

**Industry:**  
Space Industries

**Organization:**  
Alcatel Space Industries

**Description:**  
Alcatel Space ranks among the world's leading space systems prime contractors. Leveraging its dual expertise in civil and military applications, Alcatel Space develops satellite technology solutions for telecommunications, navigation, optical and radar observation, meteorology, and scientific applications.

**Business Problem:**  
When building a communication system for a satellite project, Alcatel needed to shorten testing time yet meet stringent testing standards and overcome significant testing challenges.

**Rational Solution:**  
Rational Test RealTime

**Key Benefits:**  
Increased development productivity as a result of validation testing improvements  
Heightened confidence in the overall quantity of the application under test  
Improved the predictability of the application's performance further ensuring customer satisfaction

**Rational** software

## Alcatel Space Ensures Compliance with its Market's Stringent Standards using Rational Test RealTime

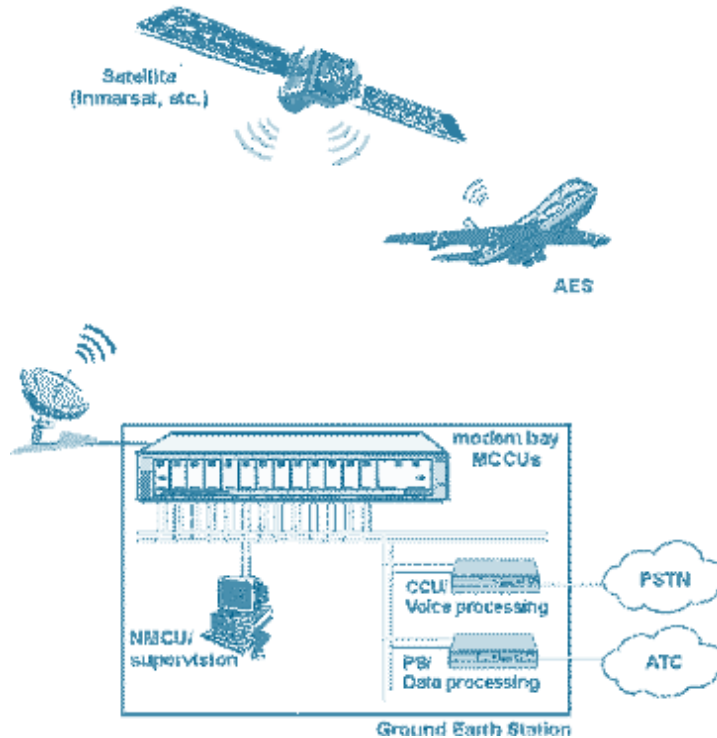
Alcatel Space ranks among the world's leading space systems prime contractors. Leveraging its dual expertise in civil and military applications, Alcatel Space develops satellite technology solutions for telecommunications, navigation, optical and radar observation, meteorology, and scientific applications. With partners around the world, subsidiaries throughout Europe, and a strong commitment to R&D, Alcatel Space plays an important role as prime contractor, operator, investor, or service provider in most of today's leading space programs. The company is also Europe's Number One prime contractor for Earth observation, meteorology and navigation ground segments, as well as space systems operations.

Alcatel Space generated 2000 revenues of 1.4 billion euros and has 6,000 employees.

### The MTSAT Project

The Multifunctional Transport Satellite (MTSAT) project consists of the definition of a communication medium between aircraft and ground for data and voice streams. The final customer is the Japan Civil Aviation Bureau, part of Air Traffic Control.

The MTSAT system includes one satellite and two GESs. Alcatel Space Industries and Mitsubishi are responsible for the complete system. Aircraft equipped with Inmarsat AESs (Aircraft Earth Stations) use this satellite as a gateway to reach the nearest GES. Alcatel Space Industries is in charge of the MTSAT GES.



[The Ground Earth Station Architecture](#)  
This diagram shows the architecture of the GES and its interface with others systems.



“The reuse of previously defined test scripts significantly increases validation testing productivity.”

The GES is composed of four main systems:

- MCCUs: PowerPC/VxWorks cards controlling traffic from the aircraft AES
- NMCU: HP700/Stratus station providing configuration and GES management services
- CCU: Gateway from IP to PSTN
- PS: HP700/Stratus Packet Switch to route data between aircraft and ground data networks

Due to civil navigation constraints, this system is very critical. It provides services not only for passengers and companies but also for Air Traffic Control. The main test requirements are the following:

- Fault tolerance: Every sub-system is doubled. The GES is also doubled. Full switching between primary and secondary GES must be done in less than 4 seconds
- Robustness: No Air Traffic Control traffic should be lost (in case of GES reconfiguration, general system failure, hardware problem, etc.)

- Load and performance: Response time for Air Traffic Control messages should always be the same. The GES should support the traffic coming from 200+ aircrafts with voice and data channels opened at the same time.

