

# **A Communication-Navigation System for Worldwide Vessel Tracking**



## **Executive Summary**

**SpaceTech 7  
Delft University of Technology  
Delft, The Netherlands  
June 2005**





## **Communication-Navigation Services Executive Summary**

Rapid technological progress in space-based communication and navigation combined with increasing regulatory requirements and pressure to reduce cost are opening up new and exciting commercial opportunities.

ICON Satellite Systems will provide an end-to-end solution for asset tracking and fleet management, positioning and tracking, messaging and security for all types of sea-going vessels via Inmarsat's geostationary communications satellites and two proprietary micro-satellites in low-Earth orbit to ensure coverage of the polar regions. The service employs a vessel-based user terminal to send and receive navigation status and other information as part of digital messages.

ICON Satellite Systems will provide a global spaceborne communication system with value-added surveillance services for worldwide vessel tracking. This will enhance security in maritime regions, enable efficient management of fishing fleets and contribute to sustainable development of marine resources.

### Final Proposal Contents

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### Executive Summary Contents

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## Overview

### The Need

To feed a rapidly growing world population, man increasingly looks to the oceans for food and nourishment. As a result, the problem of over-fishing becomes ever more urgent. Sustainable maritime activity is vital for the global economy.

In addition, security is a continued and growing concern. To protect vital shipping lanes and the global economy, government agencies rely on vessel monitoring services to protect Exclusive Economic Zones (EEZ). Commercial businesses also track their vessels to ensure security and protect against the loss of valuable assets.

**Over-fishing will lead to the potential extinction of native species with severe economical and ecological impacts.**

**Environmental agencies need to prevent the depletion of marine resources by monitoring fishing activities and enforcing international regulations.**

International Communication and Navigation (ICON) Satellite Systems provides public entities and commercial enterprises with the capability to efficiently monitor and effectively respond to vessel activity.

### Opportunity and Objectives

Today, global communication to remote areas is a well-established characteristic of satellite-based services. In addition, Global Navigation Satellite Systems (GNSS) enable global tracking of mobile assets. ICON Satellite Systems seamlessly integrates satellite communication and navigation to provide a new service to meet needs of the maritime community.

A detailed market analysis has been performed which shows that the addressable market size and growth rate provide the opportunity for a profitable and sustainable commercial business.

**ICON Satellite Systems will provide a global communication system with value-added surveillance services allowing worldwide vessel tracking.**

### The Services

The following basic services are provided by ICON Satellite Systems:

Basic service	Description
Vessel Monitoring	Automatic regular transfer of vessel navigation data and identification
Two-way Messaging	Exchange of short messages between a maritime and land-based users
Electronic Log-book	Reporting of onboard activities, e.g. amount of fish catch, through predefined forms
Geo-Fencing Alarm	Provision of alarm messages once restricted areas are violated
Distress Messaging	Transmission of alert messages from a vessel with reception acknowledgement message



**ICON Satellite Systems is a unique end-to-end service provider of a truly global and secure two-way communication system for public and commercial customers.**

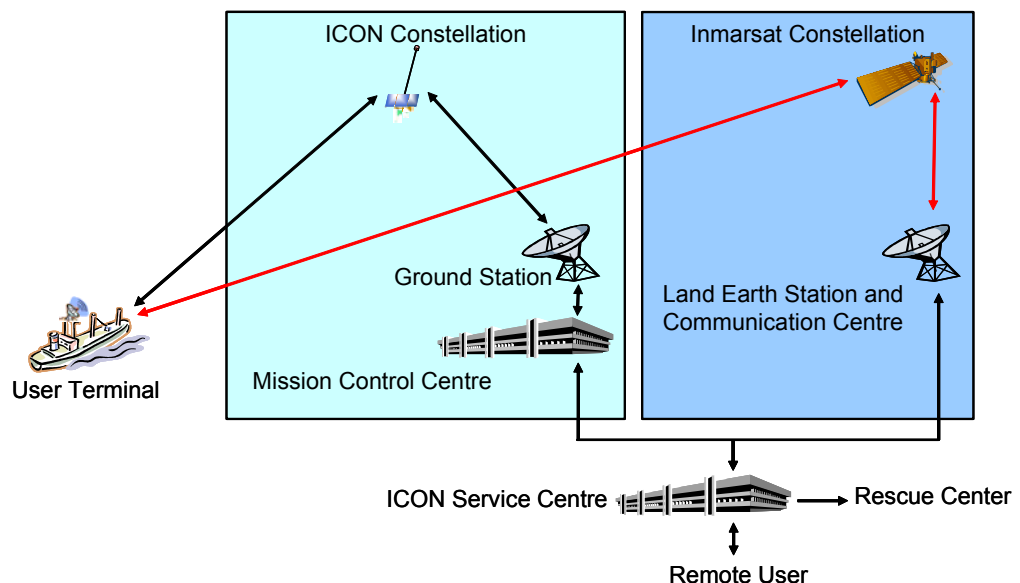
In addition, other value-added services such as the collection of fishing statistics are possible. ICON Satellite Systems' modular service concept will allow a straightforward enhancement to these additional services. An extension to terrestrial markets is foreseen.

## Systems Engineering

ICON Satellite Systems' approach also incorporates 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.

## The Solution

ICON Satellite Systems has designed an integrated mission architecture that will enable a variety of services to meet the needs of the market. This architecture consists of three major parts: user segment, space segment and ground segment. A user segment consists of all ICON Satellite Systems' terminals onboard vessels. The space segment is made up of Inmarsat and ICON Satellite Systems' proprietary micro-satellites. Finally, the ground segment includes the ICON Satellite Systems' Service Centre as well as the interfaces to Inmarsat.



Messages are sent from vessels through the space segment to the ICON Service Centre. Here, the messages are processed and provided to external users.

When distress messages are received, the Service Centre informs the responsible rescue centre and sends a message acknowledgement to the vessel in distress so the crew knows that rescue procedures have been initiated. Since the distressed may send messages with specific information about their particular situation, the rescue mission can be tailored to their specific needs.



In addition to the ICON Service Centre, the ground segment includes ground stations and a Mission Control Centre for communication and control of the ICON micro-satellites. An interface to Inmarsat's Land Earth Stations and Communication Centres is used when the communication relies on Inmarsat satellites.



## Market

### The Maritime Sector

Modern fishing vessels pursue commercially attractive stocks across vast distances and report their position to their national fishing agencies and fleet owners. Due to the long distances involved and the global nature of fishing, only satellite systems can provide viable and reliable communication and navigation services to support this activity.

Many fishing regions are threatened due to over-fishing. Therefore, in 1995 the Food and Agriculture Organization (FAO) of the United Nations elaborated the Code of Conduct for responsible fishing with articles on Fisheries Management and Fishing Operations. The implementation of the Code of Conduct identifies satellite tracking as an important instrument for fisheries monitoring and control. In response, Vessel Monitoring Systems (VMS) are being mandated by the fishery agencies throughout the world to monitor and control fishing activity. VMS relies upon terminals aboard the vessels which transmit position information at regular intervals via satellite networks.

### Market Size and Growth

ICON Satellite Systems has performed a thorough analysis of the communication and navigation market related to fishing. The combination of positioning capability with simple and reliable message communication is a key requirement for this market. A number of applications in this market have both substantial size and promising growth rates. Of these, ICON Satellite Systems' market analysis clearly identifies *Fishing Activities Monitoring* as the most commercially attractive.

Therefore, ICON Satellite Systems will begin by focusing on the communication-navigation market for monitoring of fishing activities. This particular market was further assessed using a conjoint analysis technique to forecast the market size and geographic distribution for the period 2005 to 2020.

