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Deployment and activation of the new Voice Communication System (VCS) in ESTRACK stations as part of ESA Harmonization project for Ground Stations.

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Abstract

ESA's tracking station network – ESTRACK – is a global system of ground stations providing links between satellites in orbit and ESOC, the European Space Operations Centre (Darmstadt, Germany). The essential task of all ESA ground tracking stations is to communicate with spacecrafts, transmitting commands and receiving scientific data and spacecraft status information. For this reason, the Intercom represents a key element in a ground station. It must be constantly operational during a satellite pass to let the communication between the two parties happen anytime it is needed. As part of ESA harmonization project, a study to optimize and improve the Voice Communication System (VCS) between ground stations and control rooms has been performed in order to replace the current system, close to its end of life (EOL). The system to be replaced - Integrated Communication System ICS 200/60 - is a fully distributed and modular architecture, made of communication server units, operator positions and distributed interface units. The ring-type network topology allows data transfer in both directions along the ring. The new system - MULTIFONO® M800IP® Voice Communications System (VCS) - is a digital, modular, ethernet-based system designed to operate 24 hours a day, 7 days a week. Audio is digitalized at interface level and distributed within the VCS system using VoIP (Voice over IP), which enhanced the high availability of the system by allowing point-to-point connection of all the system components, embedded in ESA private network. Three out of six ground stations, respectively Kiruna (Sweden), Redu (Belgium) and Kourou (French Guyana) have been equipped with the new system and the deployment in all the ESTRACK ground stations is foreseen to be completed by the end of 2024. This work aims at providing high level details of the new system focusing on the implementation techniques that ESA's engineers have carried out to ensure proper deployment and validation of all system components. A real use-case is presented and the integration process with tests performed to declare the system operational are also described.

Keywords: Ground Station, Integration, Validation, Voice System, communication, ESA.

Acronyms/Abbreviations

AER	Antenna Equipment Room
CWP	Controller Working Position
ESA	European Space Agency
ESOC	European Space Operation Centre
ESTRACK	ESA Tracking Station Network
GS	Ground Station
HMI	Human Machine Interface
HU	Height Unit
ICS	Integrated Communication System
M&O	Maintenance and Operations
MER	Main Equipment Room
OCC	Operations Control Centre
PCM	Pulse Code Modulation
PTT	Push To Talk
SE	Station Engineer
SOE	Spacecraft Operation Engineer
SOM	Spacecraft Operation Manager
VCS	Voice Communication System
VoIP	Voice over IP

1. Introduction

Since the very beginning of space communication, it has been clear the need to ensure a safe, robust and reliable Voice Communication System between parties located all over the word. The voice communication system is a system dedicated to host communication between the ground stations (ESTRACK network) and the Operations Control Centre (OCC) located in ESOC, Darmstadt, Germany.
The complexity of this system resides in its reliability as the system must perform as nominal 24/7, without interruption and more importantly, by maintaining real time communications at the highest quality standard.
The Voice Communication System, or "Intercom", is one of the solutions that allows voice communication between the control rooms in case of anomalies, information exchange and troubleshooting during satellites passes or during on-site upgrades.
While using the system, it is fundamental that the operator would not experience voice leakage or degradation of the quality of the communication as this result could lead to operational errors, loss of signal and in some cases loss of the passes. For example, by considering the scenario of an antenna not ready to track a given spacecraft, if the operator is not able to send the communication in real time with the SOE or SOM, there is a risk of experiencing a loss of the pass.
One important requirement is related not only to the quality of the voice and to stability of the link, but also to the availability of listening more than one time the message that has been sent by one of the parties. Also, it is fundamental that each conversation between the two ends is properly recorded to have the possibility to listen again the massage for troubleshooting or forensic analysis.
During routine activities, the local maintenance team might not be physically in the control room at all times, so having operating positions located in strategic areas of the building of a ground station is very important: e.g. MER, AER, power building, APEX, elevation room, azimuth room and also kitchen /canteen. Every person should be able to listen the voice system and react as needed.
As a natural evolution of ESA' systems, services and facilities, the ESTRACK VCS has been subject to hardware and software update. The old system is being subject to disposal in three of out six ground stations as it has reached its end of life but also because its technology will soon be not compliant with newer communication standards. One additional reason that enabled ESA in its decision, it's the level of flexibility and scalability of the system that allows further expansion and upgrades in the future. The modular design permits "hot-swap" capability for all system components that minimize the risk for outages in the event of technical interventions. The star network topology used by the new system also allows to power off individual positions without compromising the communication flow and data exchange between the system components not directly affected.
For this reason, ESA decided in 2019 to initiate the replacement activities by implementing a new system, with the ultimate goal of achieving the highest level of reliability and system performance, ensuring the satisfaction and expectations of the end users.

