Rio Tinto 2011

Mission Report

Between 15.- 25. April 2011, the Austrian Space Forum and partnering institutions from ten nations conducted a set of field tests in the Spanish Rio Tinto area. The work focussed on the Aouda.X spacesuit simulator, the ESA Eurobot Ground Prototype, medical and astrobiology experiments w.r.t. the contamination vector analysis as well as the Phileas rover prototype. Geophysical investigations and operational tests bringing together the field team and its operations team-on-site (OPS), a dedicated Mission Control Center (MCC/Innsbruck) as well as Remote Science Support (RSS) teams complemented this field mission.

This document describes the actual events, tests and hardware used during the mission. It is neither a technical report nor does it reflect on the scientific results, but should provide a basic context of what happened.

Document title	Rio Tinto 2011 Mission Report
Release	**PUBLIC VERSION**
Tracking Number	P10_005A
Version / Date	V2.0 (18May2011)
Book captain	Gernot Groemer, Project manager

The Austrian Space Forum (Österreichisches Weltraum Forum, OeWF) is a national network for aerospace specialists and space enthusiasts. Our organization serves as a communication platform between the space sector and the public; it is embedded in a global network of specialists from the space industry, research and policy.

The Forum has a small, but highly active pool of professional members contributing to space endeavours, mostly in cooperation with other -national as well as international- space organizations. The spectrum of our activities ranges from simple classroom presentations to 15.000-visitor space exhibitions, from expert reports for the Austrian federal ministry for technology to space technology transfer activities for terrestrial applications.

In summary, the Austrian Space Forum is...

- a **volunteer space organization**, led by space professionals,
- focussing on space **research** (e.g. human-robotic Mars exploration) and **outreach/education,**
- a **grass-root & independant** organisation funded via research projects, donations and outreach activities.

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Photos of this report have been made by Katja Zanella-Kux (MCC & Preparatory Activities) and Paul Santek (Rio Tinto), unless stated otherwise. We would like to acknowledge their outstanding contribution in the technical and artistic documentation of the Rio Tinto 2011 mission.

Picture: Austrian Space Forum, WLS, LTMS and ORF teams during the Dress Rehearsal in early April 2011.(Photo: Katja Zanella-Kux)

1. Welcome to the Rio Tinto 2011 Mission Report

We got our hands dirty.

After a series of seven field tests of the Aouda.X spacesuit simulator, in conjunction with various biological and geophysical experiments, a five-day test series takes place at the Rio Tinto Mars-analog site in southern Spain. In the framework of the PolAres programme of the Austrian Space Forum, a first test of the Phileas rover will be done, seven scientific and engineering experiments investigate selected aspects of a human exploration mission in an operational environment.

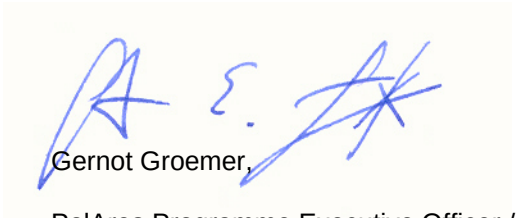
As a few highlights, this mission saw...

- the first European human-robotic field mission involving the ESA Eurobot Ground Prototype,
- the longest EVA in the spacesuit simulator Aouda.X
- the successful operations of a fully fledged Mission Control Center for Mars exploration
- a series of scientific experiments ranging from planetary protection to advanced geophysical methods
- an immense media response - with all the cable networks involved, we will reach literally millions of people

In summary, the Rio Tinto 2011 mission experienced the most complex European field simulation for human Mars exploration conducted so far - something we can be really proud of.

The lineup of international partners was impressive – ranging from two field centers of the European Space Agency (ESTEC & EAC), Center for Astrobiology in Madrid, the Universities of Trento, Manchester, Padua, Budapest, Vienna and Innsbruck to commercial entities such as Emxys/Spain or the White Label Space team competing for the Google Lunar Xprize, but also representatives of ESA and NASA taking a “virtual look over our shoulders”. In total, about 70 team members from all organizations contributed directly to this mission.

We have several sponsors proudly supporting this endeavor, and –most important- a fine group of both capable and enthusiastic volunteers making this happen after 6 months of planning time.



Gernot Groemer,

PolAres Programme Executive Officer / EXLEAD

2. Partners & Sponsors

European Space Agency (ESA)

ESA is supporting the expedition with two experiments: For the first time ever the EUROBOT - an autonomous, mobile, robotic system for planetary exploration – will be tested in the field. This marks a big milestone in the development of this robotic vehicle, which has only been tested in the lab before. The second ESA experiment is called “Long Term Medical System (LMTS)”, which monitors and records the suit tester’s vital signs.

University of Innsbruck / Medical University of Innsbruck

Both universities are involved in the Rio Tinto expedition with several experiments. Furthermore, the science team at the Mission Control Center (MCC) in Innsbruck will be supervised by Prof. Dr. Birgit Sattler of the Institute for Ecology. The Medical University provides amoungst other things the Biomedical Engineers for the MCC.

Centro de Astrobiologica

The center for astrobiology is the spanish scientific partner on site in Spain and supplied the field crew with several geophysical devices, for example a Raman spectrometer and a drill. Coordinated by Felipe Gomez, the CAB provided a link to the regional and local partners, especially the Rio Tinto Foundation, who owns the property of the test site.

White Label Space

White Label Space participates as one of the few European teams at the Google Lunar X-Prize (GLXP). For the Rio Tinto expedition White Lable Space provides their lunar landar mock-up, which will be used during a robotic damage inspection experiment.

Europlanet

The Rio Tinto Expedition is part of the transnational access scheme of Europlanet. www.europlanet-eu.org

Pröllfilm & Bayern Alpha

The filmmaker Erich Pröll accompanies the mission. The film footage was broadcasted by an Austrian television network (ORF Newton Special) www.proellfilm.at In addition, a second TV team from “Bayern Alpha” followed the entire mission from the beginning, headed by Gerd Baldauf and Norbert Frischauf.

University of Manchester: Conducts a microbilogical experiment. www.manchester.ac.uk

University of Budapest: Manages the Geophysics experiments. www.elte.hu

ILEWG/Bernard Foing: graciously provided a VIS/NIR-spectrometer

University of Vienna: graciously provided the Ground Penetrating Radar, www.univie.ac.at

Collegium Budapest: Conducts data acquisition with different spatial resolutions to extrapolate the process of data acquisition on Mars. www.colbud.hu

University of Trento: Tries to compile a 4D data model using the Microsoft Kinect which will be mounted on rover Phileas. www.unitn.it

Commercial Sponsors

T-Mobile Austria

To establish communications between Spain and the Mission Control Center in Innsbruck T-Mobile is suppling a 4G/LTE connection for the MCC. This 4G/LTE connection achives a downlink transfer rate of up to 100 MBits/s and 50 MBits/s uplink and is therefore the fastest mobile internet available in Innsbruck. www.t-mobile.at/4G/

Catalysts

Catalysts is developing software products – besides client-server applications like taskmind several useful tools for developers have been created over the years. For the Rio Tinto Mission a voice controlled software by Catalysts will be used. In addition this year's Catalysts Coding Contest is all about astronautics. This time solutions for space travel, quantum physics or satellite observation will be found. www.catalysts.cc

WeTab

For the Rio Tinto expedition in april 2011 the 4tiitoo AG is suppling us with three WeTab on loan. These devices are delivered with a linux based operating system (meego) and will be used in Spain and at the MCC in Innsbruck. www.wetab.de

Wagnerische Thalia

The bookstore "Wagnerische Thalia" in Innsbruck provides us with a show window for Mars research and the Rio Tinto expedition. Furthermore the

multimedia show including a live stream from Spain will take place in the rooms of the book store on 20th April at 7 pm. www.thalia.at/shop/wagnersche/

Fairrescue International

The company Fairrescue located in Innsbruck is a competent partner for emergency and rescue medizin. Their strong points lies in the development and production of their own emergency backbags and rescure bags. Fairrescue is supporting the Rio Tinto Mission by providing flight overalls and the emergency medical equipment and thus are securing the crew's saftey.

Buchbinder

To transport crew, material and experiments to Spain, Buchbinder is suppling us with two transport vehicles for a special fee. www.buchbinder-rent-a-car.at

Bongusto

bongusto-tirol is a meals on wheels delivery service that provides only high quality frozen meals. Volunteers at the Mission Control Center in Innsbruck can consume lunch for a special discounted price. www.bongusto-tirol.at/

Steiger Electronics

Is authorized Apple reseller in Innsbruck and consults privat individuals as well as companies on hard- and software services. For the Rio Tinto Simulation Steiger Electronics provides the MCC with an Apple iMac 21". www.steiger-electronics.at

Austrian Research Promotion Agency (FFG)

The FFG is the central Austrian organisation for promotion of research and innovation. In appreciation of the outreach and education efforts of the ÖWF, they contributed financially to the mission.

3. Preparatory Activities

The planning for the Rio Tinto mission started about 8 months before the actual simulation with regular telecons within the PolAres OPS team headed by Willibald Stumptner, followed by a “GO”-decision of the Management Board in September 2010, after the Europlanet programme had indicated they’re willingness to support the mission.

The call for expedition team members was issued in October 2011, where the core crew for Rio Tinto was selected. In October, a 10-people delegation of the Austrian Space Forum went to the European Astronaut Center for a professional visit to hear about Mission Control basics in Cologne. In November 2010 we got the “GO” from the Innsbruck Red Cross society to establish the Mission Control Center on 400 sqm, the back-up MCC would have been at the University of Innsbruck, although smaller.

A dedicated announcement of opportunity was issued to selected researchers on the 03Dec2010, closing date was the 25Jan resulting in about 15 proposals and indications of interest, 8 of these were selected.

Team leader roles were defined in January 2011, and detailed mission design was started and programming activities for mission specific software (like the OSTPV) wer initiated under the lead of Jan Klauck.

Ulrich Luger undergoing ergometry at the Medical University of Innsbruck

The potential suit testers were Daniel Schildhammer, Daniel Föger, Ulrich Luger and Gernot Grömer (Back-up), the Medical team under the lead of Thomas Luger defined the selection criteria from the physical fitness point of view. The candidates underwent a rigorous exercise and testing scheme including ergometry, spirometry, blood lab, detailed medical history, and finally MRI/CT-scans.

The final selection was Ulrich Luger and Daniel Schildhammer (primary testers), Daniel Föger (Back-up → CapCom) and Gernot Groemer (Back-up on-site).

Beginning in February 2011, team telecons were held mostly on a weekly basis, the IT infrastructure needs were defined and the search for sponsors started. For both the suit testers as well as the key staff members at the MCC, a dedicated media training was organized. Various dry runs with experimental hardware were conducted at the ÖWF Innsbruck facilities.

These activities culminated in a Dress Rehearsal on 01-03Apr2011 in Innsbruck, were also representatives of the LTMS experiment team and other external researchers were present.

Ulrich Luger, Gernot Groemer and Daniel Schildhammer engaging in a video link during the prize giving ceremony for the 3rd Polar Star Award of the Austrian Space Forum in Vienna during Yuris Night on the 12Apr2011.

Olivia Haider, Christoph Ragonig and Martin Knoflach during a dry run for the data pipeline test in mid-March 2011.

Gernot Groemer explaining the MCC Layout and functionalities during the Dress Rehearsal briefing.

4. Logistics

Scouting – the Rio Tinto analog site

A field reconnaissance was conducted on 31Jan2011 at the potential test sites in the Rio Tinto mining area. The area is owned by the Rio Tinto Foundation, the scientific activities hosted by the Center for Astrobiology at INTA, represented by Dr. Felipe Gomez, Madrid in conjunction with the Europlanet framework.

Topography / surface structure / environment

Roads were well prepared; the site had all kinds of terrain variability and steepness ranging from flat sandy surface to rock gardens. The sands had a typical granular size between a few 100 µm and a few millimeters (dominant).

Weather-wise we expected dry conditions with temperatures between 10-20°C, but were challenged by heavy intermittent rainfalls (typically 1-5 mm) and wind gusts between 10-35 km/h which were strong enough to rupture the OPS tents. These conditions were very unusual for this area for that time of the year. Night time temperatures varied around 5-10°C.

