SKYTECH DESIGN HERITAGE AND CAPABILITIES

Skytech’s present wealth of knowledge in VSAT telecommunication technologies is the result of at least six years of investment in research and development, roughly equivalent to more than USD 15 million staked. Beyond the numbers, Skytech is the result of the vision, the passion and the constant commitment of its founder Federico Zarghetta and his team.

From the beginning, Skytech believed and invested in enhancing its know-how rather than stabilize individual products on the market, proposing to large industrial groups as an adequately lean and efficient reality of R&D excellence that quickly experiences and offers integrated solutions. This allowed a relatively small company to follow at best the rapid changes of an ever changing high tech niche market, providing flexible and customized answers.

On the other hand, Skytech’s independence and design freedom allowed pursuing long-term technical strategies and important
choices that are paying off over time; practical examples on existing projects, among others, are the development of a scalable HW/SW control system, the choice for brushless motors vs steppers, the avoidance of gyroscopes in favor of compatibility with third parties IMU (and design of its own one), the development of a proprietary RF tuner, the use of a general purpose PC platform with Linux, an advanced remote monitoring and control, and much more. In other words, while being inspired from the established products on the market, Skytech was able to practice its best solutions and pursue its own vision. This gradually led to the present level of reliability and awareness of the team in its own potential.

The need for consistently superior performance, and consequently increasing integration of antenna systems, led Skytech to adopt a comprehensive approach to design, by acquiring a small but close-knit team of engineers specialized in different areas of expertise.

The advantages of a multi-disciplinary team approach are well known, constituting the very essence of a modern concurrent engineering; the right tradeoff in Skytech was sought between innovative thinking and a broader expertise, providing design flexibility by keeping a small number of young minds sitting at the
same table, performing design firsthand and sharing field and laboratory experiences.

A deliberately chosen flat hierarchy and the staff involvement in market choices guarantee high motivation of personnel, promote productivity and speed up decision making processes.
MECHANICAL DESIGN CAPABILITIES

From the beginning of its activities, despite its original vocation oriented towards electronic devices and radio-frequency applications, Skytech has heavily invested in the refinement of its own, tailored mechanical realizations, assiduously working and experimenting with designers and suppliers.

Important steps in this process concern the research of new materials and production technologies, particularly in the field of composites, such as carbon fiber lightweight structures, radio-transparent applications, dielectric materials and surface coatings. To date, Skytech is a frontrunner in exploiting the composite for civil satcom applications.

The acquisition of in-house mechanical design, which prior to year 2012 was commissioned in outsourcing, led several advantages. Firstly, mechanical design is a key aspect in the early design stages: fast and crafty usage of modern 3D CAD systems
speeds up the development of new projects, allowing the whole team to quickly materialize ideas.

It is crucial to analyze mechanical constraints and consider their impact, together with other design issues, since conceptual design up to the final release, whether the design approach is waterfall, iterative or evolutionary.

Skytech comprehensively addresses mechanical design, starting from the choice of system arrangement and materials through static and cinematic calculations, dynamic response simulations, environmental reliability, optimization of production and its costs, etc. The majority of these steps are performed in-house or outsourced under strict control, through the use of CAD-CAE (like Solid Edge, among others) and FEA software (like ANSYS, Nastran, Elmer and others).

Moreover, Skytech performs the validation of prototypes, sets tailored QC system for its products, and verifies performance with lab and field tests.
Mechanical realizations range from single parts and small assemblies, up to complete antenna systems.

Some examples:

Carbon Fiber Reflector and Feed, sizes 30, 75, 80, 90, 100, 108, 125, 150 and 154cm

Phased Array Antenna

2-Axis Pedestal, sizes: 80, 90, 100 cm

3-Axis Pedestal, sizes: 30, 75, 100, 125, 150 cm

Phased Array Pedestal

Position-reference Radar Pedestal

Composite Radomes, several sizes

OMTs, including Dual Band Turnstile

Directional Couplers, Diplexers, LNA Enclosures

Electronics Enclosures
RF Design Capabilities

The need to create highly integrated solutions with a remarkable technological content has enabled SkyTech to achieve a solid experience in the design of various types of antennas and RF components:

- **Single band and multi-band reflector antennas**
- **Horn antennas**
- **Dielectric lens antennas**
- **Various types of antenna arrays (waveguide arrays, slotted array, patch array)**
- **High performance radomes**
- **Antenna components (complex feed-horns, polarizers, filters, OMTs, diplexers, directional couplers, etc...)**
The design of these complex structures is carried out thanks to the use of some key software tools which can harness the power of calculation of two dedicated multi-processor machines:

**TICRA Grasp**: the most famous tool for the design of generic reflector antennas which is considered an industrial standard in the world of the telecommunications.

**TICRA Champ**: the ultimate tool for superior design of horns and reflectors with rotational symmetry.

**WASP-NET**: a unique and innovative EM CAD which can combine seven different solvers in order to apply the best method for each part of the antenna system.