More than 500,000 fishing vessels longer than 10 m will be active during this period. Of those, some 300,000 will be equipped with a GNSS receiver. This constitutes ICON Satellite Systems' available market. Starting with a market share of 7% within one year of service roll-out in 2008, ICON Satellite Systems will penetrate the market to a level of 26% worldwide within 10 years.

In 2015, a regional breakdown of the available market shows more than 100,000 vessels in Central Asia and more than 50,000 vessels in the Pacific Rim. In 2015, the fastest growing markets are the comparatively small fleets of Africa and India with annual growth rates of 17% and 11%, respectively.



## Customer Profiles

An in-depth customer analysis was a key part of ICON Satellite Systems' market analysis. ICON Satellite Systems conducted a number of interviews to gain an understanding of both the market application and the customer needs. As a result, ICON Satellite Systems has gathered a comprehensive and clear customer profile of the maritime environment.

ICON Satellite Systems' services support a variety of users, comprising individual vessel captains, fishing companies, the Coast Guards and the national fishing agencies. The vessel captain is responsible for the security of the vessel and its crew as well as for the routine operations. He is, for example, required to report the vessel's position and fish catches.

The national fishing agency and the Coast Guard are governmental customers, responsible for legislation implementation, environmental control and public safety. National fishing agencies require accurate means of monitoring the fishing activities so fishing catches can easily be measured and fishing quotas can be controlled. In contrast, the Coast Guards are mainly interested in monitoring the marine activity in national waters and rescuing vessels in case of distress. Knowledge of the exact location of the vessel and the capability to send and receive short messages will save lives by enabling faster, more efficient rescue. The rate of false alarms will decrease significantly when vessels use ICON Satellite Systems' services to communicate with rescuers.

## Regulatory Environment

The International Maritime Organization (IMO) and the International Telecommunications Union (ITU) contribute to the regulation, identification and surveillance of vessel traffic through participation in the IMO's International Convention for the Safety of Life at Sea (SOLAS). This regulatory body established the Ship Security Alert System (SSAS). ICON Satellite Systems' service is compliant with SSAS.

By providing space-based vessel tracking and communication services, ICON Satellite Systems takes the first step towards realizing a long-range tracking and identification system.

ICON Satellite Systems will apply for and receive permission from the International Telecommunications Union (ITU) to operate at the selected frequencies.



## Competitors

### Competitor Analysis





ICON Satellite System identified major competitors in the maritime navigation and monitoring market who are well-established and have developed strategic partnerships with terminal or space segment providers.

*Qualcomm* provides, via its *Boatrac*s distributor, similar services for the maritime industry. *Satamatics* and *Skywave* provide a Vessel Monitoring System through the Inmarsat geostationary satellites. *CLS (Collecte Localisation Systeme)* serves also the maritime security and tracking market using the spaceborne Argos payload.

### SWOT Analysis

ICON Satellite Systems performed an analysis of its product's Strengths, Weaknesses, Opportunities and Threats (SWOT) in a competitive environment. The analysis accounted for critical strengths of the competitors such as the compliance to regulations, applicability to maritime and terrestrial markets and services for fax and e-mail connections and time-to-market advantage. Identified weaknesses of the competitors include a lack of global coverage, high message latencies, limited data rates and lack of data encryption, allowed optimizing the services of ICON Satellite Systems.

ICON Satellite Systems' strategy is optimized to exploit those weaknesses. As a result, the services offered by ICON Satellite Systems provide a real-time two-way communication between vessels and most remote users on a true global scale. This enables an unrivalled response to distress situations on the high seas. The diversified business portfolio serves both commercial customers and public entities.

Characteristics				
Global coverage			✓	✓
SOLAS compliance		✓	✓	✓
Vessel Monitoring System	✓	✓	✓	✓
Emergency support	✓	✓	✓	✓
Value-added service	✓	✓	✓	✓
Two-way communication	✓	✓	✓	✓
Near real time communication	✓	✓		✓
Electronic log-book				✓
Distress message confirmation		✓		✓

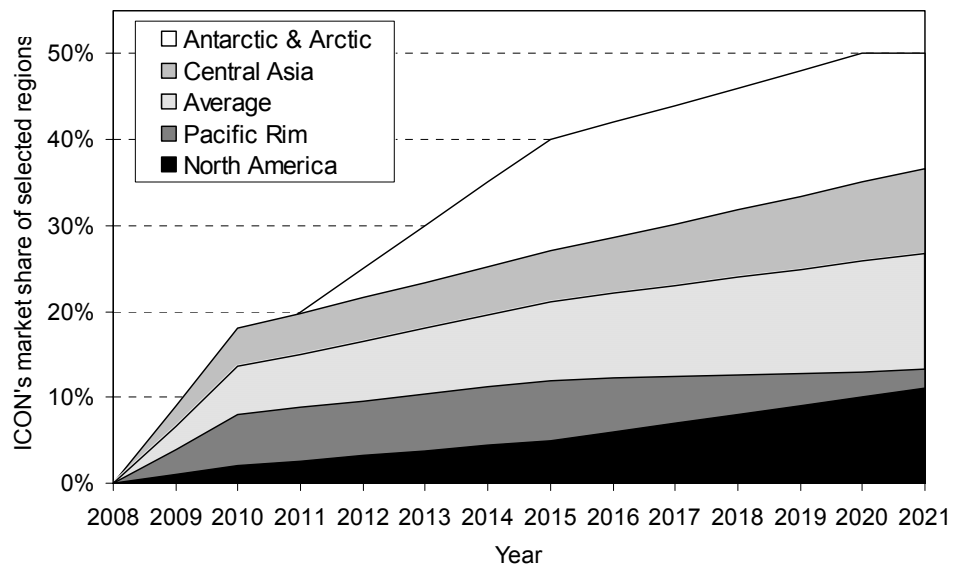
Keys to ICON Satellite Systems' business development will include compliance with the SOLAS regulations, competitive pricing, quality customer service and easy-to-use terminals.



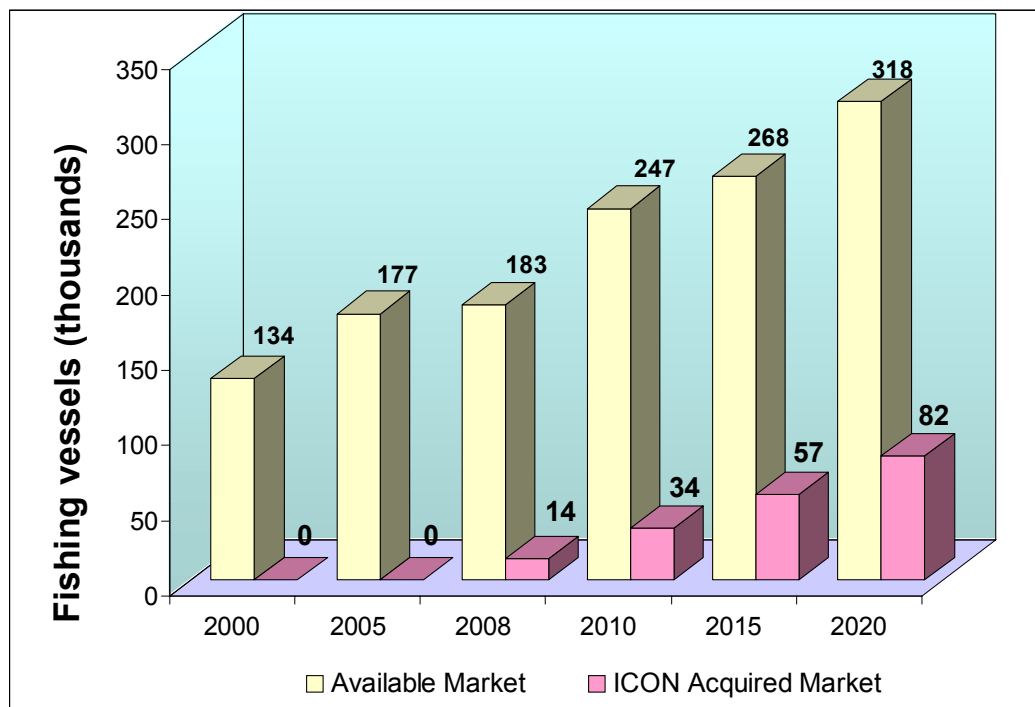


## Market Share

ICON Satellite Systems must penetrate an existing market against currently operating competitors. As part of the business strategy, ICON Satellite Systems identified strategic geographic regions with large fishing industries. The marketing strategy focuses on commercial fishing companies and governmental institutions in these regions. Pilot projects will be conducted by providing ICON Satellite Systems' terminals and services to selected fleet operators and fishing companies.