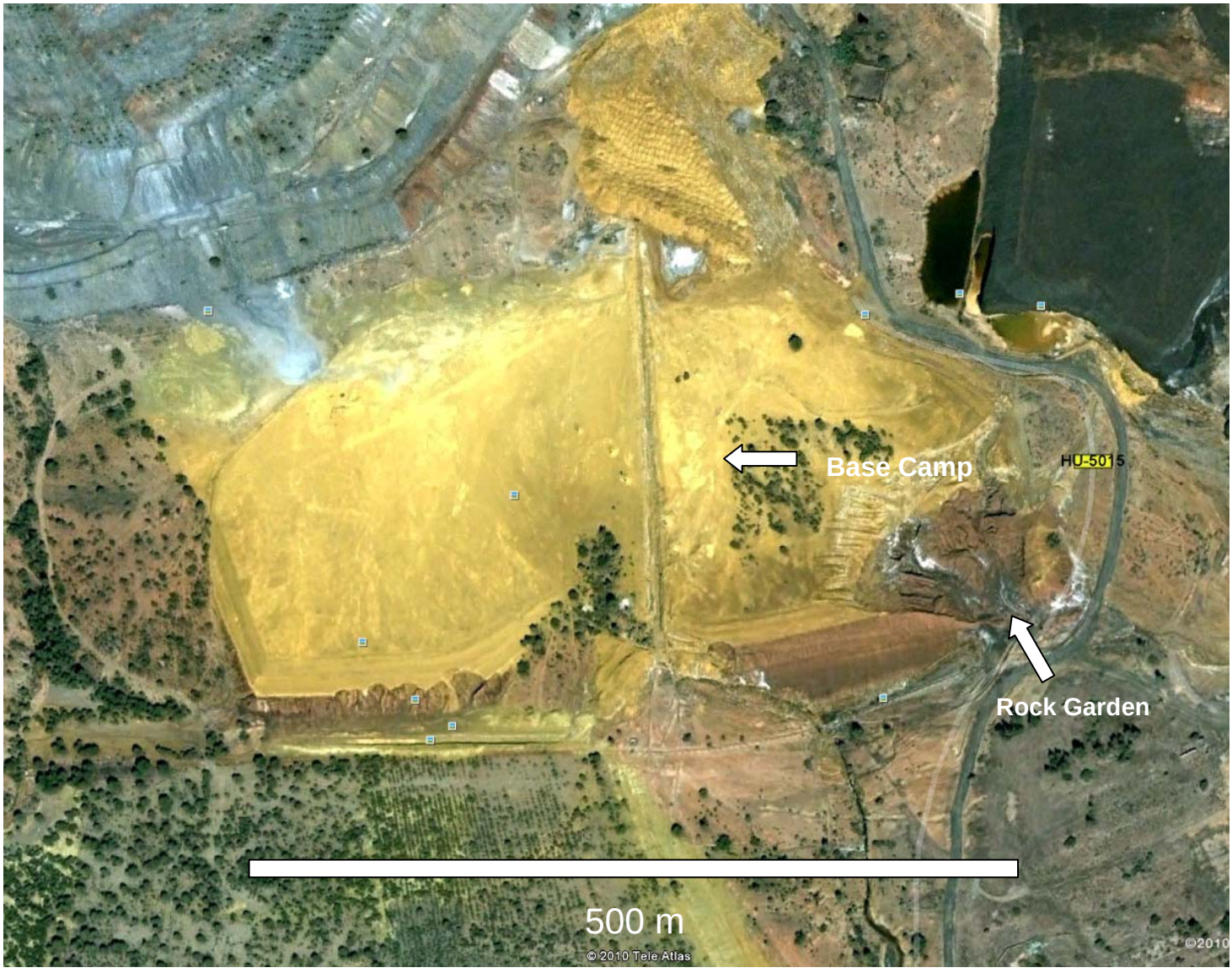
Sunrise: 06:45, Sunset: 20:05, culmination 13:26. Full Moon: 18Apr2011 (rising locally at 20:50).

Logistics / Shelter / Other issues

Mining activities have been shut down more than a decade ago. We had permission to establish a base camp anywhere on the property of the Rio Tinto Foundation.

The operational area (“site 2”) Was located near the ash disposal from the mining activities, this site has a field of Iron-deposits as well as phyllosilikates, plus a few smaller gullies at the south end. The site extension is roughly 500 x 400 m with flat terrain (see aerial image), detailed maps were obtained from the Geographical Institute of Andalucia, Spain.

GPSLat: 37 40' 39,60" [DMS], GPSLong: 6 33' 57,60" [DMS]



Weather

Despite the weather forecast in early April 2011, we experienced heavy rainfall especially during the last three days of the field mission. The MCC offered weather updates approximately on a 30min bases, so several field activities were conducted within 10-30 min time slots.

Paul Santek exchanging his camera for a shovel to build a drainage channel for the OPS tent.

The Base Camp Infrastructure in Rio Tinto

Physical Field set-up

In addition to the sleeping tents, the field crew had the following working tents:

- 2 tents 3 x 3 m, 2m high ("Ops" and "Workshop/Science")
- 1 tent 6 x 3 m, 2m high (the "garage")

We also brought along a Makerbot 3d-Printer (max object size 10x10x10cm) to replace plastic parts if something breaks (hardness comparable to Lego-bricks). As there were no major malfunctions in the hardware, the printer was not used in the field.

PolAres Field Control Center (PFCC) operations

The PFCC (aka the "**OPS**") was a forward field element which represents a local asset such as a Mars habitat or an orbital station to collect and disseminate data in real-time. During field simulations, it serves as a network hub, and local command infrastructure which can operate autonomously from a MCC, but can also serve as a relay.

Radio Language

The radio language for both the W-Lan system and the PMR back-up radios was based upon on communication rules commonly used in air traffic and emergency services. (We tested for military, casual and mixtures of conversation styles). We generally have push-to-talk buttons to minimize background noise and bandwidth; the Aouda.X vox system is usually on continuous broadcast.

Tents, food, water and hygenie

As the Rio Tinto mission was also considered a “dry-run” for a future Arctic expedition, the ÖWF team stayed in a tent camp at the site, including the participants for White Label Space, all other research and media partners were staying in the nearby towns of Mineras de Rio Tinto and Nerva. At the site, we had 7 living tents, 1 tent for provisions and water as well technical tents for housing the OPS (9 x 3 m), the “Eurobot garage”-tent (3x3 m).

The servicing tent provided the field crew with a basic electronics workshop with laboratory power, an oscilloscope, laptops, power, a soldering station, a 3d thermoplastic printer and a small selection of spare parts.

As the contract with a local company for a Dixie toilet did not materialize, we organized 2 chemical toilets.

Power & Illumination

The electrical power grid was based upon gas-operated generators (4,7 kW Herkules, 2 kW Honda, 1 kW ESE Generator from ÖWF, plus a 1 kW Honda provided by the CAB/INTA), all sensitive applications (computers, modems etc..) were fed through two 1,4 kW uninterrupted power supplies to buffer short term variations in the power output and allow for a short cool-down break during the refueling of the generators.

The largest consumers were:

- Eurobot power system charging (2 kW over 5-8 hrs)
- Powerdrill (2 kW, typically for 1 hr)
- OPS (1-3 kW, permanently)
- Aouda.X spacesuit power system charging (2 kW, typically over 2 hrs)

In total, approximately 300 m of power cables were used, as well as 10 distribution sockets with 5 outlets and various other small parts. All electrical wirings were mounted with elastic cables (“BindFix”) at the top inside the tent walls to avoid water spillage into the sockets. This turned out to be an extremely valuable decision given the rainy weather.

4 x 250 W flood lights were available for night time activities, plus a set four cold-light lamps.

IT Infrastructure @ Rio Tinto

We were using two dedicated laptops for running operations plus one external monitor for extending the desktop of one laptop. One of the laptops was used mainly for tasks related to all sorts of communication (e.g. running the VPN client, voice chat with Capcom and the suit via Mumble) whilst the other laptop was used for monitoring data from the suit (telemetry, video streams, etc.). In addition to these two laptops, private laptops of the crew members were used for various tasks whenever additional space on a monitor was needed as the three monitors of our laptops were filled rather quickly.

Network communication inside the operations tent was established mainly via Ethernet cables, mobile devices and non-stationary work places were also connected via a 802.11b/g wireless network. Aouda X was connected to the network using a separated 802.11n wireless network with a frequency within the 5GHz band to avoid interference with other devices in the cluttered 2.4GHz band. Additional range is gained by using high power wireless cards which operate on the upper end of the allowed emitted power level at operations and inside the suit and by using a directional antenna with a high gain at operations.

The connection to mission control was established by creating a virtual private network (VPN) via the internet. We planned to used two separate satellite dishes (pointing to different satellites) to connect to the internet. The main link was a system from Telefonica with up to 16Mbit/s downlink and 2Mbit/s uplink speed, the backup system was a smaller dish from StratosDSL using the Astra satellite network with up to 4,096 Mbit/s downlink and 256kbit/s uplink speed. Although the connection tests in Austria with the smaller dish were successful, we weren't able to align the dish to the right satellite in Spain why we could only use the system from Telefonica

Voice communication and telemetry wasn't limited by this but file and image uploads took rather long.

On-site safety

- 2 fire extinguishers for electrical fires were always present (one at the generators, one for the suit)
- Fire proof gloves
- Medical equipment, including oxygen, basic first aid equipment
- A full pharma set (approx. 60 drugs)
- Life Pack 15 Defibrillator & ECG with Plethysmography and Blood pressure
- 3 (Austrian) state-licensed Emergency Medical Technicians (1 EMT-B, 2 Paramedics)
- 2 doctors on-call at the Mission Control Center
- The nearest hospital with a state-run ambulance service was 10 min by car away.

MCC/Innsbruck

The Mission Control Center was set in a 400sqm area at the **Austrian Space Forum / Suitlab, Sillufer 3a, A-6020 Innsbruck.**

The Austrian Red Cross had graciously offered all the other rooms for the duration of the mission.

FD Alexander Soucek and FD Christoph Ragonig during the Simulation in the FCT room.

The Mission Control Center was comprised of the Control Rooms

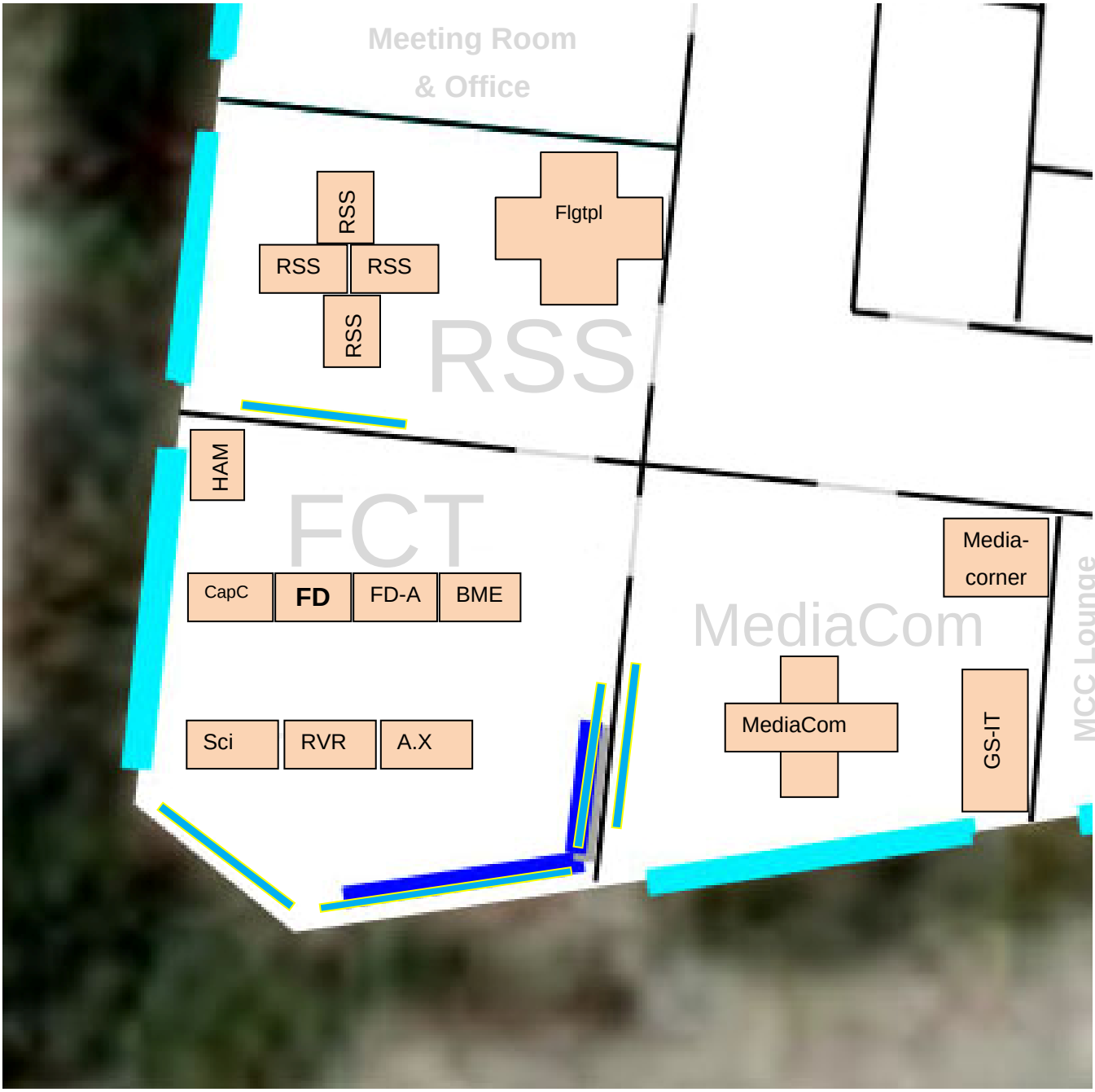
- MediaCom – the “hub to the outside world”
- Remote Science Support (RSS) – the science operations office, including IT.

- Flight Control Team (FCT) -the “situation room”

In addition, there were

- a “MCC lounge” for MCC staff members (not for visitors, not for the media)
- a meeting room
- a reception (also for signing in/out of the MCC)
- the sleeping quarters
- storage room, washrooms

FDA Christoph Ragonig and FD Norbert Frischauf with CapCom Reinhard Tlustos in the FCT room.



RVR… Rover Operator

A.X… Aouda.X operator

Sci… Science

HAM…Ham radio operator

Flgtpl…Flightplan

BME… Biomedical Engineer

FD… Flight Director (-A… assistant)

CapC… Capcom

GS-IT…Ground Support-Information Technology

Beamer Displays

The IT team was headed by Harald Fuchs (ÖWF / Univ. of Vienna).