2. Space for a new system

The new system MULTIFONO® M800IP® Voice Communication System (VCS) series [4] has been designed to operate 24 hours a day,7 days a week on a completely non-blocking and modular "open" architecture, to permit any further system extension and upgrade. As stated in the previous chapter the modular design philosophy of the system allows the "hot-swap" of any units, so that any technical intervention on the System is possible without powering off any part of it. The audio is digitalized in accordance with the G711 PCM A-Law [3] method and is distributed through the system by VoIP protocol on a duplicated IP LAN network.
The G771 is a narrowband audio codec that provides quality audio at 64kbit/s, the audio signal passes in the range of 300 – 400 MHz and at a frequency of 8.000 samples per second with a tolerance 50 parts per million (ppm).
Each Controller Working Position (CWP) works independently and simultaneously with any other in the System and will be able to access any Telephone, Intercom program and facilities without restrictions or limitations.
The new system allows the connection to loops outside the local network infrastructure providing extended intercom capabilities.

The possible external interfaces are:

- 4 wire E/M interface: the E signal is used as PTT in signal and the M signal is used as PTT out signal.
- E1 CAS interface: CAS signals are used as PTT in/out signals.
- SIP VoIP links: SIP is used to address the site and the loop to be connected to. The PTT signals may be brought by means of RTP Header Extension.

Direct Supervisor and control of access to any functions is managed through the VCS Monitoring and Controller Workstation (MMS), controlled either locally or remotely.

Another important feature is the possibility of configuring the Operator CWP with telephone access facilities. This access can be achieved through Touch-Screen keyboard with Direct Access (dedicated push button) and Indirect Access (selection pad and phonebook) function keys.

The general architecture of the VCS can be seen in [Figure 1].

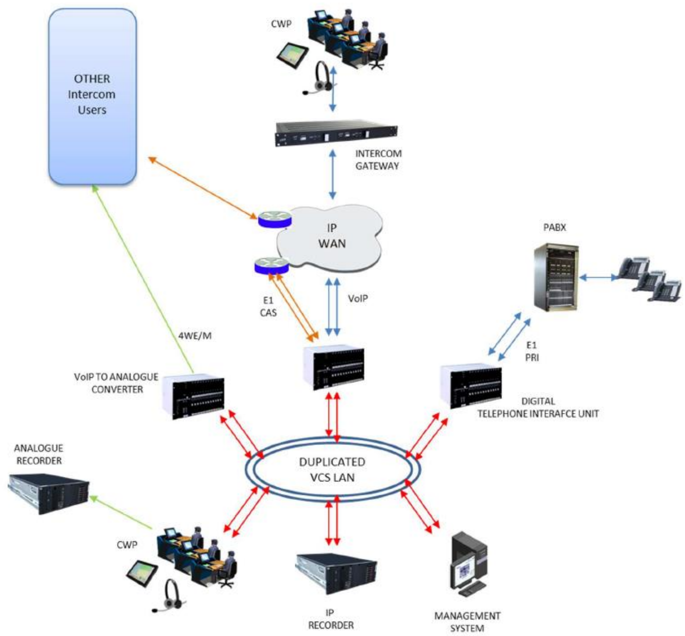

Figure 1 the new VCS Architecture

2.1 The solution

The proposed system is equipped to interface the existing ESOC infrastructures, to ensure the proper communication service between ESOC Control Rooms and Remote Ground Stations and authorize telephone links.

