1 System overview

1.1 Introduction

The new RFS Antenna Interface Standards Group (AISG) compliant product suite empowers carriers to quickly and cost-effectively optimise their networks. The new AISG version 2-compliant product suite frees the end-user from the inherent restrictions associated with proprietary control and monitoring systems, ensuring rapid network deployment and system optimisation. The solution makes it possible for carriers to control and monitor tower-top components either locally (from the tower base), or remotely from the network’s operations and maintenance centre (OMC).

A true end-to-end 3G solution, the new AISG version 2-compliant product suite comprises all key antenna line elements—the control network interface (CNI), a selection of tower-mounted amplifiers (TMA), an antenna control unit (ACU) and a modem bias-tee. The day-to-day, hour-to-hour—and even minute-to-minute—network RF monitoring and optimisation that the RFS AISG v2-compliant solution provides is essential in today’s competitive wireless world and is particularly crucial in advanced broadband wireless data solutions, along with mature 2G networks.

The following diagram depicts a typically site configuration.
The BTS (Base Transceiver Station) contains the equipments for transmitting and receiving the mobile radio signals. The BTS is also called NodeB in the 3rd generation cellular technologies. The RF feeders reach the TMAs (Tower Mounted Amplifier), which in turn are connected to the remote tilt antennas.

The antennas are usually mounted on a tower, pole or building. The CNI (controller Network Interface) controls the TMAs and antennas by mixing its signal with the RF through the Bias-Tee. The software application interfaces with the CNI to manage the devices.

1.2 The AISG

The roll-out of 3G systems has accelerated the use of cell-site products with digital remote control and monitoring facilities, but wireless carriers are concerned about the proliferation of proprietary control systems and the lack of coordination amongst the equipment suppliers. The Antenna Interface Standards Group has created an open specification covering the control and coordination of equipment at a cell-site, which is independent of frequency band and air interface (CDMA, GSM, etc) to ensure broad participation across the industry.

In November 2001, Brian Collins, current chairman of the AISG, invited 4 others British antenna manufacturers to evaluate the feasibility of defining a standard for the control of the RET (Remote Electrical Tilt). A month later, along with UK cellular network operations, RFS attended the second meeting. Today there are currently 58 members and even Ericsson has joined.

The purpose of the standard is to ensure basic interoperability between ALDs (Antenna Line Devices such as motor controllers and tower mounted amplifiers) and control infrastructure. The different AISG members organize IOTs (InterOperability Test) sessions, which consists in swapping primary and secondary (ALD) devices and verify that they can communicate with each other. This is the acid test: it validates the standard and certifies to customers that the devices of the two vendors are compatible.

The architecture of the AISG is a compact version of the 7-layer OSI reference model.

Layer 1 describes the physical interface; it covers the signaling level and the mechanical and electrical features of the ALDs.
Layer 2 focuses on the link aspect and is based on the HDCL protocol standard, which exists for a long time.
To avoid the complexity of the controller board of the ALD, layers 3 to 6, which concern the network aspect, are not part of the standard.
Layer 7 deals with the commands that are exchanged between the primary and the secondary devices.

Even though the AISG standard is air-interface agnostic, the 3GPP (3rd Generation Partnership Project) standards body recognized the value of the RET (Remote Electrical Tilt) portion of the specification and has linked it to the overall 3GPP specification. Most likely the 3GPP will have AISG 2.0 standard document as a reference to cover the TMA description in the near future.
The novelty of the AISG 2.0

During the IOTs of AISG 1.1 equipment, many issues were encountered that revealed limitations in the first release of the specification. Parts of the specification were inadequately defined leaving interpretation up to the individual vendors. Interoperability out of the box wasn’t achieved and vendors were forced to continually rewrite software. In consequence, the AISG group reconvened to update the standard.

Back in July, 2006, at the RFS hosted AISG meeting in Paris, the latest revision of the AISG standard, AISG 2.0, was released.

One issue to be aware of is that AISG 2.0 is not compatible with AISG 1.1. Fortunately, the new RFS antenna control motors can be programmed for either AISG 1.1 or AISG 2.0 and can be field upgraded, which will facilitate the transition to AISG 2.0.