The MCC network infrastructure (established to a good deal by Sebastian Sams) consisted of two subnets:

1. **The public network:** used primarily by Mediacom and guests to access the internet. This network was accessible either by tagged LAN ports or by WiFi (IEEE 802.11g, WPA2 secured). Access to the internet was granted by a gateway connected to a LTE stick provided by T-Mobile. Unfortunately the gateway (Windows XP, Pentium 4 / 3 GHz, 1 GB RAM) provided not enough cpu capacity to supply a stable connection when more than, let's say, 4-5 people tried to access the internet at the same time. None of the clients was able to achieve more than 1 MB/s download rate though LTE is able to support higher rates. The clients also had to cope with connection losses. Probable reasons were beta type drivers for the LTE stick and/or poor hardware power. A second LTE stick was tested with a high-performance computer (Quad core 2.4Ghz / 4 GB RAM) but the drivers put the operating system (Windows 7) in a highly instable state. Up to 20 people used the access at the same time claiming an estimated bandwidth of 3-4 GB per day.
2. **The internal so called "MCC network":** access to the internet worked very stable (put atop in-house DSL). A one-time connection failure (Flight Control went offline) was tracked back to the broken Ethernet cable connecting the server-room with MCC. Based on the experiences collected during dress rehearsal replacement cables were available so Flight Control went online after about 3 minutes. Due to the amount of data from Rio Tinto the computers in this network used about 5-6 GB per day. The server – though based on ordinary desktop computer hardware – worked stable as well as the software installed by Sebastian Sams.
3. For unknown reasons a lot of the external scientists who got preconfigured virtual machines to access the network by OpenVPN did not appear online during the mission though the connection software was tested successfully in advance (but at least with New Zealand further test will be conducted to learn lessons for future projects).

Dress Rehearsal week turned out to be an absolute necessity in preparation for the project. Indeed a longer time period would have been even more helpful: establishing a backup strategy was not realized until April 17th (meaning one day before the start of the project!). But due to Wolfgang Jais' high level of experience the backup script he created during the night worked flawlessly and all data were transferred nightly onto Lunarsat server in the University of Innsbruck.

Using Linux (Ubuntu 10.04 LTS) as the prime operating system for the servers, workstations but also for the virtual machines proved to be an effective and stable base of work. Thanks to a well prepared user interface even users with no Linux experience were able to use the system without any difficulty or in-depth

instructions. Each workstation in the Flight Control room, the RSS room and the Mediacom room was configured the same way:

- each software in use was quickly available by a simple icon directly on the desktop
- the web browser's start page showed links to the web tools (MCC status, webcams,…)
- each computer was remote configurable by SSH by the administrators for quick access

Use of Linux (especially the Ubuntu flavor) for servers and workstations/clients is highly recommended for future projects for following reasons:

- cost reduction (no license fees necessary for the operating system)
- stability (when using distributions like Ubuntu LTS, Debian, Cent OS etc.)
- security

and in the end, surprisingly:

- also easily adaptable for desktop use, no serious problems for users occurred related to the OS

Conclusion: Four months (instead of two) are a good lead time for establishing the IT team. Nevertheless, due to a well prepared IT infrastructure by Sebastian Sams, the network worked quite stable. Problems which occurred could be traced back mostly on hardware failure. For future projects we recommend to rely on tested and well established internet access technologies.

Also we had not enough computers to use for Flight Control so we had to rely on private hardware. This situation nearly escalated when two workstations ceased to work (possible power supply and/or motherboard failure). Fortunately Wolfgang Jais quickly got his hands on a computer from the University of Innsbruck and also provided his private PC. Nevertheless a further malfunction would have meant to leave either RSS or Mediacom without a workstation connected to the internal subnet.

External Communication MCC – RSS/Backrooms

The field data were relayed via a secure VPN tunnel to the MCC and distributed to various institutions in Europe and the US. The audio communication is done via Mumble or Skype to

- MCC – RSS
- MCC – SUIT
- Any other MCC function on a case-to-case bases

The technical monitoring is done by: GS-IT, the switching of the audio channels is authorized and monitored by CAPCOM. E.g. nearly everyone can hear the Aouda.X suit tester, but only few can talk to him. The Backrooms and external entities can talk to each other including the MCC-RSS and on-a-case-to-case-basis with FLIGHTPLAN.

As a back-up, telephone lines were used.

External Partners scheduled for VPN telemetry

Name	Affiliation	Email	Science Focus
Barbara Imhof	Liquifier Systems Group	bimhof@liquifer.at	Operations & Space architecture
Richard Hoover	NASA GSFC/Astrobiology	richard.hoover@nasa.gov	Astrobiology
Carol Stoker	NASA ARC/Astrobiology	carol.stoker@nasa.gov	Astrobiology
Simon Evetts	ESA EAC/CMSO	simon.evetts@esa.int	Operations / Medical
Maite Trujilo	ESA/ESTEC	trujillo_m@hotmail.com	Safety & Human Factors
Felipe Gomez	CAB Madrid	gomezgf@inta.es	Only for Dress rehearsal/CAB test
Cassie Conley	NASA HQ	Cassie.Conley@nasa.gov	NASA Planetary Protection Officer
William Clancey	NASA Ames	william.j.clancey@nasa.gov	NASA Ames Intelligent Systems Division
Jessica Marquez	NASA Ames	jessica.j.marquez@nasa.gov	NASA Ames Human Sys. Integration Div.
Akos Kereszturi	Collegium Budapest	kru@mcse.hu	Institute for Advanced Study Budapest
Dr. Dominik Hurnaus	Catalyst	dominik.hurnaus@catalysts.cc	Catalysts
Csilla Orgel	Univ. of Budapest	csilla_csillagasz@hotmail.com	Univ. of Budapest / MCC RSS
Andrew Barton	AOES Space/WLS	andy2isu@hotmail.com	WLS Space Control Room @ AOES
Francisco Garcia-de-Quiros	EMXYS	fgarciaq@emxys.com	Traingrid Vest

Information for external partners, backrooms and external RSS teams

- You will be called by the MCC well in advance before the experiments relevant to you experiment or expertise. We will make sure that you
  - Have the current flight plan (OSTPV) at hand
  - Are familiar with the procedures of interaction
  - What is happening right now in the field
  - That the VPN stream and the Mumble/Skype connection O.K.
- Once the contact is initiated you need to be reachable via telephone
- The data stream from the field is not meant for the general public. You are welcome to invite colleagues etc… - if you intend to do more than that, pls. get in touch with MediaCom and/or the acting FD well beforehand.

However, it turned out that most of the partners having indicated an interest in participating were not available during the agency day and choose not to contact the MCC otherwise.

5. Field & MCC Safety

PolAres followed the 3S-principle: Safety – Science – Simulation

Whenever there was an off-nominal situation, we had introduced the following four conditions:

CODE RED

- Can be declared by FD, Suit tester, experiment PI/Operator or Safety in case of serious risk for the Crew or equipment.
- Leads to an immediate abort of the activity, and –depending on the nature of the Code Red- launch of rescue activities
- Visitors, press and any personnel off-duty have to leave the FCT room immediately, unless directed otherwise by the FD.

CODE ORANGE

- Simulated code Red, dealt with in the same way like Code Red, but does not involve destructive rescue measures (like cutting the suit).

CODE YELLOW

- Can be declared by FD, Suit tester, experiment PI/Operator or Safety in case of potentially serious risk for the Crew or equipment.
- Potential risk which has been identified in the data telemetry immediately or other means of communication, and needs human verification.
- Leads to a short (1-2 min) halt of activity without abort to clarify situation. All other communication is to be ceased immediately.

Code Green: Nominal situation

Code Red, Orange and Green were indicated in the FCT room of the MCC via a “traffic light”.

Communication @ MCC

- The MCC was equipped with wireless LAN
- Internal telephones between the MCC operating rooms.
- T-Mobile is sponsoring a 4G/LTE connection providing a total of roughly 40 MB/s connectivity (tested) for the entire MCC, plus a landline broadband connection for non-critical uses.

Communication @ Rio Tinto

Our required bandwidth varies between 200-800 MB/hour of upload and a few MB/hr download.

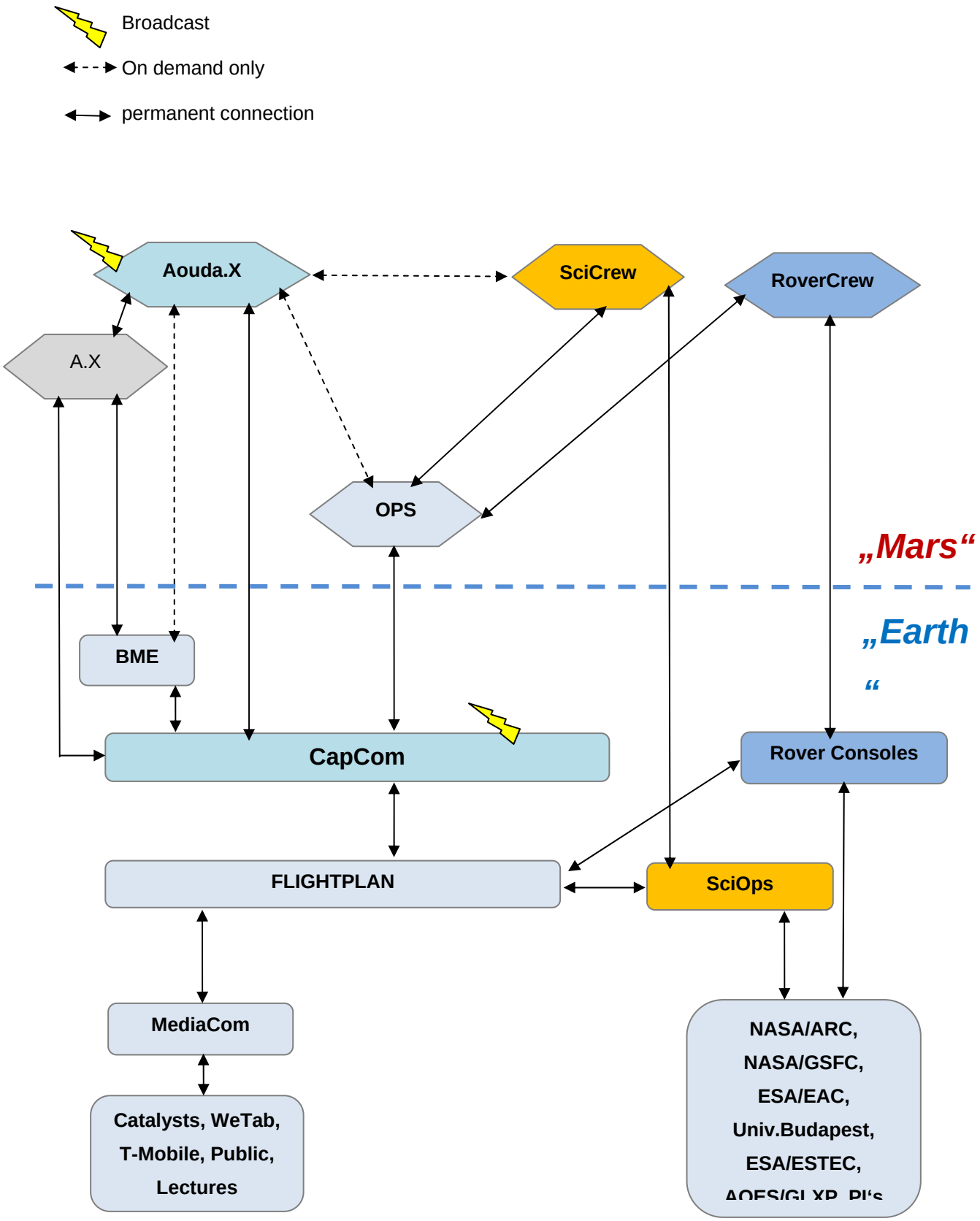
- **The COMM backbone (mission critical)** was comprised of two redundant satellite connections
    - Via a satellite link provided by Telefonica 2 MB/s up, 16 MB/s down, we had a dedicated technician on-site solely taking care of this connection. However, speedtests indicated that the actual upload bandwidth was typically around 100-500 kB/s up and 1-3 MB/s down.
    - A back-up link provided by StratosDSL satellite internet using the Astra-Satellites, providing UP TO 256 kB/s up and 4 MB/s down. This system did not work properly: we could not spot an appropriate satellite. With the aid of the spectrum analyzer of Telefonica, we targeted various candidate satellites, but were unable to log-in.
- **Mobile Phones:** We tested GPRS receiving with an IPhone, the entire area is connected. At Site 2 we conducted an upload test resulting in a bandwidth of 186 kByte/s upload (1.486 kbit/s), download @ 1.300 kByte/s = 10.410 kbit/s; this was our fall-back in case the backbone is compromised.
- **Ham-Radio:** we will have a digital Ham radio connection with Rio Tinto based upon the AX.25 protocol, operating around 7-14 MHz (30 m). There was no contact established, although the technical link was possible as the main backbone via Telefonica worked.
- **GPS locator beacon:** we have a SPOT-device to enable a tracking of hardware assets in the field (accuracy: appprox 6 m). The system uses LEO Satellites: 1610-1620 MHz L-band frequency .The position data are displayed in the MCC-FCT on a map. Once activated, SPOT acquires and sends the GPS coordinates to Aouda.X account automatically every 10 minutes for 24 hours or until canceled.