The evolution of ICON Satellite Systems' market share will be governed by the business strategy and market size of each region. While penetration of the North American market will evolve slowly, the fastest growing market is in polar regions, where ICON Satellite Systems will provide excellent coverage with its proprietary micro-satellites. A total market share of 26% will be reached in 2019.

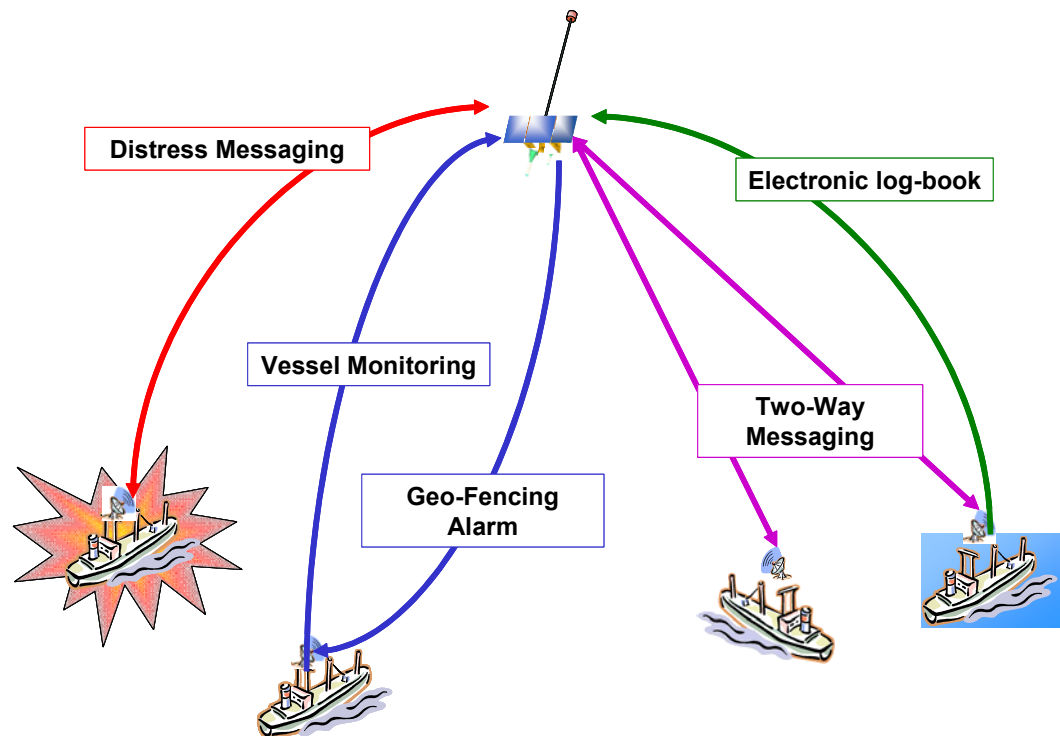




## Services

### Overview

Based on an extensive customer survey, ICON Satellite Systems has developed modular services tailored to specific needs. These include Distress Messaging, Vessel Monitoring, Geo-Fencing Alarm, Two-Way Messaging, and Electronic log-book. Each is described below. This modular service concept will in the future ease the addition of services such as weather reporting to vessels or Supervisory Control and Data Acquisition (SCADA) services.



### Vessel Monitoring

At regular intervals, the Vessel Monitoring System automatically transfers the vessel's secure navigation and identification data to ICON Satellite Systems' Service Centre. That data is then distributed by ICON Satellite Systems via customized reports to authorized end users including national fishing agencies and fleet managers. Authorized end users can change the sampling rate of location messages.

This automatic monitoring and reporting neither requires nor allows for input from ships' crew. Thus, vessel monitoring complies with the regulations for the monitoring and control of maritime activities.

### Two-Way Messaging

Two-way messages can be exchanged both ship-to-ship and ship-to-shore. Ship-to-ship messaging provides an easy, comfortable and secure inter-vessel communication without interrupting routine operations.

In ship-to-shore messaging, the terminal user communicates with a terrestrial user via ICON Satellite Systems' Service Centre. This two-way messaging enables communication between geographically remote users and provides enhanced communication for Coast Guards and fishing agencies.



## **Geo-Fencing Alarm**

Geo-fencing provides a functional extension of the vessel monitoring service. ICON Satellite Systems compares vessel position with existing geo-fences and transmits an alarm either to the Service Centre or to the user terminal when geo-fences are violated.

The Geo-Fencing Alarm reliably reminds the vessel's captain about his violation of prohibited Economical Exclusion Zones (EEZ) for fishing. Tampering of navigation data by the crew is precluded. The Service Centre forwards the alarm to the Coast Guard and fleet managers. This extension of standard services enables efficient monitoring and control of fishing activity in and around EEZ's around the world.

## **Electronic Log-book**

The electronic log-book extends the vessel monitoring function. By completing simple electronic forms, the fisherman reports the type, amount and location of fish catch or the expected arrival time at the port. The ICON Service Centre receives the log-book transmission and forwards it to the national fishing agency.

The electronic log-book replaces today's paper reporting and frees more time for fishing and vessel maintenance.

## **Distress Messaging**

In case of emergency, the terminal transmits a high priority alarm message including the current vessel coordinates. The message latency is minimized by relaying the message through an Inmarsat satellite or an ICON Satellite Systems' micro-satellite, whatever is faster. At the ICON Satellite Systems' Service Centre, the operations manager receives the alert and transmits it to the most appropriate rescue centre. In parallel, he transmits an acknowledgement to the vessel requesting details to optimize the rescue preparations.

Distress messaging provides the vessel's captain with a highly reliable alarm function. The confirmation of distress messages will significantly reduce the number of false alarms, which today represent a major cost factor for rescue organizations.

## **Value-added Services**

Statistics on vessel routes and catch logs are archived and made accessible to remote users. This allows the national fishing agencies and research institutes to perform research on fishing and other maritime activities around the world. ICON Satellite Systems' modular architecture will enable the company to offer additional value-added services as the business grows.



## Customer Interfaces

ICON Satellite Systems' customers will have access to various combinations of services as shown in the table below.

	Vessel Monitoring	Geo-Fencing Alarm	Two-Way Messaging	Log-book	Distress Messaging
Fishing vessel	✓	✓	✓	✓	✓
Fleet manager	✓	✓	✓	✓	✓
Fishing Agency	✓	✓	✓	✓	
Coast Guard	✓	✓	✓		✓
Leisure boat	✓	✓	✓		✓
Remote user	✓		✓	✓	

## Service Pricing

Customers of ICON Satellite Systems include both public entities and commercial enterprises. National Coast Guards and Fishing Agencies are served as well as fishing companies and fleet management operators. This mixed customer base challenges classical revenue generating concepts.