The system can manage the following external network interfaces:

- Redundant Analogue 4-wire E&M links,
- ISDN-B channels,
- IP PABX links
- E1- CAS link to communicate with the existing system during the transition phase.

The VCS is configured as follows:

- Fully Redundant Interfacing Equipment: composed by stand-alone Interfaces Drawers that host all the communication modules and duplicated power supply units.
- Controller Working Positions (CWP's): composed by HMI (Human Machine Interface) touch screen terminals, loudspeakers, connector panels, junction boxes and associated electro-acoustical devices.
- MULTIFONO® Management System (MMS)

The configuration also includes communication modules for internal and external voice communications:

- 2M/MPI/C Interface module: this card is used to manage the analogue connections 4W E&M. This module allows to implement Analogue 4WE&M or VoIP ED137 interfacing: it is possible to configure this module to manage Analogue or VoIP equipment without hardware replacement.
- 2M/GWT Interface module; the module can interface IP PABX/SIP connections to other SIP devices, such as SIP phones. It is used also to establish Intercom communications via VoIP connections among CWP's of different MULTIFONO VCS system.
- 2M/MPI/E Digital Interface module: Each module provides 1 (one) digital E1 link interface. It can be configured to interface and handle different types of protocol (E1 standard or some subset of 64 Kb/sec digital slots, etc.).
- 2M/MPI/E-CAS Digital Interface module: Digital link interface Module able to support the E1-CAS protocol.

2.2 VCS components

The different components of the system can be detailed by:

- Servers, they provide configuration and maintenance capabilities via dedicated client/server tools. Two or more servers are usually deployed to ensure high availability.
- Drawers, designed to house the communication modules and to be fitted in standard 19" rack. They are supplied by dual AC power supply modules to provide 24V D/C to all the modules. Each module has its own AC/DC converter to separate internal circuits from the 24 V DC rail. The modules are independent one from the others and may be fitted in any of the 10 dedicated slots. The modules provide interface to different external connections.
- Controller Working Position devices (CWP), that can have different hardware integrations:

1. Rack-mount position – the dimension of the unit is 19" x 8 HU. See [Figure 2]

Figure 2 CWP: rack mount

2. Desk position, used to be deployed in consoles or table surfaces, the dimensions of this CWP are 409mm x 230mm x 260mm respectively for length, height and depth. See [Figure 3]

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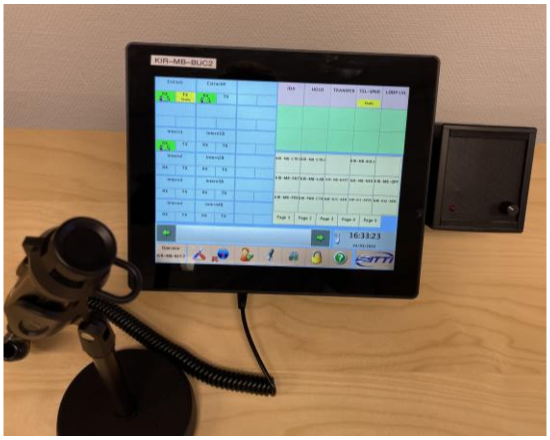

Figure 3 CWP: desk

3. Wall-mount position – used for installation in public areas of the ground station. All the components of this CWP are located inside a closed enclosure for a higher level of physical access security to the network and the system components. The size of this position is 600mm x 600mm x 300mm respectively for length, height and depth. See [Figure 4]

Figure 4 CWP: Wall mount

Each of the listed position is provided with:

- Junction box
- Touch screen
- Loudspeaker equipment
- Microphone

Each element will be described in detail in the following paragraphs.