Network devices reference

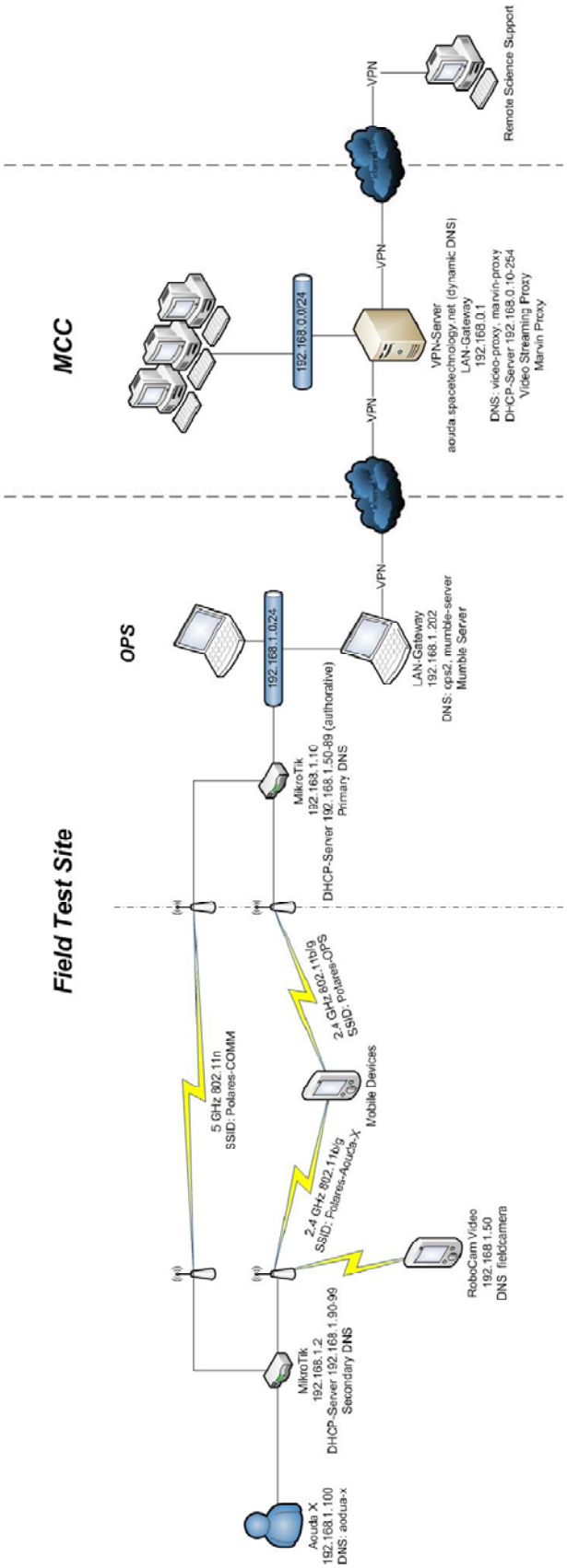
The following table lists the most used services, the used client software and the addresses.

Data	Client	Address or IP:Port (primary)	Address or IP:Port (backup)
Voice Chat	TeamSpeak 3	192.168.1.202:9987	
Suit-Telemetry	Labview -> EDDy	192.168.0.254:3333	192.168.1.100:6666
Helmet camera	Media Player (e.g. VLC)	http://192.168.0.254:8080/	http://192.168.1.100:8080/
Robocam	Web browser	http://192.168.0.254/	http://192.168.0.254/backup/
Robocam (control)	Web browser	http://192.168.1.150/	
Mission status	Web browser	http://192.168.0.254/	
File server	FTP client (or Web browser)	192.168.0.254:22 (or ftp://192.168.0.254)	

Communication Infrastructure / Overview Voice Channels



OPS – MCC connection



6. Experiments

Aouda.X: Engineering, BioMed workload

- Mobility and workload testing of the Aouda.X spacesuit simulator
- Multi-day field testing of the power and communication subsystem, investigating tear-and-wear patterns
- Investigating logistics issues arising with multiple-day field tests
- Testing the workload on the suit testers

Traingrid Biomedical Monitoring Vest

Emxys ltd. provided us with a biomedical monitoring vest. The data are received by the Aouda.X OBDH and then transmitted to the MCC via OPS. These measurements include heart rate, temperatures and electrocardiogram.

Physical Workload Perception

Principal Investigator: Thomas Luger

Institution: Medical University of Innsbruck

Every 30 min, the Capom polls the suit tester w.r.t. a standardized question catalogue addressing the physical well-being of the tester (including heat perception, pain, workload perception etc…). This information is then compared to objective data.

Catalyst speech recognition

Catalyst ltd, an upper Austrian software company will provide a speech recognition software tool, requiring a permanent link between the Aouda.X suit and the processing server in Austria. Details are currently in the planning stage.

Contamination Vector Experiment

Principal Investigator: Gernot Groemer

Institution: University of Innsbruck, Austria

We have developed a method to trace particulate contamination using fluourescent microspherules as biological proxies. This method has been field tested several times and we have a clear understanding of

the adhesive properties of the microspherules as well a robust understanding of the statistical methods necessary to determine the detection thresholds and contamination points.

Phileas Rover

Principal Investigator: Norbert Frischauf

Institution: ÖWF

- First demonstration of the OeWF Phileas rover drivetrain structure (HTL Kapfenberg)
- Interaction of the Phileas rover with Aouda.X, other rovers (Dignity) and White Label Space Lander mock-up

1. Infrastructure is essential.

Don't use a WiFi network, if you cannot trust that it will work, i.e. have a dedicated infrastructure administrator on site. Rio Tinto has proven how dangerous it is to share network connectivity with other experiments, and the influence of network latency on the critical components, like Phileas' on board data handling system (OBDH), must be considered.

2. Have a plan and be willing to change it.

Procedures are good, but only if they can be changed. Weather caprioles, hardware and software breakdowns MUST be expected, WiFi and power issues as well. Built-in fallback options are required, such that SOMETHING works when everything fails, for whatever reason!.

As an example, the OBDH was built to be remotely updateable, which was shown during the flight to calibrate the locomotion. However, this was still limited by the used network.

3. Have a knowledgeable and 100% committed person at the test site.

It must be someone who knows what the project is supposed to achieve, what are its main characteristics, what can be adapted and who can be contacted.

Preferably, the person should also have a technical understanding of at least the following components: how to administrate the machine (laptop) that runs the OBDH, how to administrate the network connectivity of the experiment site, how to administrate the mechanical infrastructure of the rover. Fixing these basic issues gives the MCC the chance to have an expert remotely update/modify/operate the rover. The person

must not need procedures or instructions from the MCC to get the on-site infrastructure running, i.e. the person must be able to identify problems themself and work independently!

4D Data for localization, mapping and robot-astronaut interaction

Principal Investigator: Alberto Fornaser

Institution: University of Trento, DIMS Department

The Phileas data stream provided by the Kinect was planned to be used for 2 different tasks:

1) the depth map and the images can be fused in 3D colored data (4D data) and used for the mapping procedure of the natural environment in front of the vehicle. From mapping also incremental localization could be retrieved.

2) the same dataset could be used to track and to recognize human body and gestures through a skeleton fitting.

However, due to a software compatility problem, the team was not able to provide the code in time and the experiment was not executed. However, we hope to try the software on Phileas at a later point.

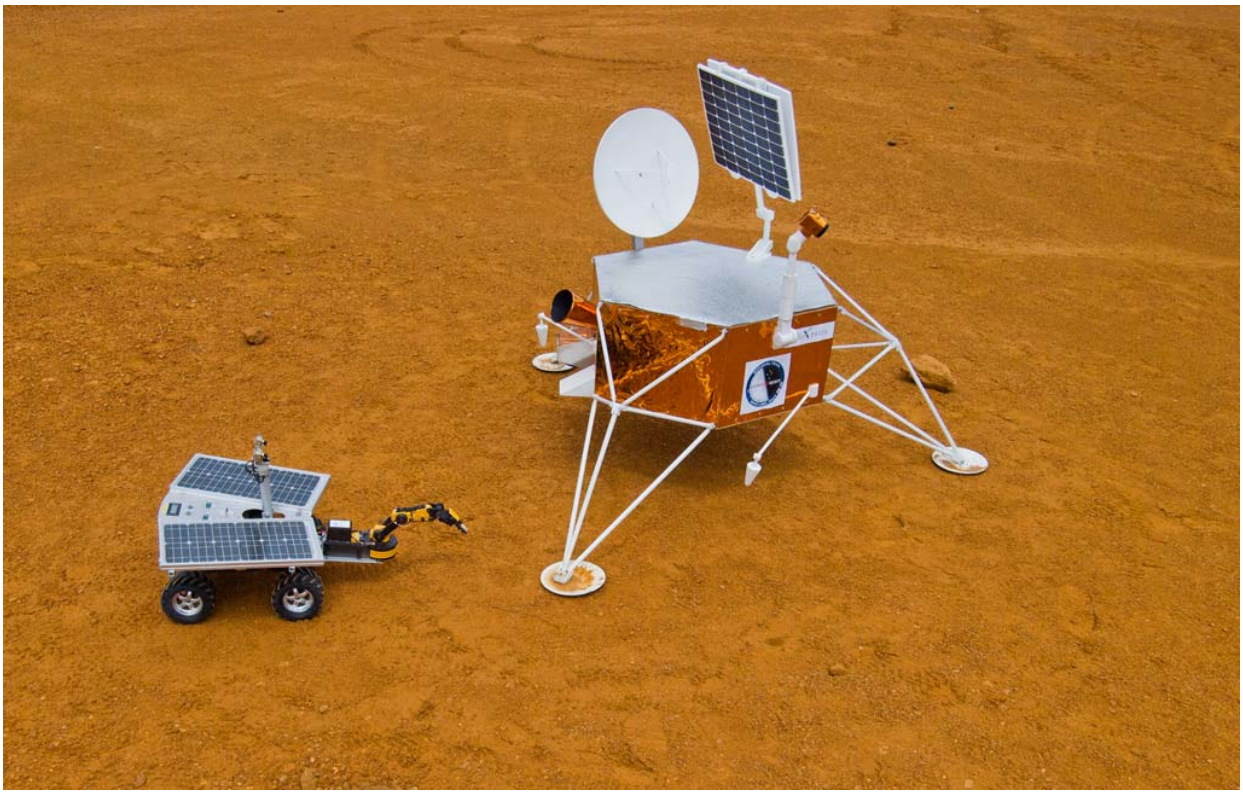
GLXP Lunar Lander Mock-up

Principal Investigator: Andrew Barton

Institutions: White Label Space

Although not targeting planet Mars but the Moon, White Label space provides a lunar lander Mock-up for the Google Lunar Xprize. This unit is used for a simulate damage inspection after a putative landing on the Moon. These tests, conducted by the Dignity and/or Philea rover -especially under

bad lightening conditions at twilight- shall provide the operators with a first impression of the operational challenges of a robotic mission.



*** Data quality & completness: are the data/samples acquired in the field useful?**

Not so useful. The damage to the camera meant that we can't really use those images for publicity, and nor could we make accurate measurements of the image resultion of the camera system. This event was useful mainly for operational aspects for future field testing, and to show interesting activities to the public via our blog.

*** Are there any preliminary findings which might be turned into publications/presentations?**

No.

*** What happens to the data/samples next, who will be handling these?**

We will keep our photos for future reference.

*** To what extent would you consider your field activities accomplished (0%: no data acquired at all, 100%: all major activities performed)**

25%

*** How are you intending to use the data/samples - e.g. where to**

publish, where to present, only internal reviews etc.. We might publish some of the better ones, but I expect we will mainly use them to communicate within the team and to potential new partners about what we are doing.

Andrea Gini and Carmen Felix stayed in Rio Tinto between the 17the and 20th of April, 2011. Vasco Nunes stayed for the 18th and 19th, and was really helpful in the first batch of tests. We had rain for the entire 19, and for the major part of the 20; the rain caused problems and delays to the simulation, and required us to cover the Lander mockup for most of the time. The guys from the Austrian Space Forum were really nice with us, and offered us equipment and support as soon as their busy schedule allowed them. During the 18, we had the chance to perform some tests using the Phileas rover with our camera onboard. Maarten came on 19: given the rain, we moved the Lander under a tent, and we filmed an interview with him. On the next day, even if Martin was working for Discovery Channel, he took some time to film our operations with the Dignity rover and the involvement of the WLS Lander during a simulated EVA.

YETI

Youth explores Terra Incognita (YETI) – searching for microbial life

Principal Investigator: Michaela Panzenböck

Institution: BG/BRG Lilienfeld, Klosterrotte 1, 3180 Lilienfeld

Panspermia the transportation of microbes from Mars or other planets to Earth is a plausible hypothesis for life evolution on earth. Thus, active or dormant microbes should be detectable on the Mars surface. This study is concerned with the procedure of sampling, cultivating and categorizing the biodiversity of microbes on rocks and sediment during the ÖWF expedition to the Rio Tinto thus simulating future research activities on extraterrestrial habitats. Testing the applicability of the sampling method and the storage of the samples were of primary interest in this study.

Microbial assessement

Principal Investigator: Alexandra Iordachescu
Institution: University of Manchester, Faculty of Life Sciences

Analyzing bacterial behavior inside the Aouda.X Space Suit Simulator can predict possible contaminations in future, long-term spaceflight missions

Bacteria can develop inside the space suit, forming biofilms or becoming more virulent in response to stress, leading to serious effects on both the astronaut's health and the internal layer of the suit. The present study would analyze how much the conditions inside the suit would influence bacterial growth by comparing it with bacterial development in a control experiment.

Aouda.X space suit simulator represents an excellent model to study bacterial behavior inside of the suit, on Earth. The goal is determining how much the conditions inside the suit are influencing bacterial and fungal growth on the internal layer. The results from this experiment could be helpful in developing new strategies to reduce bacterial impact on the inside of the suit, as well as their influence on crew health.

Geophysics & Geosample Catalogue

Scaled observations from Earth to Mars

Principal Investigator: Akos Kereszturi (kru@mcse.hu)

Institution: Collegium Budapest Institute for Advanced Study / Mars Astrobiology Group

The suggested research topics focus on the comparison of data acquired during the mission at different spatial scales, and extrapolate the results to Martian conditions. With images acquired and text descriptions made during the analog mission it could be analyzed: 1. what features are visible at different spatial scales, 2. how the targeting on Mars could be improved, 3. how lessons learned at MDRS and FMARS could be fused with the Rio Tinto test, 4. what are the main trend lines to conduct astrobiological analysis on Mars. From the results three papers could be compiled with co-authors from the group.

