legal/regulatory landscape in the future could affect S@tMax, and uncertainty equals risk. The team has elected “common sense” safeguards to facilitate safe usage while the vehicle is moving. However, the proposal stops short of attempting to make the system totally “idiot proof” as this would overly limit system capabilities and constrain users who would safely use the system while the vehicle is in motion. This philosophy includes product and service limitations for the driver while the vehicle is in motion, while offering a full suite of products and services for the backseat passengers, for example, while the vehicle is in motion (i.e. entertainment package).

Conclusion

S@tMax is developing mobile internet protocol (IP) connectivity and data solutions for vehicles on roads in urban areas, on highways and in remote areas. This will be achieved with a hybrid satellite-terrestrial wireless communications system.

Initially, an extensive market survey and analysis was conducted. Respected industry sources, market research company forecasts and consumer surveys were used to identify the most promising market sectors. The sectors selected were the high data and low data telematics market in the USA, which is at the early stages of rapid expansion. Growth rates for the USA are predicted to be 25% per annum by 2017 with the largest world Telematics market share of 40%. This market share rate can be translated into an addressable market of 90-100 telematics enabled vehicles of which the predicted S@tMax share is 16-18 million vehicles in 2017.

This research also led to the selection of S@tMax's innovative, "in demand" telematics products and services, which were bundled into service packages for Safety and Security, Diagnostics, Navigation, Business Internet and Entertainment. In the future, additional data mining products for third party vendors will be introduced to companies such as the weather service and traffic routing companies. By 2017, 49 million subscriptions to S@tmax services are predicted with the main revenue contributors being the Business and Safety & Security packages.

A system engineering package was completed which shows that the proposed hybrid satellite/terrestrial network, ground segment, and infrastructure segment is both novel and technically feasible. The S@tMax space segment employs high-performance, high capacity, bent pipe Ka-band spot-beam technology to offer a total capacity of 33.7 Gbps to the users of its High Data Rate services. The mobile rural communication payload consists of a set of Ku-band and C-band transmitters and receivers providing a total capacity of 32 Mbps and 21 Mbps, respectively for the downlink and uplink, over CONUS coverage footprint.

On Orbit Servicing (OOS) was investigated and included in the systems engineering process. The conclusion of the OOS trade study is that end of life extension OOS is desirable, orbital recovery is also a desirable OOS option as an insurance mitigation strategy, and the use of a modular satellite system is not recommended since 12 satellites must be launched to replace a system of 2 satellites without substantial business case or technical benefits.

The baseline business case was optimized and is strong, promising, and risk-balanced for founders and investors. This document shows that the S@tMax business case is viable, profitable and sustainable. The ROI has a multiple of 3.8 over 4 years, which is very attractive for the investor.

For the S@tMax proposal, a customized, configuration-managed Risk Management Tool (RMT) was used and separated into the following two categories: S@tMax Corporation Risks and S@tMax Design Risks. Risks were assessed bimonthly, including the case for insurance and legal and regulatory risks. The risk posture has been consciously chosen and is acceptable.

Overall SatMax has a vision of being the Market leader in developing mobile digital data solutions with the primary objective of providing two way, Direct-to-Mobile-User wireless communications to vehicles on USA roads via a hybrid satellite system. This business plan provides the technical and business solutions based on solid systems and business engineering methods.

The S@tMax Team

Marco Arcioni	European Space Agency (ESA)
Erik Daehler	The Boeing Company
Zeger de Groot	Ursa Minor B.V.
George Gafka	NASA/JSC
Herve Kerouedan	S@tMax
Rob Mueller	NASA/KSC
Bart Peeters	Ursa Minor B.V.
Wencke van der Meulen	Netherlands Agency for Aerospace Programmes (NIVR)

Contact

Delft TopTech
Delft University of Technology
Mekelweg 2
P.O. Box 612
2600 AP Delft
The Netherlands

Phone: +31 15 278 80 19
Fax: +31 15 278 10 09
E-Mail: info@delft-toptech.nl
Home page: http://www.delft-toptech.nl