Rational® Test RealTime has been used by Alcatel Space Industries for the following test levels:

- Integration of MCCU tasks on PowerPC/VxWorks environment
- Sub-system functional testing: MCCU, NMCU, CCU, PS
- Sub-system integration: MCCU+NMCU, MCCU+NMCU+PS, MCCU+NMCU+CCU
- System validation. Performance and load testing of the GES

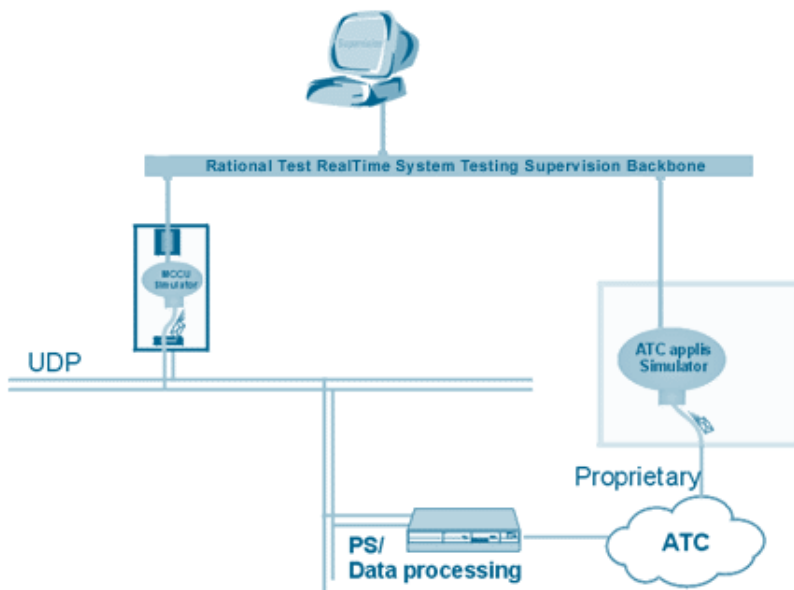
These tests are executed on a test bench mainly composed of PowerPC/VxWorks cards, Hp700 workstations and Windows/NT PCs with appropriate communication interface cards.

### Packet Switch Sub-system Testing

For the purposes of packet switch (PS) validation, test scripts are designed to generate data traffic coming from the MCCUs to the PS and to control this traffic on the ATC network as shown here:

The virtual testers generated from test scripts by Rational Test RealTime's System Testing feature are distributed over the test bench to match the real system architecture: MCCUs virtual testers are executed on PowerPC/VxWorks targets and ATC applications on a HP700 workstation. Each virtual tester uses an appropriate communication interface to exercise the packet switch (User Datagram Protocol – UDP – and ATC IP-based proprietary interface). This test architecture enables measuring the exact timing of events: control is handled by a routing protocol provided by the PS and PS performance.

To measure performance of the packet switch, MCCU virtual testers instantiate PowerPC/VxWorks cards until they reach a load of 100+ airborne systems. This configuration enables analysis of the maximum load supported by the PS before it starts flow control.



All problems traditionally found in these environments are solved with Rational Test RealTime's System Testing feature. Executing and synchronizing virtual testers over a heterogeneous environment (native and embedded) is transparent for integrator. Load generation by virtual tester instantiation is easy to set up and the test bench size (the number of PowerPC/VxWorks) can be adjusted to reach requirements. Tests results are automatically recorded and test reports are consolidated on a host machine.

### System Validation

For system validation purposes, test scripts defined during the integration phases are reused. Test scripts defining the behavior of airborne systems using voice services (MCCU+NMCU+CCU integration) as well as those defining the behavior of airborne systems using data services (MCCU+NMCU+PS integration) are reused during the load testing phase to stress the Ground Earth Station.

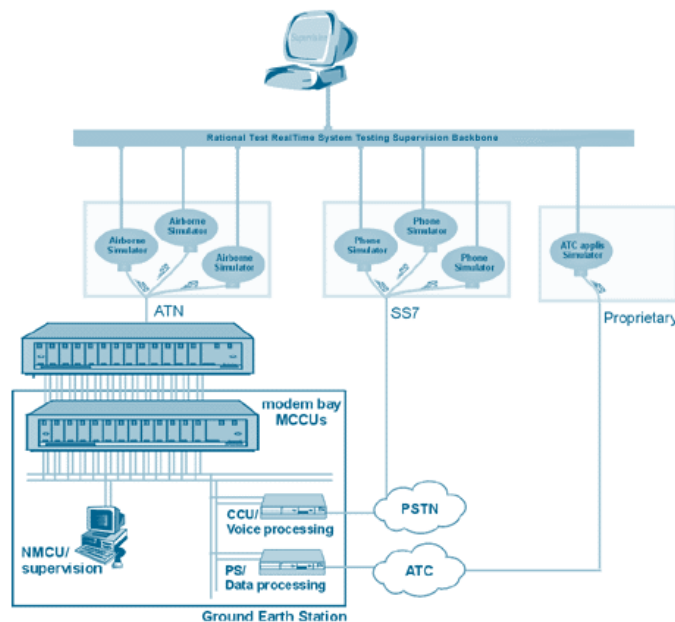
New tests, however, are developed to test the fault tolerance of the GES.

The virtual testers generated by Rational Test RealTime System Testing [CAUTION: the link here will have to be changed depending on the location of the System Testing page] from

the test scripts are distributed over the test bench to match the real system architecture: airborne system virtual testers and ATC applications virtual testers are executed on HP700 workstations, Public Switched Telephone Network (PSTN) phone virtual testers are executed on a Windows/NT PC. Each virtual tester uses an appropriate communication interface to exercise the GES, based on HP700 NIC (network interface card) for ATC applications, ATN modem bay for airborne system, and Dialogic® cards for PSTN phones.

The reuse of previously defined test scripts significantly increases validation testing productivity. Management of large, distributed simulations with appropriate trace levels is also a key solution provided by the Rational Test RealTime System Testing feature for this test level. The execution of these tests is fully automated by Rational Test RealTime System Testing, ensuring regression testing as well as delivery and acceptance testing.

GES Test Architecture



### About Rational

Rational provides a software development platform that improves the speed, quality, and predictability of software projects. This integrated, full life-cycle solution combines software engineering best practices, market-leading tools, and professional services. Ninety-six of the Fortune 100 rely on Rational tools and services to build better software, faster. This open platform is extended by partners who provide more than 500 complementary products and services.

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