Geophysical methods

Principal Investigator: PolAres team / RSS

Institution: University of Vienna / Austrian Space Forum / Center for Astrobiology, Madrid / ESA-ESTEC

Usage of the following methods to determine the best sample acquisition sites and characterizing the soil (subsurface) environment

- Georadar (SIR 3000) (provided by Helmut Hausmann, TU Vienna)
- Raman spectroscopy (provided by CAB Madrid)
- Visual / Near-Infrared Spectroscopy (provided by Bernard Foing, ESA/ESTEC)
- Drilling rig for core sampling <3m (provided by the CAB/Madrid)
- Photography and optical microscopy including a handheld fibre-optical endoscope
- Soil sampling

Preliminary Results of „Scaled Observations" experiment:

Data quality & completeness: The quality of the images is very good. The GPS coordinates are not precise, sometimes the location of images are not clear (map could be used next time). The problem is the following: we have many pictures from random positions/random directions. It's complicated to separate the images, which were taken just for the „Scaled Observations" experiment. But some pictures are useful (e.g. images were taken from the eastern cliff of rock garden, and the pictures show the cliff from the same direction from different distance. See on figure 1.)

The documentation is very useful for the data analysis after the mission. If it's not clear, we are losing many data…

Fig.1. : Scaled Observation experiment: The cliff was shooted from different distance, and the same direction. GREAT!

Samples: I would have need the data, which were taken at the University of Innsbruck (by Tobias Schneider) to compare the data from University of Budapest. Csilla Orgel and Tamás Váczi (Dep. Of Mineralogy) will analyse the samples. RAMAN and NIR/IR cameras are ready for us.

Geological samples catalog

GPS-Altitude: 260m a.s.

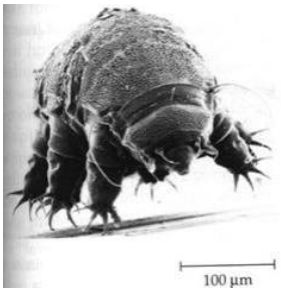
Status: 03May2011

Sample #	Sample timestamp	Position °N	Position °W	Label designation & Comments	Content
RT001	18Apr11, 15:55	37°40'35,84"	6°34'07,76"	Position 2, in flat terrain	Rock fragment, 5 cm
RT002	18Apr11, 16:05	37°40'39,58"	6°34'02,67"	Position 3, in flat terrain	Rock fragment, 1 cm
RT003	18Apr11, 16:20	37°40'37,75"	6°33'58,40"	Position 4, in flat terrain	Rock fragment, 1 cm
RT004	20Apr11, 16:48	37°40'34,04"	6°33'52,72"	Sample 1/Rock Garden	dark soil, fragmented
RT005	20Apr11, 16:55	37°40'34,27"	6°33'54,12"	Sample 2/Rock Garden	dark soil, fragmented
RT006	20Apr11, 17:08	37°40'35,18"	6°33'54,15"	Sample 3/Rock Garden	blackish organic-rich clay
RT007	20Apr11, 17:11	37°40'34,45"	6°33'55,79"	Sample 4/Rock Garden	rock fragment, 6 cm
RT008	21Apr11, 17:26	37°40'34,04"	6°33'52,72"	Sample site 2/Rock Garden-channel	dark soil
RT009	21Apr11, 17:36	37°40'34,27"	6°33'54,12"	Sample site 3/Rock Garden-channel source	dark soil
RT010	21Apr11, 17:59	37°40'35,18"	6°33'54,15"	Test site 1/Rock Garden	dark soil
RT011	21Apr11, XX:XX	37°40'34,45"	6°33'55,79"	White stuff, site 4, sample 1, rock garden	white mineral stuff? Brown soil
RT012	21Apr11, afternoon	37°40'39,89"	6°34'03,48"	Geo 1; transition sulfur spot, ident to RT001	solid rock, 12 cm
RT013	22Apr11, XX:XX	37°40' 32,69"	6°34'01,00"	S.O.#1	clay / rock fragments
RT014	22Apr11, XX:XX	37°40' 32,68"	6°34'01,10"	S.O.#1.2	clay / reddish rock fragments
RT015	22Apr11, XX:XX	37°40' 31,34"	6°34'07,20"	S.O.#2	clay / dark brown rock fragments
RT016	22Apr11, XX:XX	37°40' 31,19"	6°34'09,64"	S.O.#3	white clay
RT017	22Apr11, XX:XX	37°40' 31,53"	6°34'12,60"	S.O.#4	white clay / fragments
RT018	22Apr11, XX:XX	37°40' 31,53"	6°34'12,60"	S.O.#5	rock plate near riverbed
RT019	22Apr11, XX:XX	37°40' 31,53"	6°34'12,60"	S.O.#6	orange mineral /aggregate
RT020-A	22Apr11, XX:XX	37°40'36,02"	6°33'54,83"	quartz fragments with intrusions	crystal ball, 15 cm, rock garden
RT020-B	22Apr11, XX:XX	37°40'36,02"	6°33'54,83"	quartz fragments	crystal samples rock garden
WATER SAMPLES (2 eprouvettes each)					
	21Apr11, XX:XX	37°40'32,4"	6°34'01,2"	Rio Grande	Water sample
	21Apr11, XX:XX	37°40'31,3"	6°30'57,2"	Rock Garden Outflow	Water sample
	21Apr11, XX:XX	37°40'34,7"	6°33'55,9"	Rock Garden ource	Water sample
	21Apr11, XX:XX	37°40'35,1"	6°33'56,2"	Rock Garden White stuff	

Opportunistic Science: Tardigrade sampling

Investigator: Barbara Post

Institution: University of Innsbruck



Depending on the time available, we planned to sample wet soil samples in the vicinity of the Mars analog site in order to check for tardigrades. Tardigrades are small invertebrates (0,1-1,0 mm in body length) found around the world in such diverse places as the deep sea, high altitudes and latitudes. They can survive extreme environmental conditions and have the ability to form a tun which is caused by dehydration. Their body water drops to 1- and 3% and their body size is shrinking. In this ametabolic dry stage these animals show no visible sign of life, but become active again if rehydrated. We are investigating the soil samples for potential tardigrade tuns.

Four samples for opportunistic science activities have been taken , plus 6 water samples.

ESA/EUROBOT

Investigator: Philippe Schoonejans

Institution: ESA/ESTEC

Eurobot Ground Prototype; a mobile autonomous robotic system for planetary exploration. The vehicle is designed to work both autonomously as well as in full cooperation with astronauts. The vehicle has been tested in lab environment and would now have its first excursion into a hostile environment, a very important step in the design and development of a final system. The background for the activity is twofold. First of all, building on past research and testing, this activity will be useful in defining the next steps for a broader use of analogue activities for preparing for human exploration. Combined with additional activities it will create a European expertise for field testing of exploration systems something which is needed specifically in the early phases of exploration.


LEFT

ESA /Long Term Medical Survey

Investigator: Michel Lazerges

Institution: ESA/ESTEC

Long Term Medical System (LTMS); a self contained crew monitoring system which is capable of logging several key medical parameters of a crew member during longer durations when working in an extreme environment. The hardware has been designed for operation in the Antarctic Concordia station and will be tested there during 2010.

Additional tests in an EVA simulated environment in the framework of the Rio Tinto field mission offer a valuable addition. Building on past research and testing in analogue environments (e.g. Concordia) this activity will be useful in defining the next steps for a broader use of analogue activities for preparing for human exploration.

7. Flight Plan

The flight plan was based upon a 15 min roster for each field crew member and commentary fields for events. It was coordinated by FLIGHTPLAN and finally approved by the FD. One of the operational tests during the Rio Tinto mission was to try a near-real time adjustment of the flight plan to explore its maximum flexibility.

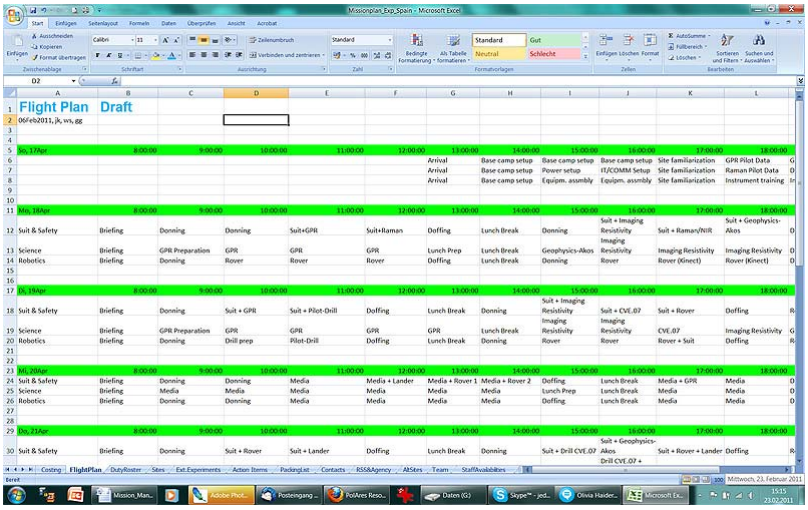
The preliminary flight plan reflects the on-site activities, 2 field crew-members were permanently staffing the OPS, the other 6 were working in pairs.

Decision making processes

The final authority was the Flight Director, if he could not be reached, the Flight Director Assistant had full authority. The Flight Directors were: **Norbert Frischauf, Alexander Soucek, Christoph Ragonig**

FLIGHT PLAN

The flight plan (a dedicated software tool displays all scheduled activities simultaneously at the MCC, the OPS as well as external organizations) is the basis for all activities. It is similar to an Excel sheet with a progression bar, based upon the OSTPV (*Onboard Short Term Plan Viewer*) software tool of the ISS flight operations. It indicated on a 15-min basis all activities for each field crew member.



Schedule changes were to be authorized by the Flight Control Team, comprised of

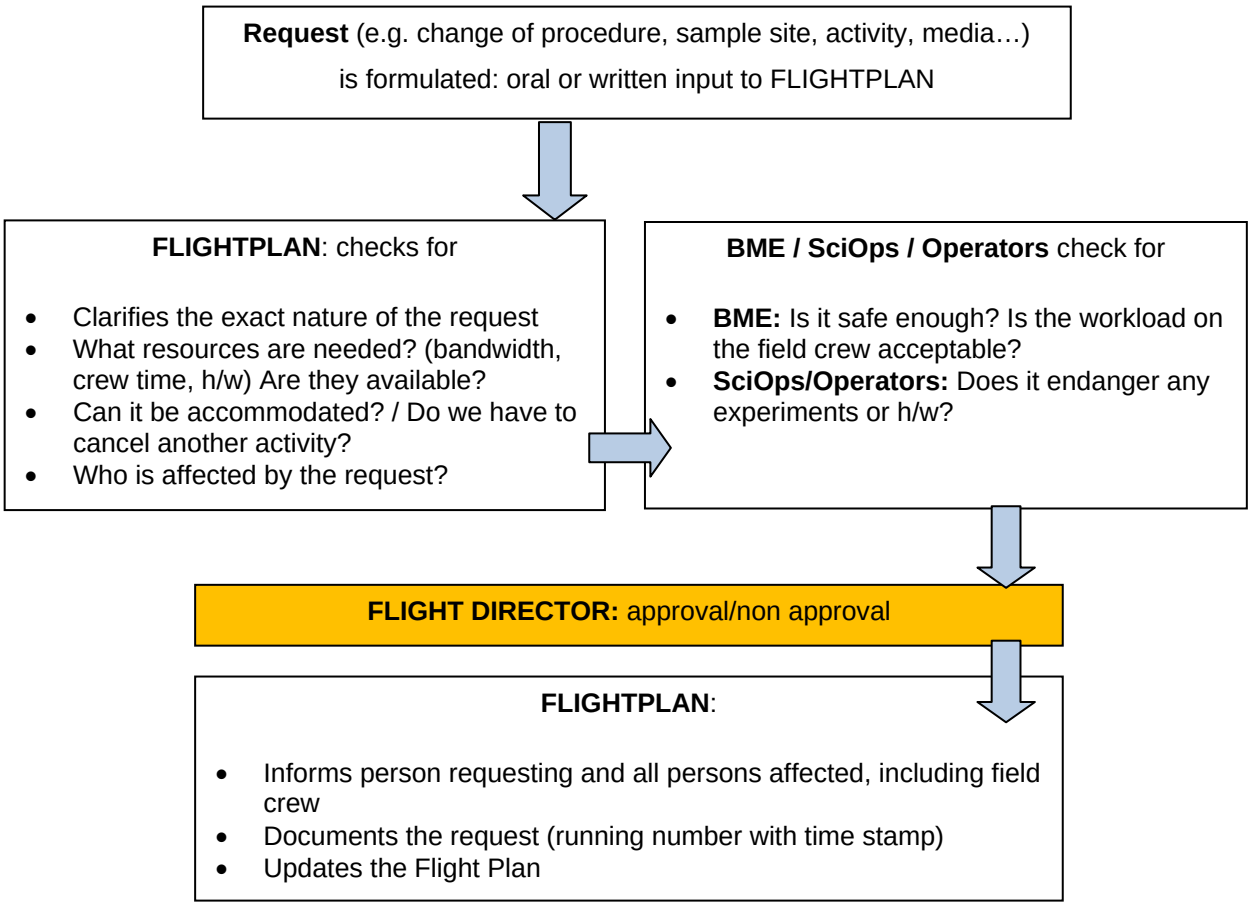
- **FD, BME**
- **Flight Plan Team, SciOps**
- **Rover & Aouda operators**