**As part of its marketing and financing strategy, ICON Satellite Systems will provide the user terminals to its customers free of charge. To further enhance market penetration, ICON Satellite Systems will not charge government agencies for value-added services.**

ICON Satellite Systems' modular services allow customer-tailored prices. A basic maritime package combines vessel monitoring, limited two-way messaging and distress messaging. Basic annual fees for this package range from 250 - 1200 €. In addition to the annual fee, a traffic dependent price is charged. Two messages of 100 Bytes length per day costs between 2.8 – 4.8 €.

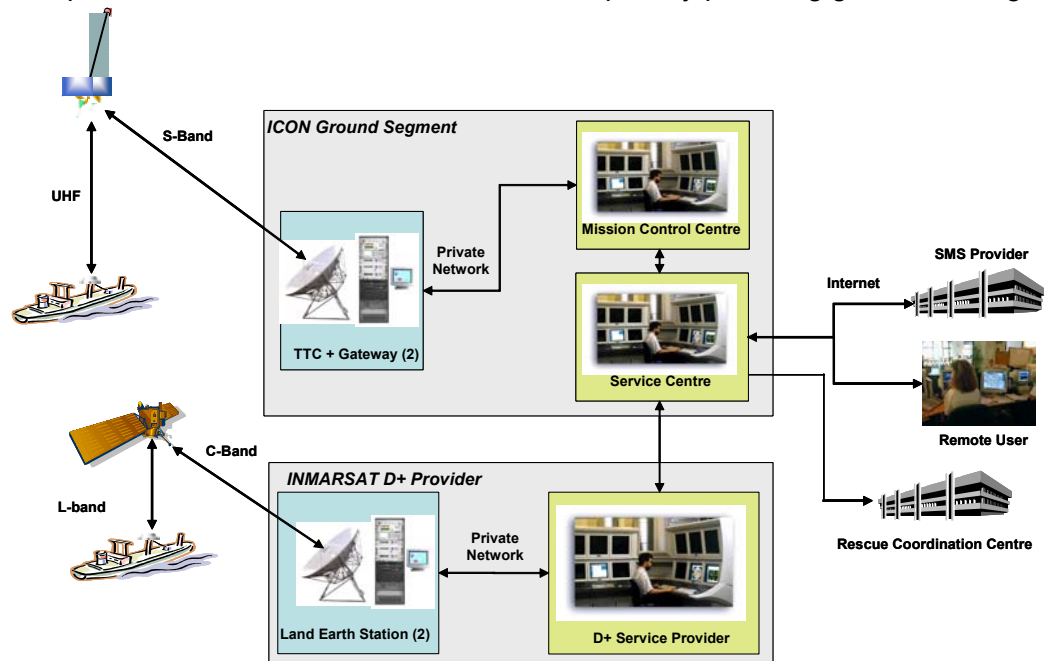
Service Packages	Annual price per vessel [€]	
	Basic Fee	Expected traffic-related
Maritime package Vessel Monitoring + Two-Way Messaging + Distress Messaging	250	-
Leisure boat package Maritime	250	700
Fishing vessel package Maritime + Log-book + Geo-Fencing	600	1200
Fleet management package Maritime + Log-book + Geo-Fencing + Statistics	1200	1200



## Detailed System Description

### System Architecture

ICON Satellite Systems has designed a system architecture for a prompt, reliable and secure space-based two-way messaging. The Inmarsat and ICON space segments relay messages from the user segment terminals to the Inmarsat and ICON ground systems. The ground segment includes a Mission Control Centre for the control of the ICON space segment and a Service Centre for message processing and connection to terrestrial short message services (SMS), rescue coordination centres and remote users. The architecture implements a continuous communication capability providing global coverage.



### Space Segment

The space segment includes Inmarsat satellites which will be augmented by proprietary ICON Satellite Systems' micro-satellites following the Initial Operations Capability (IOC). The Inmarsat constellation of four geostationary satellites offers bi-directional user links at L-band up to latitudes of about 75°. Inmarsat feeder links connect to terrestrial communication networks via C-band Land Earth Stations.

ICON Satellite Systems will operate a constellation of two micro-satellites in sun-synchronous orbit at an altitude of 800 km to fill Inmarsat's coverage gap in polar regions. The micro-satellites will provide a bi-directional user link operating in the Ultra-High Frequency (UHF) band at 490 MHz (uplink) and 415 MHz (downlink). A regenerative payload implements a store and forward capability and processes messages between the user terminal and S-Band ground station.

### Communication

ICON Satellite Systems' micro-satellites will utilize a store and forward communication payload. The maximum delay time for messages transferred through ICON micro-satellites will be 50 minutes. The bi-directional link between micro-satellite and user terminals operates at UHF-band with four uplink channels of 2.5 kbps each and one 100 bps emergency channel. The on-board computer will perform message routing between user terminal and ground station via a memory buffer. The bi-directional link between micro-satellite and ground station operates at S-Band. A 50 kbps physical channel will be split into



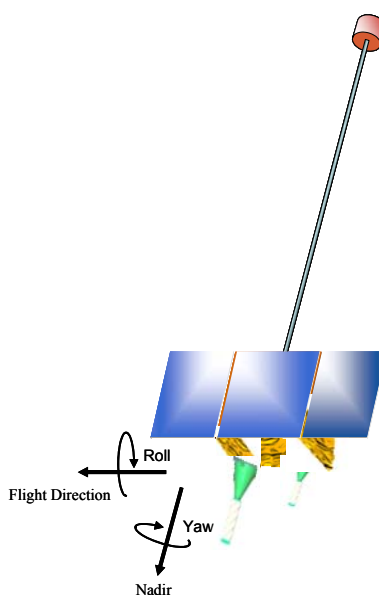
housekeeping telemetry and virtual data channels, while the uplink to the satellite provides a data rate of 20 kbps.

Frequency [MHz]	Data rate [bps]
User terminal to Inmarsat (L Band)	
Uplink 1626 – 1660 MHz	128
Downlink 1525 – 1559 MHz	20
User terminal to micro-satellite (UHF Band)	
Uplink 490 MHz	4 x 2500
Downlink 415 MHz	2500
Gateway to micro-satellite (S Band)	
Downlink 2025 MHz	50000
Uplink 2200 MHz	20000

## Spacecraft Design

ICON Satellite Systems' micro-satellite has a cubic structure with side dimensions of 0.6 m. The total spacecraft mass is 55 kg.

Two deployable multi-junction Gallium Arsenide solar arrays and one body-fixed solar array with a total area of 0.7 m<sup>2</sup> will deliver an average power of 61 W. The solar arrays provide energy to rechargeable lithium-ion batteries which supply power to the micro-satellite payload and subsystems. The thermal control system maintains an operating temperature between -5 and 35 °C.



The spacecraft will be permanently nadir pointing. Relaxed communication antenna pointing requirements do not require the micro-satellite to maneuver. A simple design incorporating a gravity-gradient boom controls pitch and roll axes. A momentum bias wheel and magneto-torquers provide yaw axis control and initial attitude capture.

The guidance and navigation system applies a Global Navigation Satellite System (GNSS) receiver together with a Kalman filter to determine and forecast the spacecraft orbit autonomously. This streamlines operations such as the prediction of visibility between user terminals and various satellites in the space segment.