2.2.1 Junction box

The JB/VoIP unit is responsible for providing the duplicated VoIP interfacing to the VCS Central Unit, Analogue-Digital/Analogue (A/D/A) conversion, audio amplifications for the CWP acoustic devices, links to MTS keyboard, loudspeakers, headsets, handsets, hand-microphones. One Junction Box per CWP is required.
At digital level the JB is able to perform different tasks like provision of the necessary clock timings, extraction from the digital frame of the data for the MTS keyboard, provision of the digital voice frame to the converters, injection of the data for the MTS keyboard into the digital frame to the LAN Switches and collection of the digital voice from the

converters and their organisation into the digital frame to the VCS LAN switches by duplicated and independent connections.

2.2.2 Touch screen:

This unit is responsible for providing Operative Position Management in terms of audio and data exhange. The unit is the Human Machine Interface and manages the operation of the CWP. This unit includes the computer that controls the switching command the data exchange with all the other units belonging to the system and interfaces the operator's touch screen device monitor. Each unit is connected via duplicated VoIP links to the VCS Redundant LAN where the other positions and the supervisor workstations are also connected. The processor installed operates by means of a dedicated application software stored in a permanent storage media (flash memory). The core of the processing unit is based on Linux operating system.

2.2.3 Loudspeaker equipment

In accordance with the functional requirements, the Position Loudspeakers may be used both for monitoring or as operative position device. Each unit includes its own amplifier and the relative potentiometer (no zero minimum level) for reception adjustment. The size of the loudspeaker is made to fit in all the three CWP types and are 97mm x 105mm x 96mm respectively for depth, height, length.

2.2.4 Microphone

This microphone is dynamic type and includes its PTT switch. It can be provided together with a mechanical support that permits its fixing on the console desk. It can work as a hand-held microphone as well as a desk microphone. Functionally it can be used in place of the headset, appropriate securities have been designed to detect the headset presence into its socket to permit the automatic adjustment of the position performances to the device connected.

2.3 Intercom loop

The MULTIFONO M800IP is designed to support Intercom Loop communications, also called Voice Loops, between both internal and external Controller Working Positions (CWP) deployed at ESOC and relevant Remote Ground Stations. The system ensures the access to more than 130 Voice Loops, each one able to connect all staff participating to a specific operation. Each Operator can have up to 18 Voice Loops configured on CWP which can be managed by the operator by enabling of the three possible modes:

- Listen mode: the operator can listen to all the Voice Loops configured on their CWP. Although some limitations exist about of the number of the Voice Loops which can be listen at the same time, due to G711 encoding and possible overflow of voce level.
- Talk mode: the operator can talk in whichever of the Voice Loop configured on his/her CWP, through the pressing of the PTT Key. The transmission by an Operator can be done only in one Voice Loop at time.
- Silent mode: the operator can disable the Voice Loops configured in his/her CWP.

Furthermore, external telephone calls can be coupled with active Voice Loops to allow conferencing capabilities.

An Intercom Loop Identifier buttons [Figure 5], displayed in the screen of every CWP, provides the following information:

- In the upper half of the button it is shown the Intercom label assigned to this selection button. By pressing this button, it is possible to access the "Dynamic Page" that allows for modifying the assigned Intercom Loop (an alternative solution is to open window for selection).

- Mode Selection. The other parts of the touch buttons are normally identified with RX and TX and permit the Controller to choose the way he wants to handle the communications exchanged with that Intercom Loop, individually.

RX: Reception enable touch button:

- Enabling the Reception mode ("Listen mode").

The reception path for each frequency can either be "Off", or "On". The selection of the reception mode is not interlocked, so that multiple Loops can be selected at the same time, individually and independently. Acknowledge to the choice is displayed in the lower part of the same button. The RX area is also used to display the Real-Time evolving situation, so in case of a "call in" the button flashes.