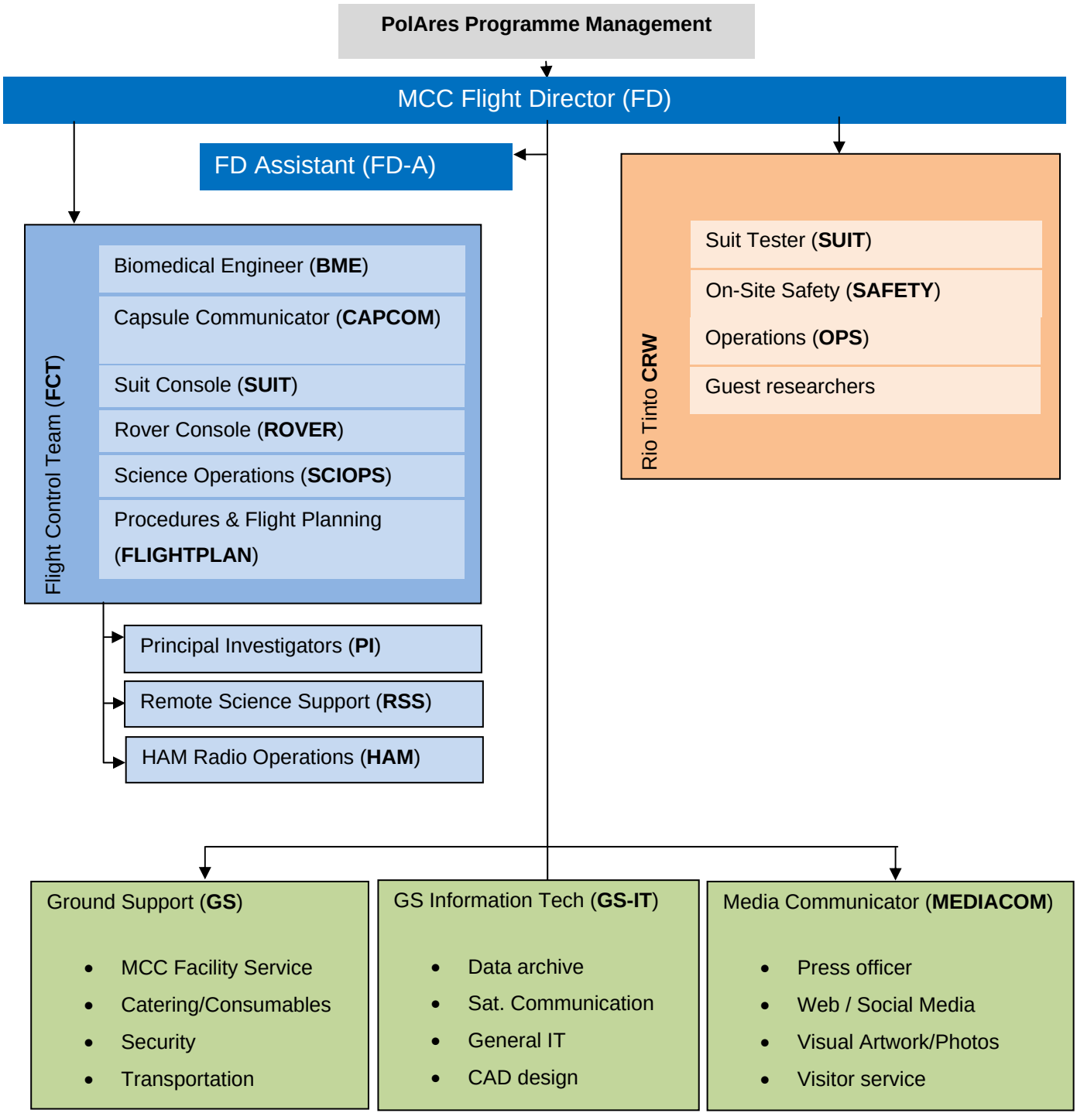
Polling

Before the start of any major experiment or extravehicular activity, the Flight Director had to give his final “Go/No Go” for the activity. This decision was preceded by a “polling”, where the console operators were asked for their attention, readiness and go/no go decision.

Flight Plan Change requests

Each request (e.g. from MediaCom, external organizations, RSS, external PI's etc..) undergoes the following procedure:




PolAres Programme Management
MCC Flight Director (FD)
FD Assistant (FD-A)
Flight Control Team (FCT)
Biomedical Engineer (BME)
Capsule Communicator (CAPCOM)
Suit Console (SUIT)
Rover Console (ROVER)
Science Operations (SCIOPS)
Procedures & Flight Planning (FLIGHTPLAN)
Principal Investigators (PI)
Remote Science Support (RSS)
HAM Radio Operations (HAM)
Rio Tinto CRW
Suit Tester (SUIT)
On-Site Safety (SAFETY)
Operations (OPS)
Guest researchers
Ground Support (GS)
MCC Facility Service
Catering/Consumables
Security
Transportation
GS Information Tech (GS-IT)
Data archive
Sat. Communication
General IT
CAD design
Media Communicator (MEDIACOM)
Press officer
Web / Social Media
Visual Artwork/Photos
Visitor service

Science Data Pipeline Infrastructure / Overview

Team lead: Birgit Sattler, **Dpty-lead:** Csilla Orgel

Team members: Julia Neuner, Thomas Bartenstein, Guy Pignolet, Martin Seebacher, Alexandra Iordachescu, Daniel Föger

Assistance: Junior Researchers/BRG Lilienfeld, external researchers/back rooms

Staff

17Apr: Birgit, Csilla, Julia (=Sunday Prep)

18Apr: Birgit, Csilla, Alexandra, Guy, Martin, Julia

19Apr (agency day): Birgit, Csilla, Alexandra, Martin, Guy

20Apr (media day): Birgit, Csilla, Thomas, Alexandra, Julia, Guy, Martin

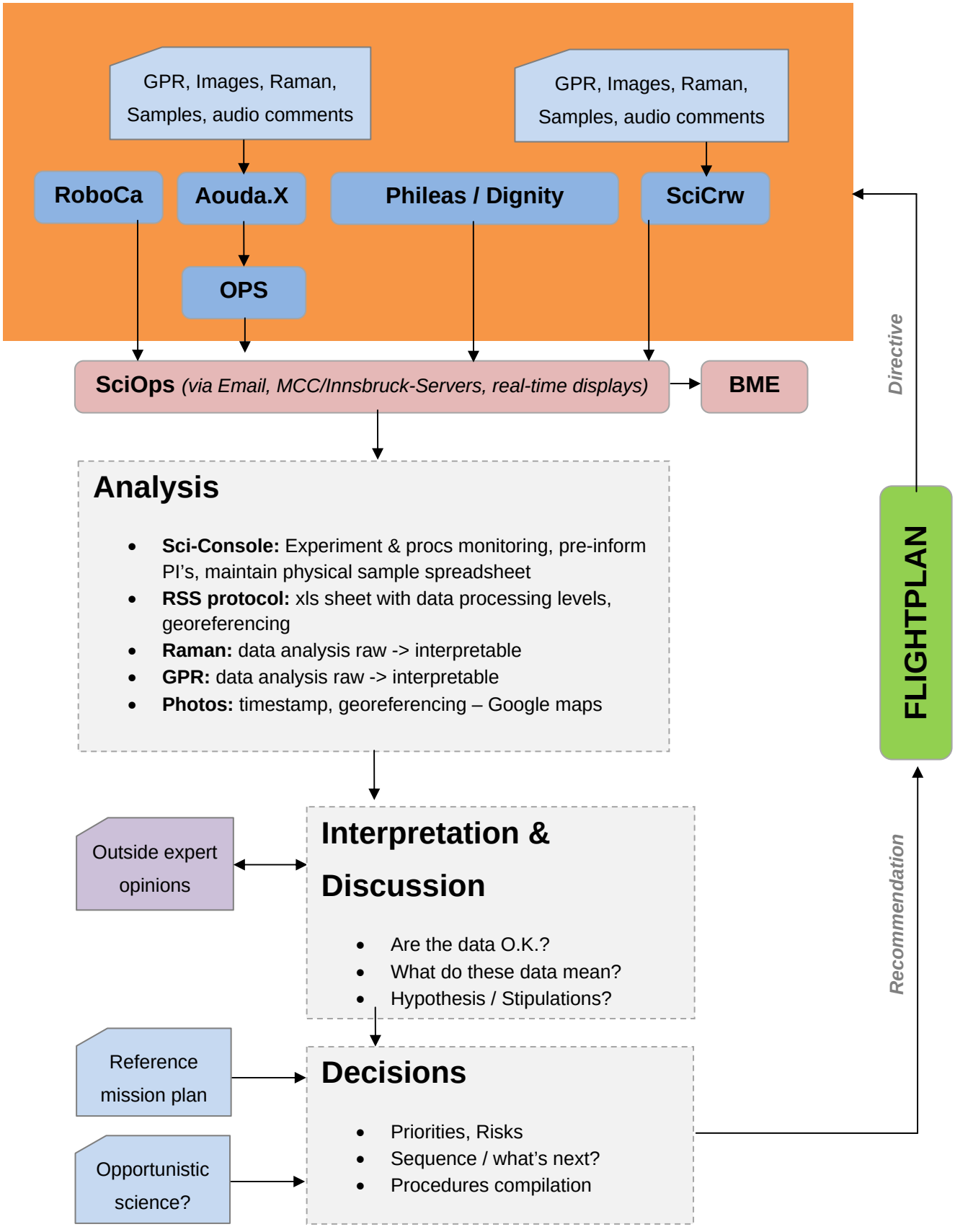
21Apr: Birgit, Csilla, Thomas, Alexandra, Julia, Martin, Guy

22Apr: Birgit, Csilla, Thomas, Daniel, Alexandra, Julia, Guy

Tasks of SciOps Teamleaders

- Task distribution, team management
- Verifiying all external PI's and scientists are in the correct communication channel and have a contact at the RSS
- Monitoring of data quality
- Continuous check
    - Opportunistic science possible?
    - Collection of hypothesis
    - Assessment of pipeline quality and improvements
    - Managing external inputs and requests
    - Thinking one step ahead – what's next?

Science Data Processing & Decision Making



Staff Duty Roster

Name	14.04.2011	15.04.2011	16.04.2011	17.04.2011	18.04.2011
Albrecht Rudolf					
Bartenstein Thomas	Tech support			MediaCom	Ham
Bickert Klaus					
Frits de Jong / ESA					
Föger Daniel					
Frischauf Norbert				Flightplan	**FD**
Fuchs Harald			**GS-IT**	**GS-IT**	**GS-IT**
Grömer Gerhard	Tech Support	MCC Prep	**MCC Prep**	GS	MediaCom
Haider Olivia			GS-IT	MediaCom	MediaCom
Iordachescu Alexandra				…/Orientation	SciOps-Bio
Jais Wolfgang			GS-IT	GS-IT	GS-IT
Klauck Jan				**Flightplan**	**Flightplan**
Knoflach Martin	Packing		GS	Aouda	Aouda
Lassnig Mario					
Luger Thomas					**BME**
Neureiter Bianca				MediaCom	MediaCom
Neuner Julia	Tech Support			SciOps	SciOps
Nordmeyer Götz				Flightplan	BME
Orgel Csilla				SciOps-Geo	SciOps-Geo
Panzenböck Michaela (YETI)					
YETI 1 (Lisa Renz)					
YETI 2 (Anna Billensteiner)					
Pignolet Guy	Packing	MCC Prep		Flightplan	Rovers
Ragonig Christoph				**FD from 16:00**	**FD-A**
Sams Arnold				Flightplan	**GS**
Sattler Birgit				**SciOps**	**SciOps**
Seebacher Martin			GS	GS	SciOps
Soucek Alexander			MediaCom	**MediaCom**	**MediaCom**
Student Tripolar				Flightplan	GS
Tlustos Reinhard					**CapCom**
Zanella-Kux Katja					Doku
CRW Rio Tinto					
Grömer Gernot	Packing	**Exlead**	**Exlead**	**Exlead**	**Exlead**
Hauth Eva		Transfer RT	Transfer RT	Transfer RT	Ops
Hauth Stefan		Transfer RT	Transfer RT	Transfer RT	Ops
Sams Sebastian	Packing	Transfer RT	Transfer RT	Transfer RT	Rovers
Schildhammer Daniel	Packing	Transfer RT	Transfer RT	Transfer RT	Science
Santek Paul		Transfer RT	Transfer RT	Transfer RT	Docu
Luger Ulrich	Packing	Transfer RT	Transfer RT	Transfer RT	Suittester
Agerer Christian		Transfer RT	Transfer RT	Transfer RT	Safety

Scheer Daniela		Transfer RT	Transfer RT	Transfer RT	MediaCom
Stumptner Willibald		Transfer RT	Transfer RT	Transfer RT	Science
External Teams Rio Tinto					
Frits de Jong / EAC-CMSO				EAC-CMSO	EAC-CMSO
Alexandre Frechette / EAC				EAC-CMSO	EAC-CMSO
S. Hovland, P. Schoonejans, B.Carey, F. Didot / ESA-ESTEC				Eurobot	Eurobot
Erich Pröll				Filming	Filming
Erich Pröll Assistant				Filming	Filming
Maarten Roos/Discov.Channel					
Felipe Gomez				INTA/CAB	INTA/CAB
Carmen Felix / WLS					
Back-Rooms					
Simonsen Oliver					
McPherson Stephanie Mae					