The advantages of AISG 2.0 vs. AISG 1.1

♦ More robust
♦ Improved documentation management
♦ Faster identification process of the devices connected to the AISG network
♦ Include the 3GPP description of the RET
2 System features

The operator can control thousands of cell sites from a centralized location, called the OMC (Operation & Maintenance Centre).

At the OMC, there are tools to monitor network and system configuration information so that the effects on network operation of various versions of hardware and software elements can be tracked and managed. The CNI provides precisely this critical information such as hardware serial number and software version.

On the front panel of the CNI, an alarm LED is associated to each AISG output. As soon as a major alarm occurs, the front panel LED will turn red, which gives an immediate indication of the sector that demands attention. Additionally, a signal is transmitted to the alarm port and to the remote link: the device with the issue will turn orange on the NEM-ALD-S, RFS Windows application.

Additional AISG commands can be vendor specific, for instance if the operator would like to include a tilt sensor to the antenna, the vendor can add a command to read the actual value of the tilt.

An OEM NodeB can also be the primary device as defined in the AISG standard, in that case it can control RFS secondary devices. During the AISG meeting after the release of the AISG 2.0 standard, OEMs were not very keen on developing software applications to control the AISG devices, whereas the RFS CNI AISG 2.0 is currently available.

System Functions

- Instant access to equipment status for remote configuration management
- Query and change antenna tilt
- Query antenna type including basic antenna specifications such as gain and horizontal beamwidth
- Monitor and adjust TMA gain
- Remote fault monitoring
- Remote software downloading
3 Benefits and Values

The wireless network operators face the challenge to balance the coverage and capacity of the cell sites, the communication quality and the cost of operation. With the steady increase of the wireless traffic, the site coverage has to be adjusted periodically. Flexibility becomes the key word.

1 - The old way of optimization is constraint

Operators can dispatch teams of engineers to the sites to adjust the antenna tilt. However, it turns out to be difficult to get the ideal weather conditions, the availability of the staff or special equipments such as cranes and also the access to the site. Moreover, during those operations, the network has to be switched off, which generates complains, lost calls and less revenue.

2 - Remote control is peace of mind

By deploying RFS AISG product suite, the operators can remotely adjust each element of the site such as the tilt of the antenna. The network does not have to be shut down, keeping the quality of service high. There is no longer neither the weather constrains nor the availability of the resources. There is a significant cost saving such by avoiding to access to the site and dispatching staffs. The almost-real time network optimization not only increases the customer satisfaction but reduce the cost of energy and infrastructure.

Any alarm or potential failure can be detected and identified in advance, so that teams can be dispatched for prevention.

3 - Standardization is freedom

Freeing the operators from the restrictions of proprietary systems, RFS AISG product suite opens the door to network optimization benefits.

Early in year 2005, RFS has organized IOT sessions with the major antenna vendors, please contact RFS for further information.
4 System Components

4.1 The CNI

The CNI (Control Network Interface) is the heart of the system. It is installed into a rack of the NodeB and is the primary device defined in the AISG standard.

It incorporates a PDU (Power Distribution Unit) to feed every secondary device. It has 3 outputs to control the TMA and the electric tilt antennas through the AISG network. Typically, each output controls a sector. This unit can controls up to 6 TMAs and 18 RETs.

Based on the master/slave architecture, the CNI controls the communication on the AISG network: the secondary device may send a message only upon a request from the primary. The CNI fully complies with the AISG 1.1 and AISG 2.0 standards, therefore it can communicated with the ALDs using the whole set of commands defined in the standard.

Four LEDs permanently shows the status of the CNI and the 3 AISG outputs. The alarm connector provides a summing signal to NodeB, which can report it to the remote OMC.

The Ethernet and PPP port are dedicated for remote control of the site elements. The IP address of the CNI can be either configured as static or dynamic, with that case the CNI request its IP address to a DHCP server. While the Ethernet or PPP port is permanently connected to the network for remote control, the site engineer can connect his/her laptop to the PC port for local monitoring.

The CNI is the bridge between the tower equipments and the NodeB so that it can be remotely supervised from the OMC via the SNMP and FTP protocols.

