Processing of more than 30,000 I/Os with BC9100 Ethernet controllers

If everything goes according to plan, the Russian Soyuz carrier rocket will blast off from the Kourou spaceport in French Guiana in early 2011. For its mission, Soyuz is to place satellites for the European navigation network Galileo into orbit. On behalf of ESA and CNES, the European and French space agencies, the Spanish company GTD is supplying the control and monitoring systems for the Soyuz launching pad. GTD relies on Beckhoff I/O components for the real-time control of more than 30,000 input and output data.

When 'Soyuz' lifts off, Beckhoff Bus Terminals are there for the countdown

The Barcelona-based company GTD has already been involved in several European space projects and is specialized in the development of control and ground control systems for spaceships as well as flight software and operational systems for the Europe Space Port. GTD's scope of performance also includes technical support for the preparation and launch of the Ariane, Vega and Soyuz rockets.

The European Kourou Space Port, in the South American country of French Guiana, is one of the most efficient launching bases in the world and is of great importance to ensure Europe's independent access to space. All launches have taken place according to schedule and under optimum conditions here for years. In 2002 the European aerospace authority decided to build a launch pad for the Russian Soyuz rocket; assembly work began in Kourou two years later. In the future, the world's most successful carrier rocket, with 1,750 launches, will place payloads of around three tons into orbit around the earth. It will mainly be used to establish the European navigation system, Galileo, and for launching larger earth observation satellites.

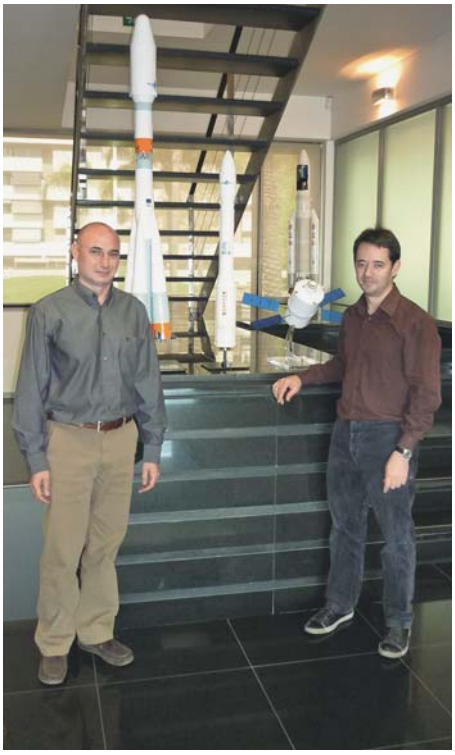
Control and monitoring of the Soyuz launching pad in Kourou

GTD was awarded the contract to develop various sub-projects for the control and monitoring of the launching pad. As project manager Josep Fontova explains, the services that GTD has to provide are very complex: "Our task is to adapt the operational and monitoring systems that are responsible for the trajectory tracking and the reception and evaluation of the telemetry data from the rocket, starting with the lift-off of the rocket and ending with placing the payload into orbit." Under the supervision of Arianespace, the European operator of the launch systems, GTD is also responsible for the operation and maintenance of the infrastructures of the new launch pad.

The CCSS control, command and service system developed by GTD is responsible for the monitoring and control of all process steps involved in the preparation, assembly and launch of the rocket. This allows the monitoring and steering of all take off base facilities by means of control terminals in the control center, which is housed in a protected building. All preparations connected with the Soyuz launch up until the launch itself are coordinated from here.

Overall view of the launch pad for the Soyuz carrier rocket. The European space agency ESA has built a launch pad for the Soyuz in Kourou, in the middle of the South American tropical jungle. The Russian carrier rocket is scheduled to takeoff from here for the first time in early 2011 and to place a satellite for the European navigation network Galileo into orbit.

The Soyuz mobile gantry at the spaceport in French Guiana under construction. The mobile gantry is 52 meters (171-ft) high and can approach the already built rocket on rails. The payload is installed in the nose of the rocket from the mobile gantry at a height of 36 meters (118-ft).



Josep Fontova, GTD project manager (left) and Ricardo Bennassar, commercial manager responsible for the CCSS project, with a model of the Soyuz carrier rocket

Founded in 1987, GTD now has branch offices in Barcelona, Madrid, Logroño and French Guiana and is specialized in the development and integration of highly critical and highly complex scientific computer systems.

Maximum requirements with regard to reliability and availability

The CCSS system developed by GTD must fulfill the highest demands in terms of reliability and operational readiness; availability must be ensured around the clock, 365 days a year. More than 30,000 signals and data – from the facilities surrounding the takeoff preparations and from the actual launch – must be managed in real-time. The control system is based on two redundant servers. They manage the flow of data between the control consoles and all devices at control level: the PLCs, the local I/Os, the power supplies, fire alarms, etc. The four PLCs and the local I/O modules are connected to one another via an optical fiber TCP/IP network with a ring topology which, with a length of 10 km (6.2 mi), traverses the entire facility.

Ethernet Bus Terminal Controllers enable the secure transmission of data over long distances

"In order to manage the total of 1650 terminals, we have constructed a network of 50 local I/O stations with BC9100 Intelligent Ethernet Bus Terminal Controllers," explains Josep Fontova, CCSS Interfaces project manager at GTD. The Bus Terminal Controllers are used independently of one another in different physical places: in the control center, the fuel store, the general power supply, the power supply for the air conditioning systems, the launch ramp (in the bunker) 20 meters below ground, the mobile gantry, the carrier system and pumping stations, etc. The I/O stations communicate with one another and with the monitoring system via Modbus/TCP. The BC9100 Bus Terminal Controllers manage systems in the launch pad and in the launcher assembly and testing building, the ventilation (of the satellite and the final stage of the rocket), the safety and fluid systems, the compressed air generation (for the process control on the rocket pad), the water pumps (on the base), the optical and video systems and, finally, the high-speed cameras that supply photos of the rocket at liftoff.