TX: Transmission enable touch button:

- Enabling the Transmission mode ("Talk mode").

The operator can select one Loop in Transmission mode. Then whenever he presses the PTT (Press to Talk) switch and speaks into the microphone his voice is directed to the loop.

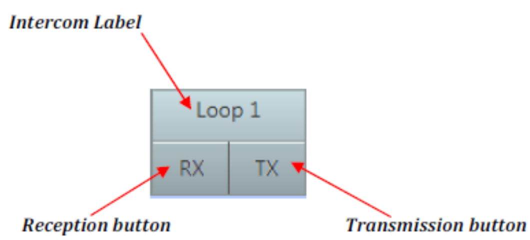

Figure 5 Intercom loop identifier button

3. Deployment of the new system

3.1 Ground station network

In the 60s, during the early phase of the space exploration era, Europe initiated its space venture, including launchers and ground infrastructure programmes. In the early 70s, the European Space Agency started to deploy its 15 meters antennas around the world with ground stations in Redu (Belgium), Kiruna (Sweden), Kourou (French Guyana). In the 90s and with the development of a deep-space programmes led by Rosetta, ESA decided to initiate the procurement of a first deep-space antenna to be located in New-Norcia (Australia) followed by Cebreros (Spain) and Malargüe (Argentina). In 2008, ESA deployed a 5.5 meters antenna in Santa Maria in order to track Ariane launchers (not part of intercom upgrade).

The ESTRACK Core Network [1] is an ESA strategic asset, ensuring independent access to space for Europe. As such, it is operated, maintained and evolved in line with the needs of current and future ESA missions, allowing in particular the Agency ability to support all critical mission phases via its own infrastructure.

3.2 Preliminary activities

The scope of the preliminary activities described in this paragraph is to ensure in a clear way every role and every major point to be prepared for the next phase: on-site activities.

Every Ground Station is managed by a Station Engineer (SE) that according to the mission must provide a possible slot in which the work can be done on-site. This time in which the antenna can be used from upgrade and maintenance activities in which it is not tracking any satellite is called downtime. The peculiarity of the integration on site of this new VCS is that it doesn't require any downtime but only few slots necessary when the operator needs to go in a location inside the antenna like the APEX or the azimuth floor. Once the timeslot to perform the upgrade has been identified various analysis must be performed in order to proceed with the activities.

Together with the M&O and the SE an assessment of the required amount and types of user position and voice loops shall be performed. Based on this assessment it is possible to define how many controllers working position a dedicate ground station needs. Once this number is set and further technical requirements are finalised, a procurement activity can be initiated. The preliminary configuration carried out at ESOC is fundamental in preparation for the activities on site.

The engineers must ensure to carry out several activities including:

- Setting up an IP and voice loop allocation table
- Applying the latest software updates to the system components.
- Configuring the cluster high availability, application server, alarm manager.
- Setting up the software configuration in the test environment.
- Performing a full validation of the system including simulation of outages and possible faults
- Documenting, inventorying and labelling of all the equipment.
- Preparing the system for shipping to the station.

3.2 On-site activities

The on-site activities are carried out at the given ground station once all the preliminary activities have been completed. One of the first activities carried out on-site is the survey of the ground station: every room in which the system must be installed is checked carefully. At this point, once the final requirements have been confirmed, the integration work can be executed by the ground station subsystem engineer along with a contractor on-site.
The servers must be installed in specific server areas to allow for proper cooling and power distribution. Each of the servers is also connected with multiple LAN connections to allow redundant data traffic and management. In addition, direct connections between the servers must be ensured.

The drawers can be installed in normal size racks. All communication modules also requires multiple LAN connections to ensure duplicated data exchange.
Each CWP is provided with their related junction box. The JB needs to be connected on the ESA-LAN via dual LAN connections. The infrastructure of the station needs to be carefully studied before the upgrade so that one can know in advance which are the infrastructure cables to be used, or, in case of unavailability of these cables, how many new cables to run, the power strip and rack availability, etc.