**SRSR**: a specialist software for the analysis of structure with symmetry of revolution that was created in the 80s by France Telecom. In the last few years SkyTech (in collaboration with the University of Milan) has contributed to its development as part of the antenna projects commissioned by Eutelsat.
Some representative antenna designs:

**BB75Ka antenna**: the first maritime Ka-band antenna in the world that has passed the RF tests for Eutelsat certification (April 2015)

**BB120 Tri-band antenna**: an X/Ku/Ka maritime antenna equipped with a triple auto-switchable RF payload (currently under development for Selex ES)

**BB30IG Ku-Ka antenna**: an extremely light, compact and efficient aeronautical U-Sat antenna
Electronic Design

Skytech electronic division builds up the electronic system as a whole. It integrates the extremely performant and innovative solutions from the Mechanic and RF groups with the best HW and SW to meet the system specification. This goal can be achieved only by a deep understanding of the system specifications and through the choice of the best available components.

Where a high degree of optimization is not necessary, third party COTS can be used in the system integration, in order to ensure more modularity and flexibility especially in the development and maintenance of the user interfaces.

Indeed, it is a Skytech focus point to design its products to allow a technician to verify the operation of the equipment via a remote connection.

Thanks to this feature, a skilled operator is able to troubleshoot a possible failure and/or vary the operative parameters, without having to disassemble the equipment and without the need for special tools.
**Custom Design**

Often the requirements of the electronic system are too stringent or too peculiar for a COTS item, in these cases the design of a custom board is necessary.

Typically, Skytech runs the entire design flow starting from the specifications up to the master, in order to obtain a fully customized board, which provides the designer full control over all the critical signals.

If time is a critical factor or the item does not present critical issues, the documentation produced in the design phase is suitable to finalize the prototyping and manufacturing phase through external contractors.

An example of this process is the realization of the Tuner board.

The tracking system of an antenna requires a fast and reliable lock source to identify the carrier, in addition to a signal strength measure to perform the signal tracking.

To accomplish this task, a local DVBS/DVBS-2 and a narrow band tuner have been designed and integrated in the antenna electronic.
**SW and FW**

All our boards hosts some kind of reprogrammable logic (Xilinx, Altera) whose FW is internally developed and thoroughly tested.

We develop the SW of our systems at different levels:

Application level (C, java ...) developed on Linux embedded environment.

Customization of the HLOS and regeneration of all the toolchains in order to obtain the executable code at a higher degree of optimization.

Baremetal application in C code using LLOS (like TI SysBIOS), going down to the ASM code where a fine-tuning is required.

HW and SW/FW integration is implemented through custom made test jig, that are also used for troubleshooting during the production phase.
AHRS

The necessity to obtain good performance of dish pointing in harsh environments has driven Skytech to select and use the best in class of IRU system with good dynamic response, fast communication protocol, and reduced mechanic delay.

This necessity has driven the company to develop proprietary IRU system to meet the desired performance requested to keep the pointing of the antenna inside the project specifications.

This Inertial Reference Unit includes direct measurement of acceleration, angular rate, and atmospheric pressure. Sensor measurements are processed through a sophisticated estimation filter algorithm to produce high accuracy computed outputs with compensation options for magnetic and linear acceleration anomalies, sensor biases, auto-zero update, and noise offsets.
Control System
To achieve optimal tracking performance we require a good pointing model so that we can tell the antennas where to point with high accuracy. But that isn’t enough; we also need a high quality feedback mechanism to keep the antenna stably pointed in the correct direction.

Optimal tracking performances can be achieved by considering at the same time different design aspects such as:

- **Control Software** Non-Linear Control techniques to perform servo control and high lever tracking algorithms are developed to improve dynamic motion performances and tracking signal capabilities. This is obtained simulating experimental algorithms and control schemes in Matlab/Simulink or directly in C and then tested on the physical system.

- **Electronics** The reduction of delays in the control loop is a necessary effort to improve performances in real-time systems. This is achieved with a careful design of the hardware architecture consisting in the distribution of the computing units and organization of the communication bus between the various devices.
- **Mechanics** The dynamic behavior of the mechanical system, for what concerns the rigidity of the structure and the accuracy of the transmissions, has a key role in the control of the system. Identify the tradeoff between constraints of space and manufacturing compared to electromechanical sizing is the goal to achieve.

- **RF** The radiating pattern of the antenna, computed in the design stage, is a fundamental aspect to consider in the tracking algorithms tuning. A real-time analysis of the received signal ripple compared to the radiating pattern allows to estimate the pointing error and correct it.
System Integration and High Level UI

During its history, SkyTech has been committed to always think about what future will be, pushing at the highest levels of integration, management and maintenance for applications of all types of programming.

Today SkyTech has developed seven applications that offer varying degrees of the interaction and management of VSAT antennas, allowing the customer to have a 360-degree view of the product.