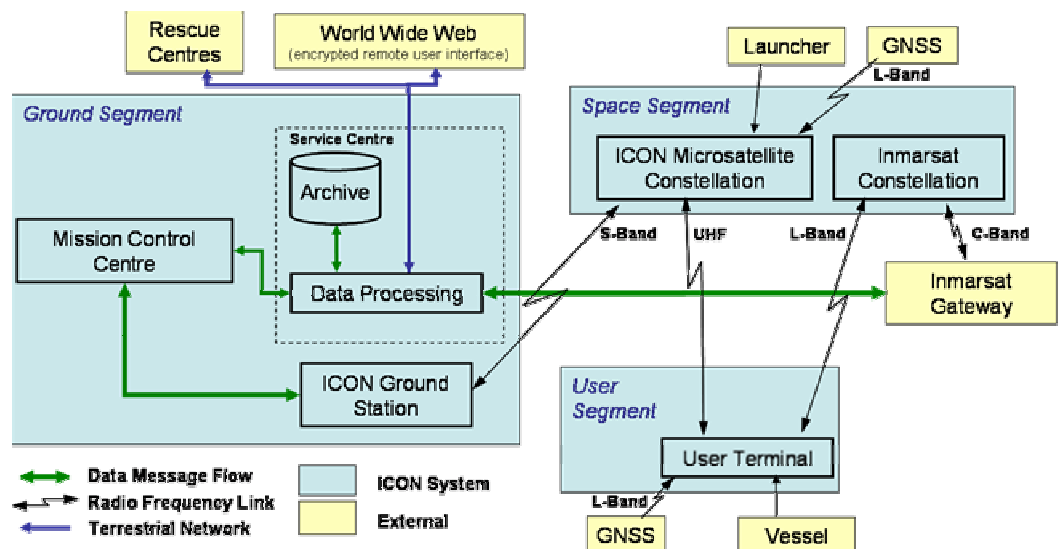
Micro-satellite constellation acquisition and station keeping will require a propulsion system. After separation, the satellites will drift apart during an acquisition phase until they are separated by 180 degrees, thus minimizing the time between contacts to user terminals. At this time, the on-board propulsion will stop the drift rate and enable the satellites to remain in this relative position. Each spacecraft will be capable of generating a total velocity increment of 4 m/s for constellation acquisition, keeping and end-of-life operations.

## Launcher Selection

ICON Satellite Systems has identified two launchers which meet the requirements of reliability, availability, cost, target orbit as well as payload mass and volume. The Volna rocket allows a dedicated launch of a single micro-satellite, while the Dnepr-1 launcher supports the delivery of two micro-satellites into orbit with a single launch. In either case, a propulsion system onboard the micro-satellites enables them to achieve their desired position relative to each other.

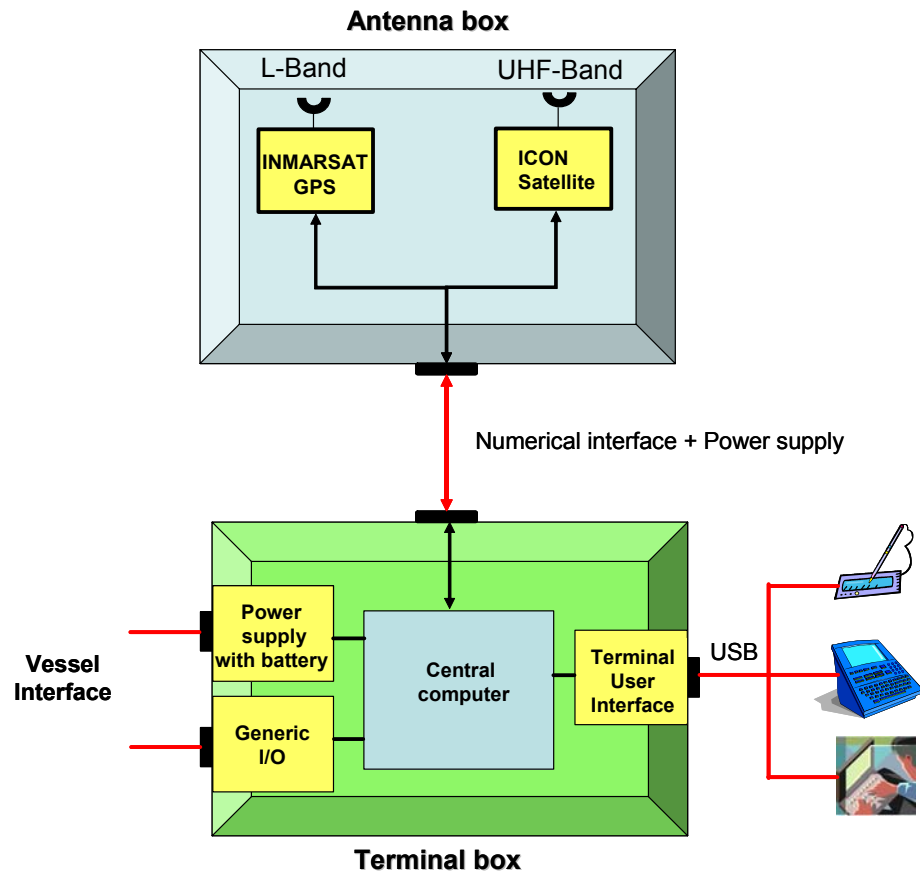
## Ground Segment

The ground segment for the micro-satellites comprises two S-Band ground stations for communication and spacecraft control. Each station will be located near polar latitudes to provide access to each satellite twice per orbit. The ground stations are connected to the ICON Mission Control Centre. Message data will flow from the ground stations to the ICON Mission Control Centre and on to the Service Centre for processing, distribution and archiving. The Inmarsat gateway, remote users and external service providers will access the Service Centre via secure internet and web-based interfaces.





**User Terminal** The user terminal is the physical core of user segment and provides mobile communication and navigation onboard vessels. To optimize its flexibility, the user terminal is modular and consists of an external antenna unit and a terminal unit. Data exchange will be done via a simple protocol and an encryption algorithm will reduce the risk of altering navigation data.







## Marketing

### Marketing Strategy

ICON Satellite Systems' marketing and sales strategy satisfies our customers' needs while building a healthy, robust company. The strategy considers:

- Regional presence in fast growing markets
- Market-oriented organization
- Continuous product development.

The marketing plan is guided by the following objectives:

- Market Penetration: Increased market share in competitive environments
- Market Development: New markets for existing products
- Product Development: New products to a growing customer base.

ICON Satellite Systems will market its services through advertising, promotion and public relations. The company will market its business through the internet with client and news groups, feedback and electronic order forms. As part of its marketing effort, ICON Satellite Systems will seek strategic partnerships and technological alliances in selected geographical regions.

ICON Satellite Systems' Product, Price, Placement and Promotion plan will be continuously controlled and adapted to the market in each business phase.

### Sales Strategy

ICON Satellite Systems will generate revenues by selling its service products to customers. All revenues will stem from annual license fees and traffic-related services used by fishing vessels, fleet operators and leisure boats. The user terminal is provided free of charge as are value-added services for governmental organizations.

The pricing strategy will follow the business goals of each particular phase of the company. ICON will price to the market during service roll out in order to achieve a high growth rate and will price to cost to earn maximum profit when the business is mature.

The sales strategy for ICON Satellite Systems' products will emphasize use of Internet and a worldwide reseller network.

### Business Development

To achieve the targeted growth rate of 12% in 2011, ICON Satellite Systems identified large markets with attractive penetration and share factors. For example, the acquired market in India grows at an annual rate of 15% while Central Asia's market grows at 12% from 2010 to 2015.