During the implementation activities, engineers are also responsible for additional configuration and testing activities, such as:

- Validation of servers and drawers with the existing network infrastructure of the G/S.
- Validation of all Controller Working Positions.
- Configuration of the voice links between the sites.

3.3 Validation of the new system

All the activities listed in the previous paragraph leads on the most important step of the Intercom Voice Communication System upgrade: the validation. Once all the positions are correctly installed the first step is to verify the quality of voice communications by performing the first voice check.

The voice check between ESOC and the ground station is very important to verify that the link responds to the expected quality levels. Once the test is passed, line saturation tests are carried out by stressing the lines through which the voice communication between the sites is converged. In the next paragraph the Kourou case study is shown, where, under the saturation line test condition, the system was not able to ensure a clear voice communication without losses and a bad quality of voice has been experienced. More analysis should be performed during this final phase to be completely sure that the system is ready for the nominal operational activities at the end of the downtime:

- Mitigation of network errors, ensuring that all ports are error free.
- Testing cluster and server failover behaviour.
- Checking applications and alarms looking for anomalies.

Finally, when all the listed tests are carried out, the system can be declared operational enabling the removal and subsequent decommissioning of the system previously installed.

4. Case study – Kourou intercom upgrade

In this paragraph a real case study is described. In October 2022, the new Voice Communication System was planned for deployment at the ESA Kourou Ground Station (Guiana Space Centre – French Guyana). The intercom upgrade was one of the activities to be performed on-site, along with other simultaneous projects concerning the evolution of systems and facilities.

Located around 60 km northwest of the French Guyana capital Cayenne, Kourou is a coastal town in the north-central part of the country. Since Kourou lies just 500 km north of the equator, it is ideally placed for orbital launches as the rockets gain extra performance thanks to a 'slingshot effect' from the speed of Earth's rotation. The station hosts a 15-m dish [Figure 6] antenna that transmits and receives signals in S- and X-band wavelengths, plus facilities for tracking, telemetry, telecommand and radiometric measurements (ranging, Doppler, meteo).

There is also a 1.3–m dish mounted on the side of the 15-m dish as an X–band acquisition aid. Kourou provides routine operations support to XMM-Newton and back-up support to missions such as Cluster satellites 1 to 4, as well as to other agencies' missions under resource-sharing agreements. This paragraph describes all the activities that have been done starting from the preliminary activities performed at ESOC, (Germany) to the activities on-site, in French Guyana.


Figure 6 Kourou Ground Station

4.1 Preliminary activities – preparation of the system

The preliminary activities are the starting point of any project, at first it is important to understand the needs of the Ground station by collecting requirements and needs from the station management and the local M&O team. The cooperation between the stakeholders is a fundamental part in the project as it helps defining the requirements and tailoring the implementation phase according to specific needs.

Table 1 reports the analysis of the number of CWP and the install locations. As shown, not all the old positions have been replaced with the new Voice Communication System and, in some cases, new locations have been added. This is one of the examples that shows the important of effective planning and communication.

Table 1 New VCS location position

Room	Desk	Rack	Wall	Comments
Meeting room			X	
MER console		X		
Safe room			X	New room
Office manager	-	-	-	No longer needed
Office M&O - 1	-	-	-	No longer needed
Office M&O - 2	-	-	-	No longer needed
Workshop	-	-	-	No longer needed
MER rack - 1	-	-	-	No longer needed
MER rack - 2	-	-	-	No longer needed
MER rack - 3		X		
AER ground floor	-	-	-	No longer needed
AER Ground floor - rack		X		
Antenna – Azimuth floor		X		
Antenna – Elevation floor		X		
Antenna - APEX	X			
Antenna – Airco shelter		X		
Power building		X		