	Agency Day	Media Day			
Name	**19.04.2011**	**20.04.2011**	**21.04.2011**	**22.04.2011**	**23.04.2011**
Albrecht Rudolf			GS	GS	*leisure*
Bartenstein Thomas	Ham	Ham	SciOps	SciOps	*leisure*
Bickert Klaus					
Frits de Jong / ESA		EAC-CMSO	EAC-CMSO		
Föger Daniel		**CapCom**	**CapCom**	SciOps**/ FD-A**	*leisure*
Frischauf Norbert	*Rio Tinto*	*Rio Tinto*	*Rio Tinto*	**FD**	
Fuchs Harald	**GS-IT**	**GS-IT**	**GS-IT**	Reprtng prep	*leisure*
Grömer Gerhard	MediaCom	MediaCom	**GS**	**GS**	*leisure*
Haider Olivia	MediaCom	MediaCom	MediaCom	**CapCom**	*leisure**/on-call***
Iordachescu Alexandra	SciOps-Bio	SciOps-Bio	SciOps-Bio	SciOps-Bio	*leisure*
Jais Wolfgang	GS-IT	Visitor Srvc	GS-IT	GS-IT	*leisure*
Klauck Jan	**Flightplan**	**Flightplan**	Aouda	Reprtng prep	*leisure*
Knoflach Martin	Aouda	Flightplan	**Flightplan**	**Flightplan**	*leisure*
Lassnig Mario	Rover	Rover/Media			
Luger Thomas	**BME**	**BME**			
Neureiter Bianca	MediaCom	MediaCom			
Neuner Julia	SciOps	**GS**	SciOps	SciOps	*leisure*
Nordmeyer Götz	BME	BME	**BME**	**BME**	*leisure*
Orgel Csilla	SciOps-Geo	SciOps-Geo	**SciOps**	SciOps-Geo	*leisure*
Panzenböck Michaela	…/RSS-YETI	RSS-YETI			
YETI 1 (Lisa Renz)	…/RSS-YETI	RSS-YETI			
YETI 2 (Anna Billensteiner)	…/RSS-YETI	RSS-YETI			
Pignolet Guy	Rover/Flightplan	SciOps	SciOps	SciOps	*leisure*
Ragonig Christoph	**FD-A**	**FD**	Ham	**FD-A / …**	*leisure*

Sams Arnold	**GS**	MediaCom	MediaCom	MediaCom	*leisure*
Sattler Birgit	**SciOps**	**SciOps**	SciOps	**SciOps**	*leisure*
Seebacher Martin	SciOps	Aouda	SciOps	Ham	*leisure*
Soucek Alexander	**FD**	**MediaCom**	**FD**	**MediaCom**	*leisure*
Student Tripolar	GS	SciOps-Bio	SciOps-Bio	SciOps-Bio	
Tlustos Reinhard	**CapCom**	**FD-A**	**FD-A**	Aouda	*leisure*
Zanella-Kux Katja	Doku	Doku	Doku	Doku	*leisure*
CRW Rio Tinto					
Grömer Gernot	**Exlead**	**Exlead**	**Exlead**	**Exlead**	**Exlead**
Hauth Eva	Science	Rovers	Science	Ops	Return trip
Hauth Stefan	Ops	Rovers	Science	Science	Return trip
Sams Sebastian	Rovers	Ops	Ops	Science	Return trip
Schildhammer Daniel	Suittester	Safety	Suittester	Safety	Return trip
Santek Paul	Docu	Docu	Docu/Exp.ass.	Docu	Return trip
Luger Ulrich	Science	Suittester	Rovers	Suittester	Return trip
Agerer Christian	Rovers	Ops	Safety	Rovers	Return trip
Scheer Daniela	MediaCom	MediaCom	MediaCom	MediaCom	Return trip
Stumptner Willibald	Safety	Science	Ops	Ops	Return trip
External Teams Rio Tinto					
Frits de Jong / EAC-CMSO					
Alexandre Frechette / EAC	EAC-CMSO				
ESA/ESTEC team	Eurobot				
Erich Pröll	Filming	Filming	Filming	Filming	
Erich Pröll Assistant	Filming	Filming	Filming	Filming	
Maarten Roos/Discov.Channel		Disc. Channel			
Felipe Gomez	INTA/CAB	INTA/CAB	INTA/CAB	INTA/CAB	
Carmen Felix / WLS					
Back-Rooms					
Simonsen Oliver					
McPherson Stephanie Mae					

Name	**24.04.2011**	**25.04.2011**	**26.04.2011**
Albrecht Rudolf			
Bartenstein Thomas	GS	Demobilization	
Bickert Klaus			
Frits de Jong / ESA			
Föger Daniel			

Frischauf Norbert			
Fuchs Harald	Reporting	Demobilization	
Grömer Gerhard			
Haider Olivia	MediaArchive	Demobilization	
Iordachescu Alexandra			
Jais Wolfgang	GS-IT	Demobilization	Demobilization
Klauck Jan	**Reporting**	**Reporting**	Demobilization
Knoflach Martin		Demobilization	
Lassnig Mario			
Luger Thomas			
Neureiter Bianca			
Neuner Julia	Reporting	Data compile	Demobilization
Nordmeyer Götz	Reporting	Data analysis	
Orgel Csilla	Reporting	Data compile	
Panzenböck Michaela (YETI)			
YETI 1 (Lisa Renz)			
YETI 2 (Anna Billensteiner)			
Pignolet Guy	Reporting	Demobilization	Demobilization
Ragonig Christoph	Reporting	Demobilization	
Sams Arnold	Reporting	Demobilization	
Sattler Birgit	Reporting	SciOps WrapUp	SciOps WrapUp
Seebacher Martin	Reporting	Demobilization	Demobilization
Soucek Alexander			
Student Tripolar			
Tlustos Reinhard	Reporting	Demobilization	
Zanella-Kux Katja			
CRW Rio Tinto			
Grömer Gernot	**Exlead**	**Exlead**	Demobilization
Hauth Eva	Return trip	Return trip	
Hauth Stefan	Return trip	Return trip	
Sams Sebastian	Return trip	Return trip	Demobilization
Schildhammer Daniel	Return trip	Return trip	Demobilization
Santek Paul	Return trip	Return trip	
Luger Ulrich	Return trip	Return trip	SciOps WrapUp
Agerer Christian	Return trip	Return trip	
Scheer Daniela	Return trip	Return trip	
Stumptner Willibald	Return trip	Return trip	

8. Job descriptions

MCC Flight Director (FD or “Flight”)

The MCC Flight Director is responsible for the overall mission operation, safety and effective system and payload operations. During mission/simulation preparation, the FD is responsible for ensuring (at a management-level) that the resources of the MCC and the supporting operational ground segment are adequate to conduct mission operations. This includes ensuring adherence to mission rules, and proper coordination of any necessary actions caused by deviations from the Flight Plan.

The FD position is planned to be manned on a single shift 8-12 hour per day basis. One FD and one back-up is available in the MCC. During the mission the Lead FD always has to be reachable via cell phone 24/7.

In addition, the MCC Flight Director is responsible for modifying and revising the existing overall mission schedule so that it includes any necessary changes based on the state of the Rio Tinto expedition site and the health of the crew. The Flight Director is – together with MediaCom - responsible for updating the MediaCom news feed of the ÖWF/PolAres website as part of the outreach activities of the MCC.

Flight Director Assistant (FD-A)

The FD-A acts as the “first officer” of the FD. In principle, the FD can delegate any task to the FD-A, however, the final responsibility and decision making authority stays with the FD. Interactions are the same as the FD.

Biomedical Engineer (BME)

The BME has overall responsibility at MCC for crew health related issues. The BME provides support for all issues relating to crew health and medical data management, including pre-flight preparation, real-time monitoring, real-time conferences, and post-flight rehabilitation. The BME also provides support regarding medical or life science payloads, hazardous operations and medical policy making within the complete PolAres program. BME is also available to help with health related issues amongst the MCC staff.

The BME position is staffed on an „as needed“ basis as directed by the FD. BME can communicate with the crew on site via electronic communication systems – that includes a private channel available only to BME and the crew member needing medical help.

The BME is also responsible for assessing crew member’s psychological health and directed psychological experiments. The BME can monitor communication with the crew and use it for determining the psychological situation of the crew during the simulation phase. The BME evaluates the psychological impact of health related actions. In case of medical emergencies he/she is the primary liaison between the

patients, the hospital, the MCC and the patient's families. The BME will organize medical evacuation if necessary.

Rover Console (ROVER)

The Rover Console Operator (ROVER) has overall responsibility at MCC for the operation and readiness of the PolAres Rover(s) used on-site. That includes traverse planning, scheduling rover tasks (e.g. sampling, remote sensing, measurements, taking pictures), ensuring regular maintenance and recharging of the batteries. He is the primary point of contact in case of technical problems with the rover(s).

Suit Console (SUIT)

The Suit Console Operator (SUIT) has overall responsibility at MCC for the operation and readiness of the PolAres Space Suit simulator "Aouda" used on-site. That includes suit activity planning, scheduling suit tasks (e.g. measurements, taking pictures), ensuring regular maintenance and cleaning as well as recharging of the batteries. He is the primary point of contact in case of technical problems with the "Aouda" suit.

Science Operations (SCIOPS)

The Science Operator (SCIOPS) has overall responsibility at MCC for the operation and readiness of all experiments conducted during the Rio Tinto field trip. That includes experiment activity planning and balancing time, power and data rate requests from multiple experiments. He has to keep in mind (and minimize) the influence of experiments on the performance of the crew and other experiments and equipment. He has to ensuring regular maintenance and cleaning as well as recharging of the batteries of all experiments. He is the primary point of contact in case of technical problems with the experiments. He is responsible for keeping in touch with the PIs and ensuring that they get the results of their experiments ASAP.

Expedition Lead (EXLEAD)

The Expedition Leader (EXLEAD) has overall responsibility at the Rio Tinto field test site for the operation and readiness of all personnel working on-site and all equipment used on-site. That includes overall activity planning and scheduling tasks. He is in constant communication with the MCC Flight Director. He has final authority on all decisions to be taken (in sim and out of sim) at the Rio Tinto field test site, especially in the case of an emergency. The Expedition Leader is reponsible for maintaining contact with local authorities and media.

On-site Safety expert / Paramedic (SAFETY)

The On-Site safety is a paramedic who has overall responsibility at the field trip site for team and crew health related issues. SAFETY provides support for all issues relating to crew health and medical data management, including real-time monitoring and real-time conferences. The SAFETY also provides support regarding medical or life science payloads, hazardous operations and medical policy making during the Rio Tinto field trip.

SAFETY - together with the BME - is also responsible for assessing crew member's psychological health and directed psychological experiments. SAFETY maintains the on-site safety equipment (fire extinguisher, first aid kit, medication etc.).

Rio Tinto Field team (CREW)

The Crew (including the Suit Tester) is responsible for conducting all analog science mission activities in „simulation" („in-sim") mode, simulating a real flight mission. That includes all extravehicular activities (EVA) in the PolAres project simulation space suit „Aouda". The Crew is responsible for the „in-sim" operation of all on-site systems and payloads. Science experiments are conducted „in-sim" under supervision of the responsible experiment PI's. (Bio-)Medical experiments are coordinated also with the BME and on-site Safety/Paramedic. Technical equipment is operated and maintained together with the Flight Control/Engineering team.

Capsule Communicator (CAPCOM)

The Capsule Communicator or CAPCOM is responsible for coordinating the use and distribution (enabling/disabling) of Space-to-Ground communications and voice link with the Crew for operations. The CAPCOM is planned to be manned on an single shift 8-12 hour per day basis. It gives the space-to-ground communications a necessary comradely touch amongst all the pressures of mission schedule and payload operations duty. CAPCOMs also excel at explaining to crew or MCC staff the respective point of view of the other group. CAPCOMs also act as confidential channel between the crew and their families. That includes looking after family members visiting the MCC. CAPCOMs have to be able to do extensive multi-tasking and often have to handle multiple requests from the MCC staff at the same time. CAPCOMs need a high resistance to stress. Especially during situations of degraded communication quality (simulated solar storm or real life storm or equipment malfunction) it is their job to communicate to the crew the most essential information clearly and quickly.

HAM Radio operator

In addition to the satellite link, a HAM-radio connection between MCC and Rio Tinto will be established. This connection may only be operated via a licensed HAM-radio operator.

In case of a brake-down of the satellite link, the HAM radio operator replaces the CapCom.

In the Austrian Space Forum, the following people are registered operators:

- MCC: Thomas Bartenstein (HAM-lead), Olivia Haider, Christoph Ragonig, Martin Seebacher
- Rio Tinto: Sebastian Sams, Gernot Grömer, Christian Agerer, Eva Hauth

Flightplan

During mission preparation and real-time operations, technical support is responsible for solving any and all technical problems around the MCC as well as coming up with solutions for all kinds of problems and malfunctions at field trip site. This involves an intimate knowledge of the technical equipment and procedures used during the field trip, technical and media equipment used by the crew, communications technology and payload/experiment hardware. Exploration vehicles (e.g. rover) malfunctions will be solved in close cooperation with crew, rover and suit operators in the MCC and those parts of the FCT team acting as on-site technical support. The technical support also locates replacement parts near the test site and/or organizes replacement part shipment to the field trip site as needed. Technical support is also responsible for data archiving and back-up data storage.

Ground Support (GS)

The Ground Support (GS) is responsible for the management of all the MCC and on site ground facilities necessary to support PolAres mission operations. The GS provides support to both the real time and preparation activities for the MCC and on site Operations, infrastructure services and partner communications support. The GS provides 24 hours MCC facility control, communications support and data capture functions. The GS supports the MediaCom in public outreach activities. The GS is responsible for purchasing the necessary equipment, supplies and food to sustain the MCC and on-site team for the duration of the field trip operation. GS is responsible for providing transportation, power, fuel, water and shelter (including restrooms and showers). GS is responsible for maintaining a daily motor pool. GS is reponsible for meeting any newly arriving team members and giving them a briefing about the way the MCC works. GS is also known under the name „Logistics“ or „Ground Operations“.

Media Communicator (MediaCom)

The Media Communicator (MediaCom) is responsible for coordination of media activities and for configuring PolAres video conferencing and managing all preventative and corrective maintenance of the

media equipment. The MediaCom supports the Ground General Support in planning resource utilization and configuration of the media resources to support mission/simulations operations.