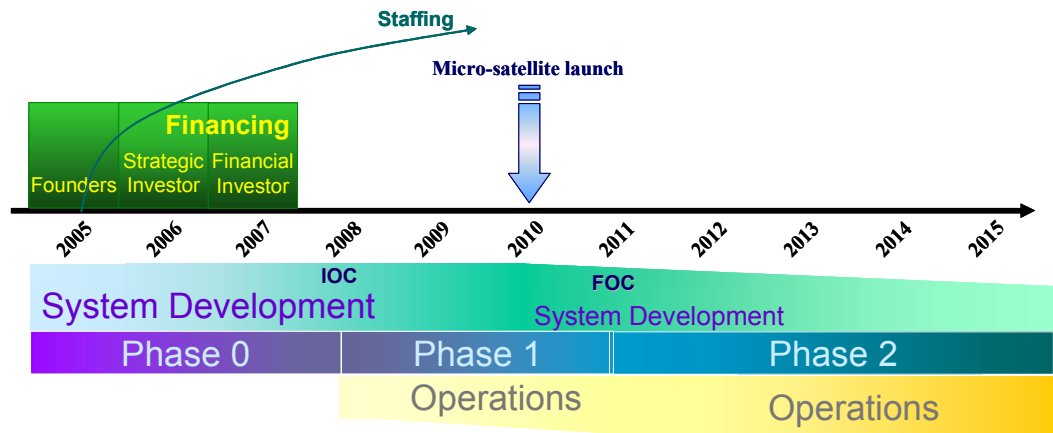
ICON Satellite Systems' products will earn type certifications by national authorities. These will further emphasize the market confidence in the system.

Regional pilot projects will be initiated as test beds for receiving market feedbacks in terms of acceptance of products, services, marketing approach and effectiveness.

The successful introduction of products in the regional pilot projects will be promptly replicated in other markets as well. Product experience will ease the penetration into new regional markets.



Initial services will be augmented by new products. To that end, ICON Satellite Systems' Product Development group will follow the evolutions in market demands and technology. ICON Satellite Systems will continuously assess the potential of new applications such as asset tracking, remote fish finding and mobile asset management and new customer portfolios including land-based fleet operators, insurance companies and oil companies.



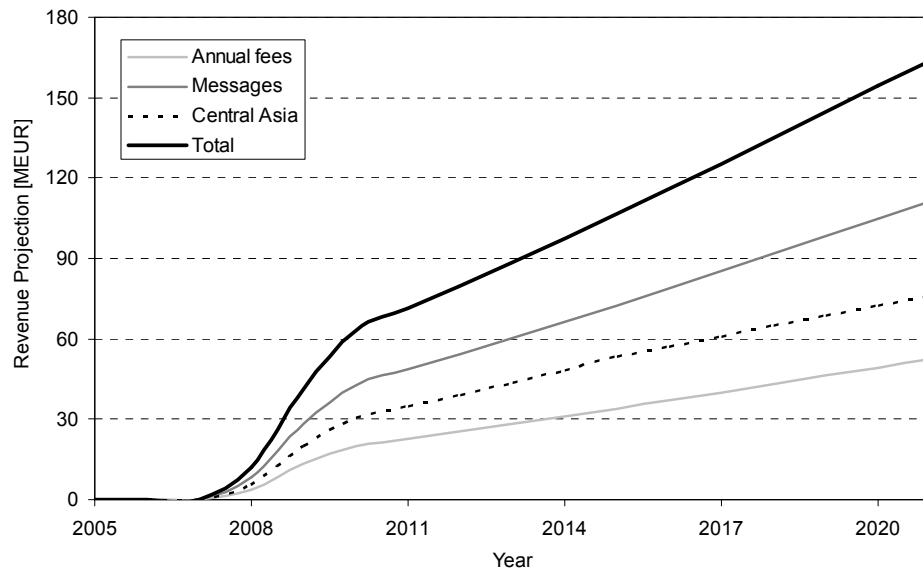
The company structure of ICON Satellite Systems reflects the high relevance of marketing and sales. Between 30% and 45% of all company personnel will work in sales and marketing for ICON Satellite Systems' entire period of operation.



## Business

### Revenues

ICON Satellite Systems will generate revenues by selling navigation and communication services to customers operating in the maritime sector. About 30% of these revenues are annual fees while 70% stem from two-way communication services. More than 40% of ICON Satellite Services' revenues are generated in the Central Asian market.



Three years after the registration of the company the service will be rolled out. Revenues start in 2008 with the Initial Operational Capability (IOC) and rapidly increase until 2011 when the Final Operational Capability (FOC) is reached. The projected revenues exceed 50 M€ two years after IOC and 100 M€ four years after FOC. The accumulated total revenues reach 1.4 B€ in 2021.

**ICON Satellite Systems' revenues are not affected by the availability of micro-satellites. Instead, the micro-satellites allow a transfer of message traffic from the Inmarsat to the ICON space segment, thus reducing cost.**

### Procurement Strategy

ICON Satellite Systems provides high quality services worldwide which meet the customer's evolving needs and are compliant with existing regulations. System and service integration is key to accomplish this goal. The procurement strategy supports these goals through extensive procurement and outsourcing while keeping core business competency in-house.

The micro-satellites will be procured via an in-orbit delivery contract from a company specialized in micro-satellite development and manufacture. The ground stations, the Mission Control Centre and the Service Centre are procured as well. Finally, a communication hardware manufacturer will supply the user terminals.

As system integrator, ICON Satellite Systems will define the overall system and segment requirements, monitor and supervise the development and, finally, be fully responsible for the integrated system level tests.



**Cost** Cost estimates were derived from technical system analysis and applied as part of a business development strategy. ICON Satellite Systems' cost model covers a 15 year period starting in 2005 and assumes a 10 year depreciation period for all investments.

The cost of the space segment is estimated 40 M€ for a total of four micro-satellites. These comprise the initial two satellite constellation and two additional satellites for replenishment after five years. Satellites will be launched either individually on Volna or in pairs on Dnepr-1. In both cases, the launch cost is about 1 M€ per satellite. Since the business case is profitable even without micro-satellites, the satellites will not be insured.

The ground segment for ICON Satellite Systems is composed of the Mission Control Centre, the Service Centre and the two ground stations with total procurement costs of 8 M€. Inmarsat's ground facilities also support ICON Satellite Systems' services but remain under Inmarsat's control.

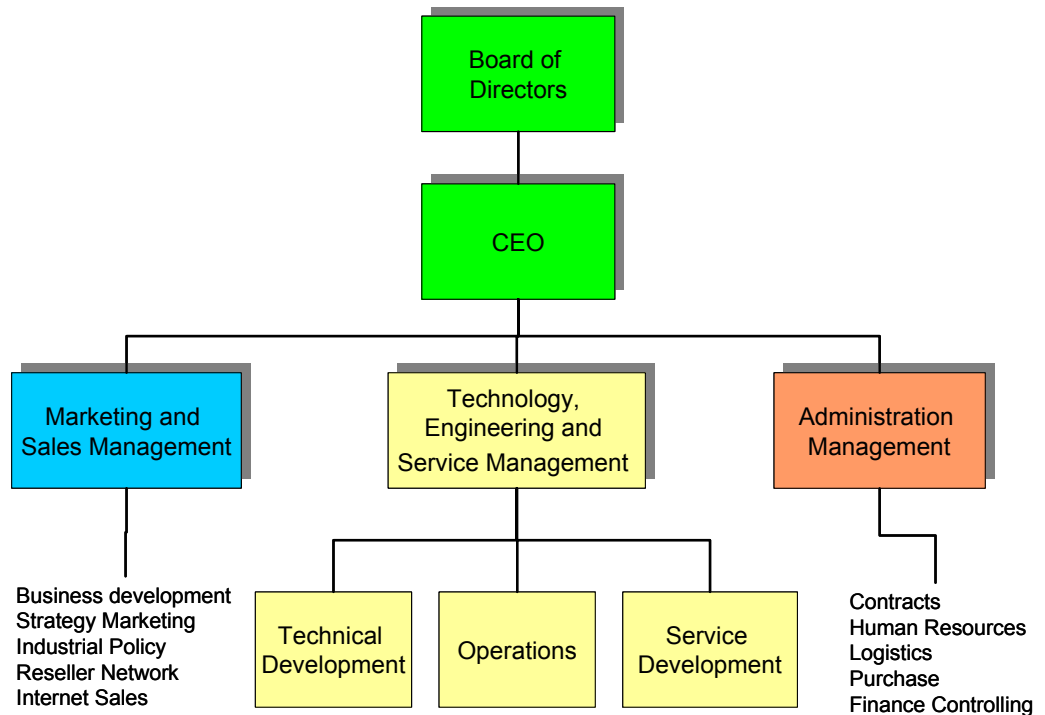
The cost of Inmarsat D+ services, rented by ICON Satellite Systems from a service provider, depend on the estimated message volume. This allows ICON Satellite Systems to optimise the use of the Inmarsat versus the ICON assets. The Cost of Goods Sold for using Inmarsat only is 30% of the revenues. This decreases to 18% when maximum use is made of the ICON Satellite Systems' micro-satellites.

