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Video transfer in the Galileo Control Centre

The development of the European satellite navigation system Galileo is being pressed ahead with in Oberpfaffenhofen, complex media technology is also being used: the information required for operation merges together in several control rooms and has to be visualised on different video output systems for scientists and engineers.

From left to right: André Bauerhin (Head of Infrastructure at DLR GfR), Karl-Heinz Wenisch (Teracue), Stefan Feysinger (CAM Systems), Rainer Link (Teracue)



The German Space Operations Centre (GSOC) and the DLR Company for Space Applications (DLR GfR mbH) are located in Oberpfaffenhofen near Munich as part of the German Aerospace Centre (DLR e.V.). One of two control centres for the planned European satellite navigation system Galileo can also be found on the extensive premises, the other one is based in Fucino in Italy. DLR GfR mbH as a one hundred per cent subsidiary of DLR e.V. is commissioned with the maintenance and operation of the Galileo control centre in Oberpfaffenhofen as well as the associated ground infrastructure.

The foundation stone for the Galileo Control Centre (GCC) was laid in Oberpfaffenhofen in November 2006 and the building was already handed over for the configuration of operating equipment in September 2008.

Upon entering, the GCC building surprises with its airy foyer, whose exposed concrete look



In the MCR ("Main Control Room"), up to eight specialists responsible for ground systems and satellite operation will in future be working in shifts around the clock.

bears the mark of the Schultes Frank Architekten architect's office, a certain architectural similarity with the Berlin Chancellery cannot be denied. The GCC has three floors in total with a floor space of more than 2,500 m², with control rooms and server rooms based in the secure basement. The technical infrastructure is designed symmetrically and all relevant system components are redundantly available.

Video Data Distribution System

During the visit in Oberpfaffenhofen, we were able to look into the four different sized control rooms that are labelled with abbreviations in Galileo language like TVR (Training Validation Room) or SOR (Special Operations Room). The smaller control rooms up to 70 m² in size are intended for work on the satellites or ground infrastructure in addition to routine operations; the largest room (MCR, Main Control Room) extends over 120 m² and will in future be occupied round the clock in shift operation by up to eight specialists responsible for ground systems and satellite operation.

Three projections are worked with in the functionally designed MCR, which show different

images in regular operation. Directly below the wall projection surface are six TFT screens flushy integrated into the wall. The smaller control rooms are organised in a similar way, the number of workplaces and large screen displays varies here depending on the range of tasks.

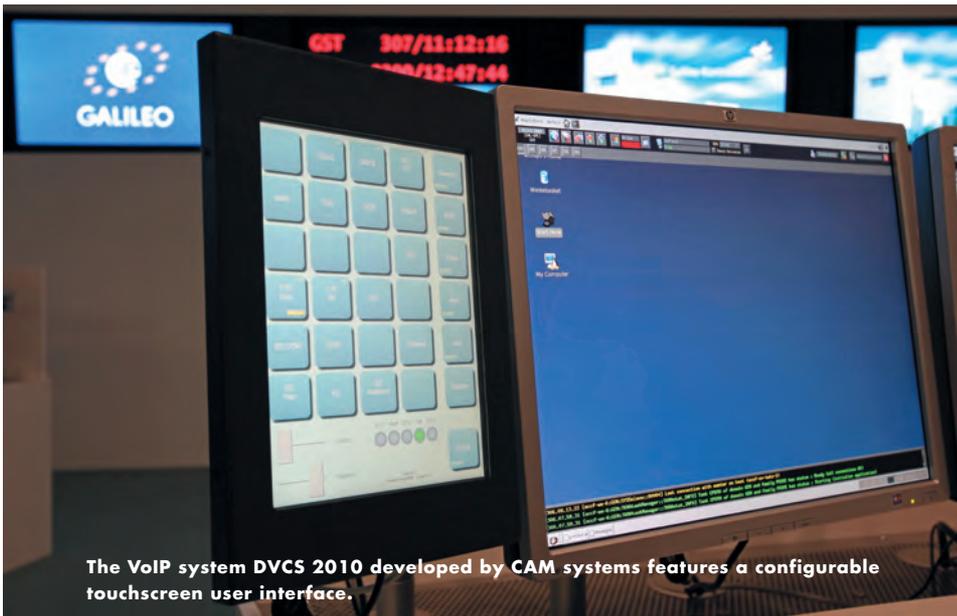
Projectors permanently fixed to the ceiling in tandem order supply sufficient brightness to be able to cope with the varying light situations – users can dim the brightness in the room, if required.