All of these systems are dedicated to fleet management and monitoring system to serve the needs of

- Operation managers
- Ship Personnel
- System administrators
- Technicians
- Customers
SkyTech with an innovative technological approach has been able to create during these years a software, installed on each VSAT, that works with twelve models of antenna without distinction, two bands at the same time, nine types of modems with different communication protocols and four different inertial platform.

**BBSTAT**

BBStat Log Analyzer is a tool that is able to automatically and remotely download, extract and elaborate data available inside the log files generated by the SkyTech’s antenna software. Once configured, it periodically locates the requested information and store them for future analysis in its own online database.

All SkyTech antennas -since the BB90- create and store 20 days of log data inside the ARCU by default. Log data contains detailed telemetries and status information.

This tool is designed to store, analyze, plot a graph, aid in troubleshooting and show antenna performance.

The database allows to save data, import log, read data, set software status, access and alarm criteria. These functions give the users a complete vision of the Antenna.

Programming Language: PHP – Html – SQL
**BBCONTROLLER 2**

The BBCController2 is a web application, running on the antenna PCU (ARCU) that provides local and/or remote access to the control functions and parameters of any SkyTech BB series antenna.

The web application can be accessed over a network such as the Internet or from an intranet/LAN: this means that you can view the BBCController2 web pages using a public IP address assigned to the antenna or aboard the vessel, connecting directly to the Ethernet cable of the antenna and using the local IP.

This is the really core of the VSAT in fact, from the web page is possible to set the all parameters of the components present in the SkyTech VSAT. Through an internet connection, also from remotely, and any device mobile or pc, the user can start or stop to the antenna, set Tracking Configuration, set modem configuration, and monitoring signal, motor current and position.

Programming Language: Java - GWT
**LOCATOR**

The Locator has the following important features: fleet position and reporting of any kind of moving object, entirely web-based, smartphone compatible, multi-layer cartography rich of additional information, dedicated iPad app, extensions or custom functions on request.

This software can receive position and telemetry-data from different sources, for example VSAT antennas with “always-on” internet connection, diverse VSAT modems technologies, Skywave terminals via Inmarsat iSatData pro service, Iridium modems using SBD service, Iridium Nano Shout personal tracker, AIS over VHF receivers.

In addition, Locator shows satellite coverage maps to verify fleet connectivity, full featured weather maps, clouds, rain, wave height, pressure, and overlay of navigation buoys, Oil Rigs and other important waypoints.

Programming Language: Html5 – Css3 – Javascript - Jquerymobile
**STSURVEILLANCE**

The ST Surveillance is different from the Locator because this is «Antenna» oriented not «Vessel, Truck» oriented, and is completely dedicated to KA Band.

Offers to users the remote Surveillance with different access levels: Customers, Technicians, Administrators.

The system is integrated with a central database that receives telemetry data constantly from the antennas, and shows all antennas installed around the world. For each antenna can be shown all information system, like Serial Number, Part Number, System uptime, Modem Online, Position and Customers.

Can be accessed from any PC or smartphone with dedicated user interfaces for small screens.

Programming Language: Html5 – Css3 – Javascript - Jquerymobile
BBMONITOR

The BBMonitor was the first system developed by SkyTech of remote surveillance.

Today is used for maintenance of the first antennas installed by SkyTech, however offers to the users the possibility to show the actual status of the antenna (ONLINE – OFFLINE), percentage of signal calculated on the response of the modem ping, real time positioning on the map.

For more information is possible to examine all details of the antenna, reported in the other tab in the different sections: Antenna, tracking configuration, ARCU settings, MODEM setting, software parameters.

By clicking the marker are available: Vessel name, Signal average, Position, Gyro-data, Sea-Status, Last-update of software.

Programming Language: Java – GWT
**BBCLIENT**

Dedicated to a technical experts, allows the user through a local connection to interact with the VSAT SkyTech.

The BBClient is, specially, used to verify the antenna pointing accuracy, through the calibration of the PID, it offers a general overview of the VSAT, like the motors currents, signal, temperature and other parameters, all displayed on the real time graphs.

With BBClient is also able to play the Log_File saved on the BBController2 to check the behavior and the status of the all component of the antenna. It allows to understand the current state and to track any malfunctions or faults.

Programming Language: C#
MAWIC

MAWIC, Mobile App Web Interface Controller was created by SkyTech to make easy the use of its tools to less experienced users.

This gave rise to the idea of having a mobile application user-friendly, which gives to the users, the elementary function, like start or stop the Antenna on different Tracking Configuration, add or delete the configuration saved, show the preliminary value of the telemetries, for example, motor currents, signal, and azimuth position, and also the real-time coverage area.

Compatible with any operating system, browser and mobile device, SkyTech with this app wanted to offer its customers an instrument able to complete its package of products for every users.

Programming Language: Html5 – Css3 – Javascript - JQueryMobile