The development and production of the user terminal hardware is outsourced to a communication hardware provider. A total of 140,000 terminals will be produced by 2020 with production cost of 480 € per terminal including warranty and maintenance. A worldwide reseller network will distribute ICON Satellite Systems' product in return for commission of 10% of the annual revenues.

**Organisation** ICON Satellite Systems is a service-oriented company with headquarters in Douglas, Isle of Man. The company benefits from a zero rate corporate tax implemented by its government for high technology businesses. The technology centre will be located in Milton Keynes, United Kingdom.

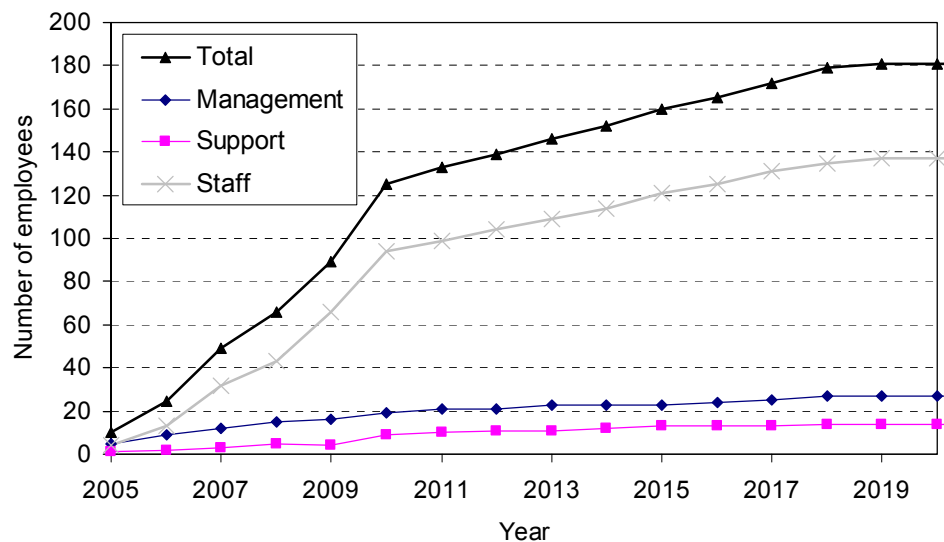
The high-level company organisation reflects this orientation and includes divisions for Marketing and Sales, Technology Engineering and Services, and Administration. These divisions support the Chief Executive Officer (CEO) who reports to and interacts with the board of directors.

The board of directors represents the interest of shareholders, sponsors and founders of the company and will advise the CEO in strategic decisions and the corporate vision.



## Personnel

ICON Satellite Systems' staffing plan includes positions for the CEO, Vice Presidents acting as division heads, managers, staff, support personnel and secretaries. The company will start with 10 employees in 2005 and will reach 70 employees at Initial Operational Capability in 2008. The Final Operational Capability requires about 120 people in year 2011 growing to 180 employees in 2019.



As evidence of the importance of marketing and sales for ICON Satellite Systems, the Marketing and Sales Division makes up between 30% and 45% of the staff. The Technology, Engineering and Management Division contributes 30% to 50% of the personnel, depending on the business phase.



## Financial

### Strategic Partnership

The founders of ICON Satellite Systems will establish in 2007 a long-term strategic partnership with the supplier of the user terminal. The capital invested by the partner will enable ICON Satellite Systems initiate the service in 2008. The terminal supplier will benefit from the partnership through terminal orders guaranteed over 10 years, access to a new market and participation in a rapidly growing company value.

Countries with strategic interests in the offered services might support the company with grants and in-kind investments though ICON Satellite Systems' business strategy does not rely on anchor tenant agreements. Candidates are Russia for launch opportunities and the European Community for Galileo services.

### Financing Plan

The financing plan of ICON Satellite Systems includes equity and debt. Equity financing starts in 2005 with start-up capital from the company founders. In 2006, the terminal manufacturer contributes to equity financing as part of his long-term strategic interest. Finally, a venture capitalist invests in 2007 to achieve profit on a three to five years time frame.

Two short-term loans are needed in 2008 and 2011 to cover investments for Initial and Final Operational Capability, respectively. The interest rate is 8% and the payback period is three years with final payment due two years after each loan is taken.

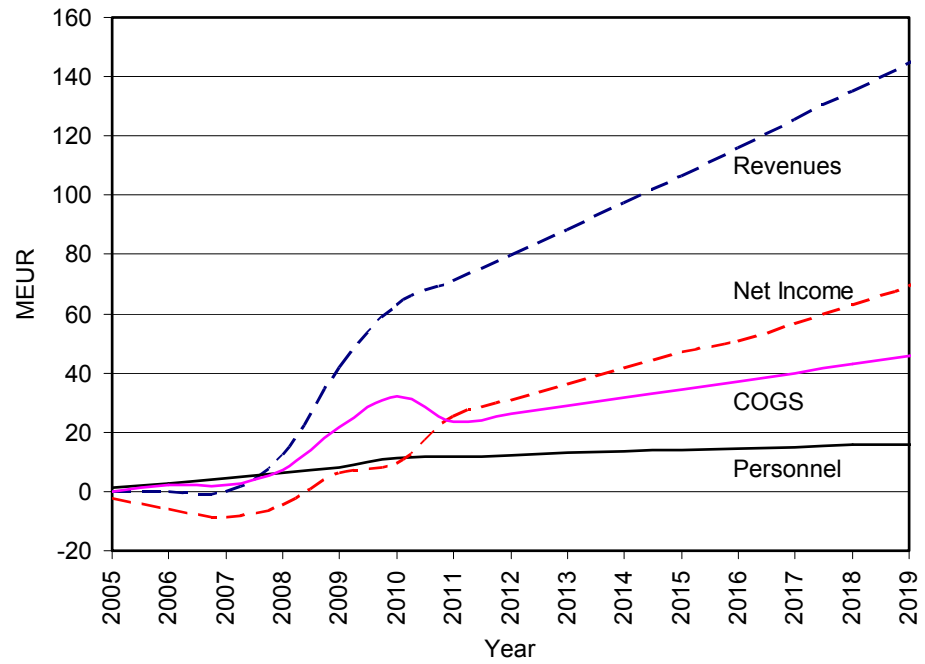
A total equity financing of 23 M€ and total debt of 15 M€ relates to accumulated investments in the ground and space segment of 30 M€ at Final Operational Capability in 2011.

	Investor	Type	Year	Amount [M€]	Total [M€]
Equity	ST7 Team	Founders	2005	3	23
	Terminal manufacturer	Strategic	2006	7	
	Venture Capitalist	Financial	2007	13	
Debt	Bank	Loan	2008	5	15
			2010	10	

The company's value will increase to 515 M€ by 2012 estimated on the basis of a Price/Earning ratio of 30 reduced conservatively by 60%. At this time, the venture capitalist is expected to sell his shares achieving a capital gain of 193 M€ over six years. By 2014, the investors may sell their shares to an international service provider and ICON Satellite Systems will be ready for Initial Public Offer (IPO).