The H.264 compressed video content is distributed via a video data distribution system (VDDS), which was designed by CAM Systems GmbH (www.cam-systems.de), who works for GCC as a system integrator, and is based on Teracue AG (www.teracue.com) components. Using VDDS, any video source can be connected to any video sink routes. It is therefore not only possible to display individual workplace images in large format as a projector image or on the screens installed below but it is also possible to exchange any of the displayed content between the individual workplaces with appropriate authorisation. To prevent potential confusion with dynamic desktop distribution, a yellow highlighted strip is provided on the top left edge

of the screen, which informs the user about which computer image is currently being shown. The informative insert is already integrated into the video signal to be transmitted by the Teracue encoders provided.

The so-called shift leader decides on which content shall appear on which output medium at which time by making a selection using a selection unit: a compact laptop is equipped with "ElementManager", the Teracue Windows software, with which the individual video signals can be allocated to existing image output options (projector, TFT screens) in the room. If required, the signals can also be switched to other control rooms within the networked system. The fact that ElementManager runs separately on a laptop is due to security aspects – no third-party software is to be installed on the computers needed to operate the satellite navigation system.

All the workstations in the control rooms are connected to the VDDS; digital image formats with a resolution of 1,600 × 1,200 pixels are output via a DVI interface, which is connected to a Teracue encoder. The screens installed at individual workplaces all have two DVI inputs, which the user can easily switch between using



The VoIP system DVCS 2010 developed by CAM systems features a configurable touchscreen user interface.

a hardware button on the front of the display. Generally, your own workstation's output locally situated at your workplace is displayed on the screen; at the press of a button, however, you can switch to the connected network signal aligned to the individual encoder (dedicated PC compact hardware with Teracue iCue Player). As expected, access to the network signals is linked to specified authorisations – not every employee has the option of having all the exist-

ing streams displayed. It can be recognised who is authorised by who is authenticated by the log-in, which is stored in a central database on an iCue server; in this way, content can not only be called up directly in the control rooms but at any workplace anywhere in the building.

Beyond the control rooms mentioned, the GCC also has an auditorium and several meeting rooms. Large format image display is possible

using projectors in both the auditorium (60 seats, lectern with floor connection, separate control room) and in the meeting rooms (smartboard, projector) and, as expected, H.264 video signals can also be accessed here with appropriate authorisation. Image films are shown in the auditorium for interested groups of visitors by arrangement and guests can even have a quick look at what is happening in the control rooms via a visitor's bridge with large glass fronts. Naturally, on this occasion the projectors and TFT screens display innocuous content.

Everything via IP

CAM Systems GmbH was able to win the EU-wide tender for media technology in the GCC; the company founded in 1975 specialises in the aerospace industry. "We have grown with the location of Oberpfaffenhofen, we have had a branch here for more than 30 years," reported graduate computer scientist Stefan Feysinger, Senior Consultant at CAM Systems. "Besides the video data distribution system we also set up the voice system in the new GCC building, whose components we produce ourselves. Furthermore, we also provide services with CAM Systems Consulting."



One of the smaller control rooms



iCue Players take over the conversion of encoded video streams at individual workplaces, which can be used independently by users.

The VoIP system DVCS 2010 developed by CAM Systems has already been successfully operated at DLR in Oberpfaffenhofen since 2008 and they are also using the IP-based voice intercom system in the GCC. Its features include a configurable touchscreen user interface, support of a high number of loops as well as dynamic connection of loops, a network architecture without a single point of failure plus redundant communication via Ethernet, a transparent interface to existing voice systems/IP networks/ISDN as well as the operational monitoring of all voice workplaces. Thanks to a specially developed interface, the audio quality meets high standards; headsets are largely used for voice communication in the GCC control rooms. The operating language at GCC is English, which is due to both the international team and global networking.