In summary
- The CNI feed and control every AISG equipment of a cell site
- It connects those equipments with the OMC
- It has many ports to access to the AISG networks
- Fully AISG 1.1 and AISG 2.0 compliant
4.2 The TMA

The Tower Mounted Amplifier is installed very close to the antenna. With the power of the antenna transmitted signal much stronger than the received signal, the LNA (low noise Amplifier) of the TMA improves the receiver system sensitivity, reducing significantly the call drops. This is a cost-effective solution to increase the capacity of the network and to extend its coverage.

The TMA demodulates the RF signal to extract the AISG information. At the bottom of the TMA, the connector can extend the AISG network by daisy-chaining the RET. Fully AISG compliant, the TMA software can be remotely downloaded. It is characterized by low noise figure and insertion loss with a lightweight design.

The dual-duplex AWS-band TMA is the first model of RFS portfolio to meet AISG 2.0 standard. Designed for both pole and wall mounting, the TMA is housed in a sturdy and compact IP66-protected enclosure. The units are temperature performance-rated to between -40 to +65 degrees Celsius (-40 and +149 degrees Fahrenheit) and are designed to withstand extremes of solar radiation and thermal shock.

In summary
- The TMA improved the capacity of the network and the quality of service
- Withstands extreme conditions
- Fully AISG 2.0 compliant
4.3 The ACU

The ACU (Antenna Control Unit) is connected at the bottom of the antenna. There is an ACU dedicated per band, for instance a tri-band antenna will have 3 ACUs. The ACU is referred as RET (Remote Electrical Tilt) in the AISG standard. Its main purpose is to translate digital information into a mechanical tilt. It integrates a stepper motor that provides a constant torque and a good precision (0.2 degree) of the tilt. It has 2 AISG connectors so that up to 18 antennas can be daisy-chained. The ACU can be mounted on any type of RFS antenna. The configuration table, proper to each antenna model, provides the relationship between the electrical and mechanical tilts. This configuration table is provided on a CD or downloadable from RFS web site. Once mounted on the antenna, the antenna has to be calibrated, this operation can be remotely executed and take about 10 seconds. Due to its small footprint, the ACU has minimum visual impact, is RoHS compliant and received many CE and EMC certificates. The ACU firmware is remotely upgradeable.

In summary
- The ACU is the AISG interface of the antenna
- It works on any type of RFS antenna for a smooth adjustment of the tilt
- Environment-friendly
- Fully AISG 1.1 and AISG 2.0 compliant
4.4 The NEM

The NEM (Network Element Manager) is the application that the site engineer runs on the laptop during the installation of the AISG equipments. It can also be installed at the Operation & Maintenance Centre.

To access to the element of a cell site, the user enters the IP address of the CNI, a user ID and the password.

The overview displays the AISG network topology of the secondary devices connected to the CNI.

The device Navigation bar shows the CNI and ALDs, they can be sorted by various criteria such as the CNI output port, the vendor ID, the sector, the device type.

The NEM provides more details of each ALD, such as the serial number, the version of its firmware, the frequency bands and all the information defined in the AISG standard.

The operations of changing the tilt or the gain of the TMA are easily completed. The NEM permits to configure the ALDs, display their status and errors, and update their firmware.

The NEM is a Java-based application, which only requires a couple of minutes to be completely installed.

**In summary**
- The NEM is the software application to supervise the AISG network
- Graphical oriented
- Very intuitive and user-friendly
5 Conclusion

RFS is a system provider focused on service, assisting the client during the deployment and maintenance phases.

As previously mentioned, flexibility is the key work. RFS delivers configurations that can be easily tailored and upgraded in different environments. For instance, antennas and TMA can be deployed on sites; the NEM-ALD can control those devices locally. Later on, the operator can invest in CNIs, which will link the devices to the OMC.

The system is very easy to set up, the NEM-ALD 2.0 is a single application that can accommodate any standard; with a reduced learning curve, this is a cost effective solution.

RFS AISG product suite is based on the same hardware platform: switching from AISG 1.1 to AISG 2.0 can be completed by upgrading the firmware with a single click of the mouse.

The CNI, TMA are ACU are very light and easy to handle.

Finally, the NEM has been recognized to be very user friendly, accommodating any protocols with the same graphical user interface. Its step-by-step commissioning wizard is a very useful tool especially during the installation.