### Profit and Loss Account

ICON Satellite Systems' financial statements show a time-to-market in 2008 and demonstrate time-to-profit in 2009. The net income increases at a growth rate of 30% from 2010 to 2020. In 2020, the net income amounts to 80 M€. The Cost of Goods Sold (COGS) increase rapidly before 2010 and more gradually from FOC onwards as message traffic is transferred from Inmarsat to ICON satellites. The personnel costs are 11 M€ at FOC increasing moderately to 16 M€ in 2020.

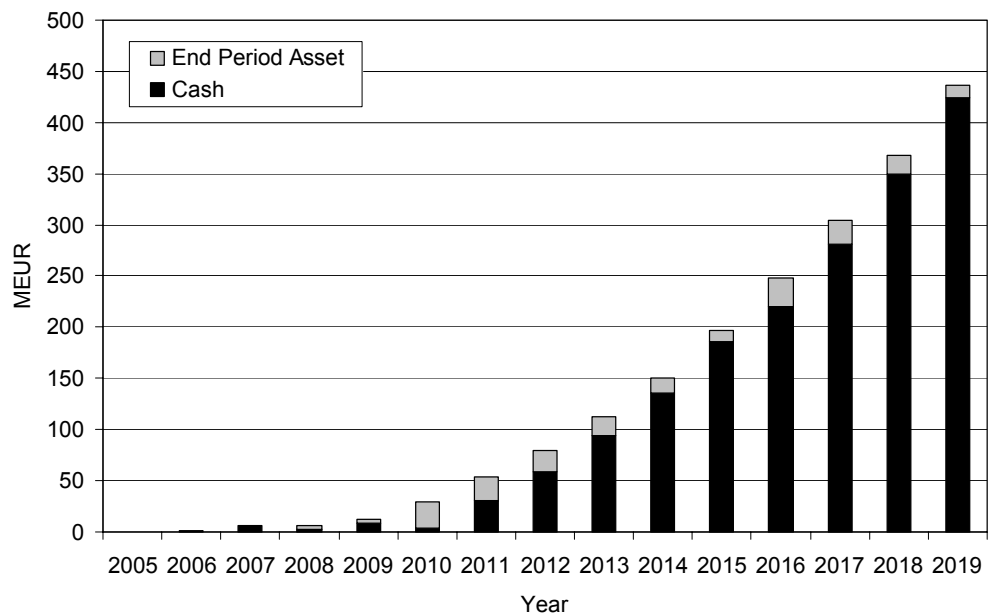
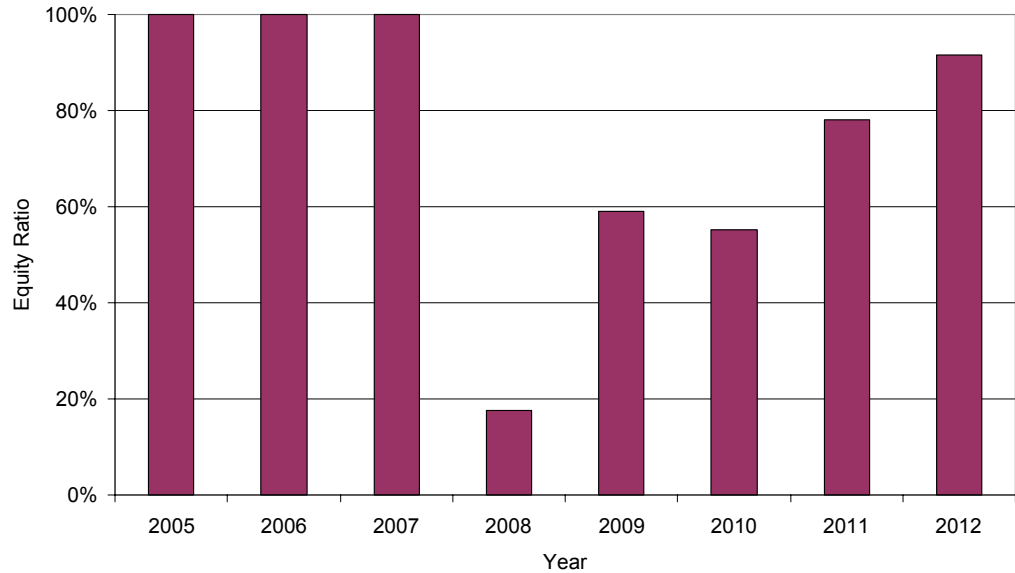


The profit on revenues is 28% on average when dividends are paid. ICON Satellite Systems will pay dividends to the investors from 2012 onwards when the total equity exceeds the value of the share capital. The net present value (NPV) increases from 2008 onwards and reaches 80 M€ in 2020. The Internal Rate of Return (IRR) averages 25% from 2012 onwards.



## Balance Sheet

The balance sheet shows a total equity value of 437 M€ in 2019. Adequate financing keeps the equity ratio at a safe level with a minimum of 18% in 2008. The equity at FOC is 16 M€ and continuously increases with growth rates between 20% and 150% reaching 437 M€ by 2019.



The cash to assets ratio is 74% at FOC and increases to 95% in 2019 which underlines the service-oriented business concept of ICON Satellite Systems.





## Risk Management

ICON Satellite Systems faces risks in three major areas: product, market and business. In each area, critical risks have been identified, described and assessed in terms of probability, severity, and mitigation.

ICON Satellite Systems has investigated the sensitivity of its business to four major risks:

1. Reduced market share
2. Delay in product deployment
3. Lack of agreement with Inmarsat D+ provider
4. Launch failure.

To prove the robustness of the business, the assumptions made in analysing the risks were conservative and represent worst-case scenarios.

Reduced market share was modelled by a cut of annual revenues by 50%. As consequence, the break-even point would shift from 2009 to 2011 and the required financing would increase. This risk can be mitigated by an intentional delay of the micro-satellite deployment by two years.

A one-year delay in product deployment affects the revenues and delays the break-even point from 2009 to 2010. Hence, the required financing would increase. Mitigation is achieved by delaying the launch of the micro-satellites.

If ICON Satellite Systems is unable to agree with a provider of Inmarsat D+ services, the company will build two proprietary gateways to access the Inmarsat satellites. An additional investment of 5 M€ will be required.

Failure of a dual-satellite launch would delay the micro-satellite deployment by two years to 2012. Since ICON Satellite Systems would be relying fully on Inmarsat for two more years, the Cost of Goods Sold will be higher. However, as the earning will be already significant, no additional financing would be needed.

A worst-case risk and sensitivity analysis did not reveal a failure of ICON Satellite Systems' business case.

## Conclusion

**ICON Satellite Systems is a unique service provider of a global two-way communication system offering a viable business case for private investors.**



## The Company

**ICON Satellite  
Systems**



CENTRE NATIONAL D'ETUDES SPATIALES



**F. Burger**  
**K. Capelle**  
**T. Chapuis**  
**J. Dittrich**  
**B. Fox**  
**E. Gill**  
**M. Hernek**  
**E. Russo**  
**A. Stragapede**

European Space Agency (ESA)  
European Space Agency (ESA)  
Centre National d'Etudes Spatiales (CNES)  
German Aerospace Center (DLR)  
The Boeing Company  
German Aerospace Center (DLR)  
European Space Agency (ESA)  
Italian Space Agency (ASI)  
European Space Agency (ESA)

## 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](mailto:info@delft-toptech.nl)  
Home page: <http://www.delft-toptech.nl>