As all the positions must be assigned with unique hostnames, a pre-defined naming convention is put into place. Each position will be precisely assigned to a specific location of the ground station by configuring the software of the VCS. During this phase the number and characteristics of voice loops shall also be defined, internal and external loops are usually configured, used for different purposes. The internal loops are very useful for routine maintenance activities, it is possible in fact to talk between one position and the other.
As listed in the previous paragraph, many of the preliminary activities are hosted at ESOC where the software and hardware configuration of all system components takes place.
Meanwhile the system is prepared for shipping to the ground station, the project continues by studying in details the implementations on-site, considering the existing infrastructure at the ground station. In this phase of the design, it is important to have up to date documentation showing the current status of the GS and its plan for future modernisation.

4.1 On-site activities

The on-site activities start when all the parties involved in the project are physically on-site.
In the following paragraph a detailed description of the activities to performed and the major task that must be achieved to declare the system operational are presented.

4.1.1 Survey

On-site survey helps the engineers assess the readiness of the station, by mitigating possible obstacles.
The survey in Kourou was extremely important, in order to confirm the list, the amount and the type of the Controller Working Positions of the system by providing last minute customizations.

4.1.2 Set-up of the new system

To declare the new system operational, successful voice checks saturation line saturation test have to be performed.
Before a successful validation of the performance, the configuration of the system shall take place by deploying, connecting and configuring hardware and software.

The installation took place as follows:

- Installation of servers and cluster components, including integration into existing network
- Installation of drawers, communication modules and connection to ESA-LAN switches
- Installation of CWP in MER control room console.

This basic installation allows the core system to run in a minimal configuration still allowing effective voice communication between the station and the ESOC.

4.1.3 Voice check and saturation line test – System validation

Once the setup test has been configured and that the system was set to communicate with ESOC the first voice checks with the control room in ESOC could be performed. As voice distortions and glitches were detected on both ends during the first tests, further analysis were carried out and a decision was made to adapt the lines using a higher bandwidth for effective data transmission. Friday 28 October 2023 the implementation of the new voice communication system in Kourou was completed and the new system declared operational.

4.1.4 Final deployment – end of the upgrade

Following the activation of the new system, additional activities were carried out on-site, mainly focused at the disconnection and decommissioning of the old system:

- Disconnection and removal of the old intercom system and clean-up activities. [Figure 7]

Figure 7 Disposal of old intercom

- Relocation of the drawers in final location within the existing data centres.
- Finalisation of the remaining CWP in all areas including Meeting rooms [Figure 8], APEX [Figure 9], AER, and power building.
- Configuration Management: final documentation was provided and delivered to the SE. The final documentation includes a dossier documenting the system architecture and characteristics, along with floor plans, naming conventions, connection matrix, test results and maintenance procedures. All the cables and devices are also labelled according to the GSSIS [2] standard and carefully inventorised.

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Figure 8 Meeting room VCS – New vs old