The generously sized server room, where the heart of GCC's media technology beats, is very useful: in the last row of cabinets there are two 19" racks in which a whole host of Teracue encoders (25 x MC-ENC-DVI2-1RU with two DVI inputs) are housed. A feature within encoding is the option of processing source signals, the insertion of logos and encoding with adjustable image repetition frequency are supported, among other things. For example, with a frame

rate of 5 fps, static screen content can be transferred in full original resolution without loading the network – this is important at Galileo as the screens have to present telemetric and control data with very fine structures and numerous symbols.

The encoder outputs are connected to the GCC master communication switch, which itself distributes to other switches.

50 video sources are currently distributed to 60 video sinks, although it has already been decided to top these up. The GCC therefore probably represents the largest installation that has so far

been realised with Teracue products in the control room segment. Dipl.-Ing. Univ. André Robert Bauerhin, Head of Infrastructure at DLR GfR explained: "Our client wanted to implement a suitable system, it wasn't specified whether it should be designed as analogue or IP-based. However, we wanted to have a state-of-the-art system that we can use over the next ten to fifteen years and, if required, extend it."

Karl-Heinz Wenisch, member of the management board and CTO at Teracue AG commented on the Galileo project as follows: "The project poses a particular challenge as lots of different signals must be switched in the GCC:

» Galileo satellite navigation system

Galileo is a joint project between the European Union (EU) and the European Space Agency (ESA); the programme is financed by ESA and EU funds. During our visit at the start of November 2010, ground system tests and simulations were being run; ESA wants to initially start the launch with 18 position satellites in the third quarter of 2011 at the latest. The satellites are being distributed on three orbital planes that circumnavigate the earth at a height of more than 23,000 kilometres. Originally presented as a purely civil alternative to American GPS, a military use of Galileo has not been officially denied for a long time now. The information in this article is based on project details made accessible by the press and possibly do not reflect the full scope of the installation and products used.



The generously sized server room, where the heart of GCC's media technology beats, is very useful.

besides the individual PC workstations' signals, which have to be output with a resolution of 1,600 × 1,200 pixels via a DVI interface, video signals coming directly from satellites also have to be fed in, in native resolution via DVB-IP and DVB-TV gateways. A DVD player is also to be integrated into the system later on and output from cameras is also supposed to be able to be processed in future. It was requested that the crossbars work transparently and can handle the incoming signal in its native resolution. It would have been difficult to nigh on impossible to find a crossbar that natively processes all formats and can provide optimum quality using conventional technology."

The encoded HD streams are first decoded at the output point using a Teracue decoder in the format suitable for the respective medium. iCue Players take over the conversion of encoded video streams at individual workplaces, which can be used independently by users. Added to these are Teracue's Streamview-1-WVS receivers, which can be remote controlled via the selection units already mentioned and serve the large screen displays. Theoretically, it would be possible to already carry out scaling in the encoder, however, the GCC is not making use of this at the moment.

It is also planned to record the streams; two video servers are used for this: "We will use the recordings in future for PR purposes, among oth-

er things, if controlled content is to be presented to the outside world, for example, if there is media interest on the occasion of a satellite launch," says André Robert Bauerhin. "The recording also provides control opportunities and serves as documentation." Beyond its recording options, the extendable video servers (Teracue iCue Servers) are also used as a recording medium for image films that are shown to visitors in the GCC auditorium. All system-relevant devices are redundantly available so that secure operation would still be guaranteed in the event of an accident/emergency. The GCC has its own team for the operation and maintenance of technical systems, which will supervise the technology around the clock in future regular operation.

It should be noted that the video signals generated in Oberpfaffenhofen are also made available to the Italian partner control centre in Fucino via secure VPN connection, so that the same level of information is always available on both sides of the Alps, which should make the coordination of operational activities easier. The Teracue MC-Route-TRU stream router is used in this context, with which GCC's internal multicast traffic is broken down into individual unicast streams.

Three, two, one ...

At the time of our visit in Oberpfaffenhofen, the GCC was still in the testing and validation

phase and was already working with two orbiting test satellites. The first two operational Galileo satellites are supposed to be brought into space in the third quarter of 2011 and if everything goes according to plan, a total of 18 artificial satellites will be doing their duty by 2014 – the first Galileo services are then supposed to be available with this minimum equipment.