Cabling work reduced – reliability increased

According to Ricardo Bennassar, commercial manager at GTD with responsibility for the CCSS project, one of the biggest challenges was to implement the acquisition of data from the various sensors and actuators, taking into account the large geographical distances involved (several thousand meters on the site): "The modular Beckhoff Bus Terminal system allows the construction of a flexible architecture that connects widely scattered components with one another and conducts the data stream centrally to a building. The considerable amount of cabling that this saved was very important. A further advantage of the BC9100 Bus Terminal Controller is that it is equipped with two RJ-45 ports, which makes a linear topology possible without distributors.

Thanks to the controller, which is programmable in IEC-61131-3, the user has the option to dock to the inputs and outputs of local information systems."

Outlook

GTD will also be involved with the further development of the 'Ariane 5,' the objective of which is to produce a new version of the carrier rocket by around 2016. At the same time, the intention is to significantly increase the flexibility and capacity of the rocket (11.2 tons of freight for geostationary orbits). In the long-run, GTD will also play an important role in the realization of a new generation of European Launch systems (Ariane 6), which is planned for 2025. There will additionally be involvement in other satellite projects, such as GMES (Global for Monitoring Environment and Security) or SSA (Space Situational Awareness).

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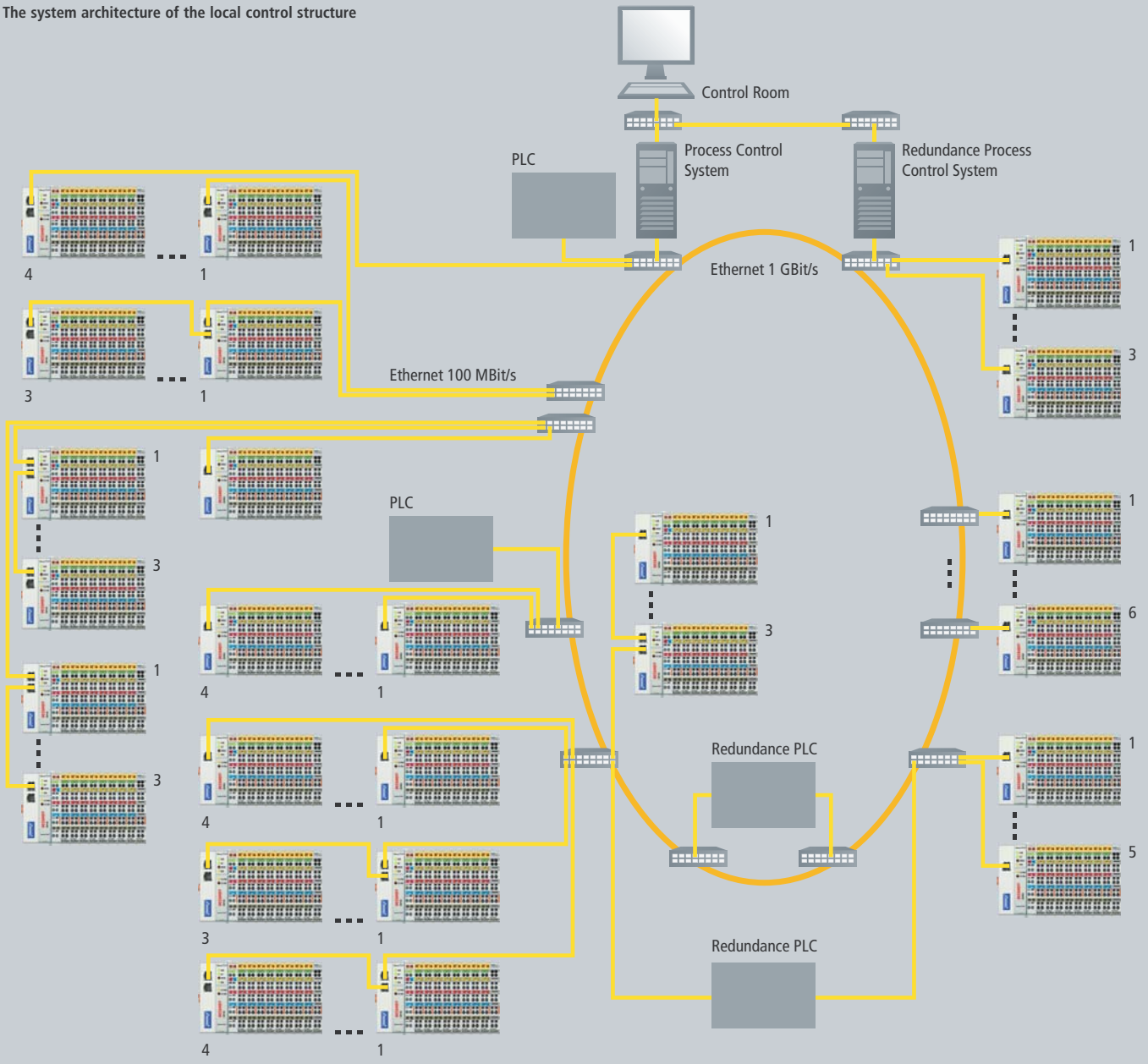
The system architecture of the local control structure