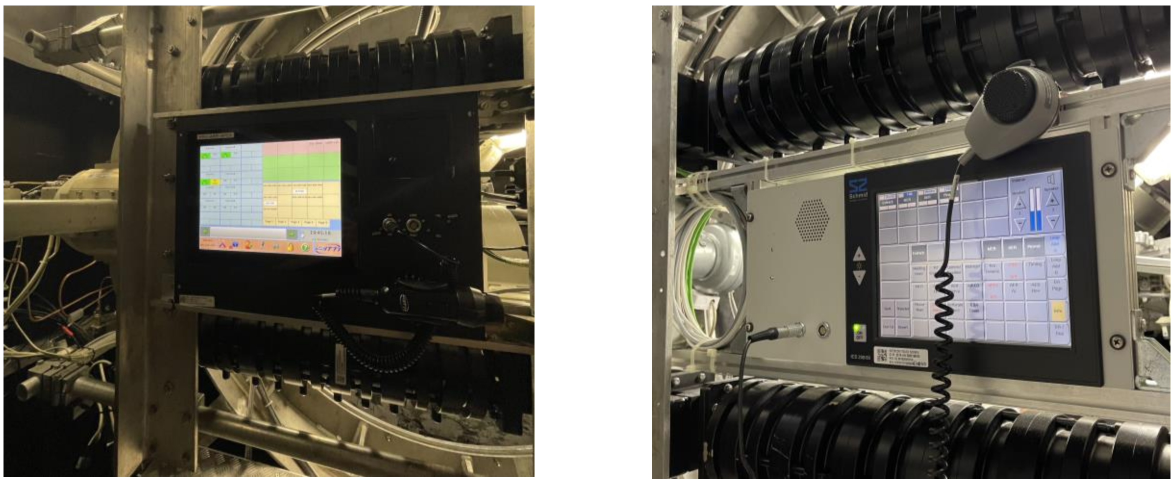

Figure 9 APEX VCS – New vs old

4.1.5 Lesson learned

In the frame of this upgrade, it was important to recognize the importance of a careful planning and on-site surveys in order to plan possible deviations and respond with corrective actions. Additional importance was recognised in the collection of detailed requirements and by making sure that before the on-site implementation takes place, all the network configuration activities including QoS and preliminary saturation tests are carried out to validate the lines in test environment. The Kourou intercom upgrade was an important success for the teams and for the station and it was achieved thanks to the expertise and the availability of all the parties involved in the project.

5. Conclusion - Ready for the future

This paper has presented one of the activities parts of the ESA harmonization project for ground station: the Intercom Voice Communication System. The new system has been described and all the characteristic regarding the Controller Working Position, the functionality, the configuration, and the integration on site have been listed in the previous paragraph.

In Table 2 the status of the Antennas for the replacement of the old system with the new one is presented:

Table 2:ESTRACK new voice system deployment schedule

	2021	2022	2023	2024
REDU (Belgium)	October			
Kiruna (Sweden)		March		
Kourou (French Guyana)		October		
Cebreros (Spain)			April/May	
New Norcia (Australia)			Q4	
Malargue (Argentina)				Q1/Q2

Q=Quarter

Three out of six ground station have been already upgraded, Redu, Kiruna ad Kourou respectively. In paragraph 4 the Kourou case study has been described. The next station, Cebreros, will be able to host and deploy the new system by the end of May. The dates for this upgrade were carefully chosen not to impact the next campaigns and planned ESA launch activities. This will be the first 35m antenna to be upgraded with the new system. Since the facility is much bigger with respect to the facilities of the 15m antennas the number of CWP and the amount of work to be perform is expected to be more challenging.

In Q4 this year, New Norcia Station is expected to follow, while Malargue Station will be the last Antenna to be upgraded with the new system, currently being planned in 2024.

At the time the new system will be fully implemented in all ESA’s ground stations, the ESTRACK network will benefit from a state of the art, more reliable, secure and redundant communication system for high performance and future scalability, reach an important milestone in view of the challenges that the Agency will be called upon to meet in the coming years.

References

List of references

[1] Doat, Y., Lanucara, M., Besso, P. M., Beck, T., Lorenzo, G., & Butkowic, M. (2018). ESA Tracking Network–A European Asset. In 2018 SpaceOps Conference (p. 2306).

[2] Andres Scior, Peter Mueller, GSSIS v.7.0 DTOS-SYST-GST-ST-1001-OPS-GS

[3] Garcia, Jean-Luc, Claude Marro, and Balazs Kövesi. "A PCM Coding Noise Reduction for ITU-T G. 711.1." Ninth Annual Conference of the International Speech Communication Association. 2008.

[4] MULTIFONO® M800IP® Intercom voice communication system for ESOC control room, February 2019

[5] ICS 200/60 Voice Communication Control System Technical Description R3, Document Version Issue 3.5-06