The IT infrastructure is already fully ready for use now and is supporting the team of scientists and engineers with the preparations for this ambitious project. It is the opinion of those responsible that the IP-based transfer of audio and video signals not only guarantees the best possible signal quality but also promises a high degree of future security as an extendable system, if required, whose basis will still be useful when the currently installed projectors and TFT generations are well and truly ready for the scrap heap and are replaced by subsequent models.

Text and photos: Jörg Küster

» Disclaimer

The views expressed herein can in no way be construed as reflecting the official opinion of the European Union and/or the European Space Agency.

Technical Data:



ElementManager

The ElementManager™ is Teracue's remote control application for encoders, decoders, set top boxes and display devices. ElementManager™ enables you to effectively administrate individual LAN and intranet products. It is ONE application that allows you to easily control, monitor and manage almost all Teracue products.

ElementManager™ - One for All



MC-ENC-DVI2-1RU

Teracue's DVI & VGA Encoder is an advanced encoding appliance for streaming computer based signals on standard IP networks. The task: taking any PC or screen signal and making it available on the network in real-time, delivering a true ISO/open standard video stream.



iCue Server

Any video - at any time - on any workplace:

The iCue™ system is your own streaming media TV station with a built-in video library: for intranet IPTV and for professional in-house streaming. iCue™ allows the digital distribution, management and recording of TV channels and camera signals. iCue™ stands for flexible and instant video access for both PC's and TV's - in DVD-quality.



MC-ROUTE-1RU

Teracue's Stream Router is an advanced routing appliance for converting, routing and bridging different streaming types into multicast- and unicast- networks. Designed for streaming to external locations, for WAN transmissions or for the adaption and alignment of live streams within an IPTV system.



iCue™ Player

iCue™ Player The iCue™ Player is a software player for Windows®. It enables users to view live and video on-demand (VOD) streams. Linear channels, house channels that are being broadcast from the server as near video on-demand can also be accessed. All important functions for replaying videos as well as the basic control of the server are directly integrated into the iCue™ Player: playback, setting up recordings, broadcasts, archiving, metadata and category definition.



STREAMVIEW

Teracue's Streamview is an advanced audio/video live stream receiver and decoder appliance for displaying live video streams on DVI and VGA displays. In other words: This is Teracue's professional fully remote controllable software decoder! The task: Receiving H.264 SD/HD or MPEG-2 SD/HD LIVE streams and viewing these directly on standard LCD's, TFT's, plasmas, screen displays and with projectors. The Streamview can be fully remote controlled over IP and is designed for LAN and intranet video-networking applications.


Finance: digital company TV

Dresdner Bank, Kleinwort Wasserstein – Frankfurt
 E.ON AG – Düsseldorf
 E-Plus Service GmbH & Co. KG – Potsdam
 Raiffeisenbank – Kleinwalsertal
 CSOB Bank – Prague
 NXBP Bank – Paris
 Süddeutsche Zeitung – Munich


Video monitoring: control stations

DLR German Aerospace Centre – Oberpfaffenhofen
 EADS Astrium – Bremen
 GCC – Galileo Control Centre - Oberpfaffenhofen


Control and operation centres

SIMOS integrated control centre – Stuttgart
 Saxony's State Ministry of the Interior for Disaster
 Prevention – Dresden
 Carl Zeiss Optronics GmbH – Oberkochen


Medicine and campus TV, Tele-Medicine

Karl Storz Systemtechnik GmbH - Tuttlingen
 University Hospital of Würzburg
 Medical Faculty of the University of Erlangen – Nuremberg
 Eberhard Karls University in Tübingen


Documentation and training

Fachkrankenhaus Coswig of the Technical University
 of Dresden
 Medical Faculty of the University of Greifswald
 Centre for Ophthalmology at the University of Cologne
 UCC Faculty for Sign Language – Denmark


Stadium and event TV

Olympic stadium – Berlin
 Mercedes-Benz Centre – Stuttgart
 Esprit Arena – Düsseldorf
 SAP Arena – Mannheim


Monitoring, editorial TV and compliance recording

PLAZAMEDIA GmbH – Ismaning
 ProSiebenSat1 Production – Munich
 N24 – Berlin
 Ministry of Treasury – Rome
 TV Markiza – Slovakia


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