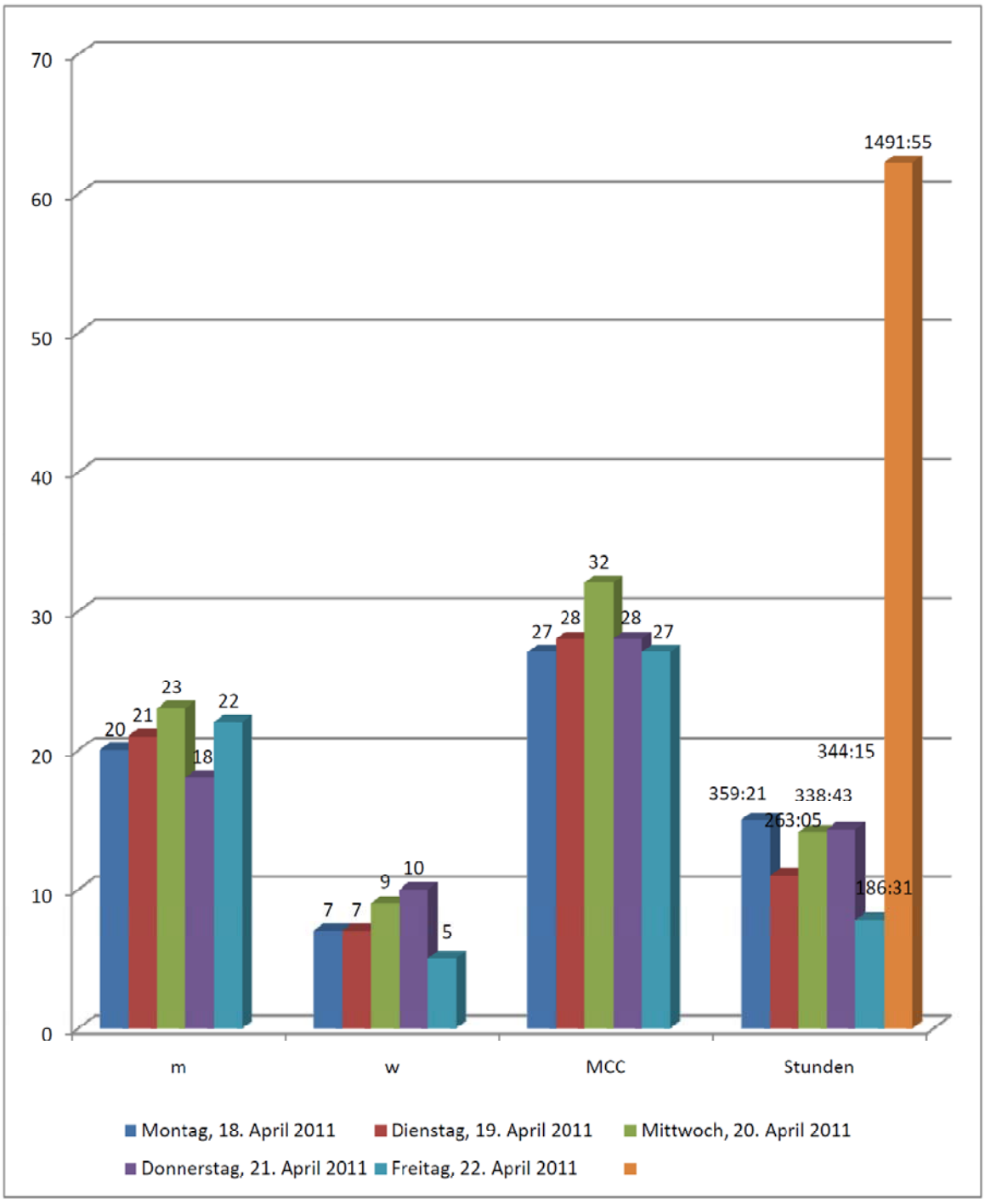
This position is also responsible for the implementation of user video product requirements and supporting the distribution of video/video products for the purposes of public relations. MediaCom is responsible for event planning, especially involving interaction with VIPs. Promotional activities are planned by MediaCom and executed with the help of GGS. MediaCom is also responsible for website and Social Media content product generation.

The MediaCom position is planned to be manned on a single shift 8-12 hour per day basis, but provides extended support during periods of high activity.

Working hours at the Mission Control Center

(M = male, w = female)

	m	w	MCC	Stunden
Montag, 18. April 2011	20	7	27	**359:21**
Dienstag, 19. April 2011	21	7	28	**263:05**
Mittwoch, 20. April 2011	23	9	32	**338:43**
Donnerstag, 21. April 2011	18	10	28	**344:15**
Freitag, 22. April 2011	22	5	27	**186:31**
				1491:55



9. Lessons Learned

The experiment-specific lessons learned are mentioned at the respective experiment descriptions in the previous sections.

On-Site @ Rio Tinto

Facilities:

The installations were successful in providing: power generators, communications including internet, elementary shelter, rudimentary toilets and provisions (water, food, sun's protection…)

Potential improvements:

1. Hope for the best but be prepared for the worst weather including rain, strong wind and hot/cold temperatures. (e.g. Establish camp on highest ground to avoid problems with rain)
2. A closed habitat with an air lock type of installation could help prevent problems with dust/rain/wind and equipment in the main base and help simulate a more realistic Martian base
3. Separate tents for shelter and operations could also help avoid overcrowding

Operations

Organisation and Public Relations:

The OeWF team did a great work in gathering partners from several entities including ESA, academics and various public media. The team should be proud of their outreach accomplishments. It provided a good platform to interact and work toward a future Mars mission.

- Operations is also about routines. There are certain elements that are coming back on a day-to-day basis within the flight control team and between FCT and crew. Try to define these routines and implement these routines consequently.

- The idea of a CAPCOM is that the same person talks to the crewmember. This campaign showed both OPS and CAPCOM talking to SUIT. In addition, SUIT could often hear additional communication between CAPCOM and OPS, resulting in distraction and/or hearing things twice. I am not 100% sure but do expect that also on MARS the community will decide to have a single communication line between SUIT and OPS.

- Health and Safety played a big role during the campaign, for good reasons. On MARS, I expect that astronauts will always work in pairs when they are outside. The individual astronaut will have an important safety role towards the other astronaut. Have you

considered for the future campaigns to have 2 astronauts out in the field (in 2 Aouda.X suits)? Even if you stick to (only) one SUIT in the field, you might want to consider playing it more realistically, with SUIT on his own in the field or maximum one additional person who plays the second astronaut (and takes care of safety at the same time)

- OPS needs direct insight in ÖSTPV. I was impressed by the ÖSTPV tool that you have put into place for this campaign. The communication between OPS and MCC, as well as within the MCC really benefitted from it; you had one basis that everybody used. Obviously, OPS needs direct access to the tool.

- The ÖSTPV of the day was updated several times per day to integrate realtime events, delays, issues, etc. It is interesting to consider this concept of near R/T plan update versus the mode of operandi onboard ISS. Here the planning community ensures that a good plan is onboard the evening prior to the execution day. In the morning, the crew is informed about possible deltas, receives additional info as needed either by DPC or in the Daily Summary and that's it. Depending on how the day develops, activities may be deferred (by making the activity purple on the OSTPV) or moved around as the crew things is best. This may involve the ground or not. What you normally do not see is an actual update of the plan. Except for maybe archiving purposes, there is no real advantage. Those positions that have activities on the timeline have no problem in following what is going on that day – either it does not matter for the activity or they are aware because of communication with the crew.

- I often enjoyed the communication between OPS and CAPCOM – they used a clear communication protocol and found a good balance between serious stuff and some fun once in a while. On site, I would have given OPS a more central role. Certainly during a SIM, it should be OPS that pulls the strings. This requires a lot of discipline …

- On MARS, I expect that there will be unlimited comm. between OPS and SUIT. Between MARS and EARTH, besides the well-known comm delay, I am not sure if there will be something like an LOS as well. This would further impact the communication between both sides. Something to consider for the future.

- When 2 astronauts are in the field doing a MARS-EVA, I would consider one astronaut in the habitat that continuously communicates with the crew to help with the procedures. A second astronaut in the habitat would take of the link with EARTH and with SUIT for the big ticket items (like when to return, what activity to defer, info from earth, etc.)

In addition…

1. Try to limit suit tester downtime and standing time. There might be an opportunity to find an innovative way that could be used on Mars to reduce the burden during these periods (tripod that can be quickly installed to help support the back, or two astronauts leaning back to back or whatever that could work)

2. An alarm clock or light for power generators refuelling monitoring could be a good reminder

Site:

Breathtaking landscape with definite Mars like areas. It was overall a great location for a simulation. So unfortunate that the weather was far from ideal.

IT Infrastructure

- We need more time to prepare the internet connection, especially when using new hardware. At least two to three months with every hardware component available for tests and configuration would be a good time frame, although this might not be easy for several reasons (especially satellite links are really expensive).
- Instead of laptops, desktop computers should be used. The main reason for this is that laptops are rather hard to service and exchanging broken components is rather expensive and complicated when compared to normal desktop hardware. Electronic components also have to be protected from dust and splash water.
- Be careful which network devices get connected and check their configuration for compatibility to the rest of the network. In the operations tent additional wireless access points were installed which were never connected to the network before and after some while we experienced connection problems with Aouda. Investigations showed that an address conflict between one of these access points and the suit existed which was then resolved by shutting down both access points.

Science / Remote Science Support

First, the Science Team wants to acknowledge the extremely positive working atmosphere between all members in the MCC and the smooth and uncomplicated handling of troubles.

The major challenge during this mission was IMPROVISATION (due to unforeseen weather conditions) which has been dealt with a high level of discipline, creativity and and a good culture of communication.

Preparation:

For the EVAs it is required that the crew familiarizes upfront the EVA about starting points, tracks and end points.

Communication:

Although it is not planned that SciOps talk directly to the field crew in general to discuss experiments, EVAs, etc. sometimes it is crucial to do so. This could be solved in a good way between FDs and SciOps, however, despite it is not actually in the procedures. Changes and improvisation sometimes require a direct contact (also due to scientific and technical terms). Suggestion: Include SciOps more in direct comms.

Direct Action:

The field crew was requiring more interference from SciOps at MCC to direct them. However, this was not always possible due to missing information of where the suit tester or sampler is at the moment. If pictures would be more precise to realize the situation the field crew is then there would be more room to interfere.

Ground Support

- MCC: as long as the MCC is not operational (during night time), all IT apparatus was up & running – we should have a dedicated person making sure everything except vital systems are shut-down (e.g. beamers).
- In order to provide a 24h service from Ground Support, at least 3times the staff number must be foreseen.
- There should be a first aid-kit available also at the MCC
- Ordering meals should be done on a shorter notice to maintain flexibility (1-3 days in advance if possible) tob e able to react to short term changes in the duty rosters.
- Get a document shredder for sensitive paperwork (name lists, various print-outs)
- Define in advance up to which extent Ground Support is allowed to do small item shopping (Cable, paper, cleaning material, fruits, milk,…)
- Car rides should be combined – a dedicated car pool and stand-.by drivers was not possible – we would need more cars and drivers.
- Registration of where everybody is sleeping would be good – Ground Support made an actualized list of who can be reached in what manner.

Field Crew / CRW Feedback & Lessons Learned / 23Apr2011

Preparations

- Longer lead times for preparations – e.g. Internet connection should have been set up earlier, GS-IT should have had more lead-time and man-power reserves
- Software freeze 1-2 months ahead
- Transit phase: when entering cities: do not drive with long convoys into cities, but dispatch the fastest/smallest car.
- Navi-GPS for all cars
- Plan breakfasts at Hotels to save time effectively
- BE STRICTER WITH DEADLINES (e.g. prep of Rover, Traingrid,…)
- Dress Rehearsal NOT in the Suitlab, but off-site to ensure autonomy
- GOOD: Hotel bookings

Camping stuff / Base Camp logistics

- No cardboard boxes – they are solved in the rain
- A cleaner set-up of the provisions tent – systematic placement of stuff (labeling?) – Introduce a quarter master!
- Boxes in the van: more systematic storage, we had to repeatedly unloads boxes to access the deeper/lower ones
- Color marking of boxes or RFID
- Office rack for OPS, maybe a ink jet printer (laser printer kills UPS)
- Strong UPS – maybe with a device in advance of the UPS to adjust the voltages coming from the generators (Herkules 270V!)
    - → out of this, make a dedicated power grid planning scheme.
    - → test the behavious of the generators under load
- Buy bindfix & more power tape
- GREAT: mounting power grid right under the roof of the tent
- Fixed antenna mast for OPS for the W-Lan antenna;
- Dust proof RoboCam – mountable on a standard photo connector; e.g. also operated on battery?
- Bring better & stronger needle, pins and strong threads; back-up tissue
- GREAT: coffee machine was super, we just need to get it dust proof
- GREAT: granola bars

Sim

- As we do not use WeTabs permanently, we should put procedures them into plastic foil
- Clearer structure for OPS tables – e.g. labeling what is meant for what (media table)

- Daily Briefings were extremely important
- Plan housekeeping also in the Flight Plan (toilet maintenance, dish washing etc…)
- GOOD: camping toilets, but put them more apart ;-)
- Distribute list of telephone numbers to all in printed forms.
- Tester was standing sweating and cooled down after the doffing

MCC

- How about mutating from Mission Control to Mission Support – MCC should not control every small activity, but give OPS more autonomy (e.g. how about if MCC would not usually talk directly to the Suit tester?).
- eGroupware tool to be changed? Renew the data management system?
- Put MCC staff into the field
- Keep communication simple: one question per radio contact

Science

- Better training for experiments, stricter EDS & Procs, Training for EVERYONE, so that people are more flexible in who can handle what kind of equipment and/or experiment; this includes also people from MCC!
- Skill list of who is capable of doing what?
- Software training Ubuntu/Linux, teamspeak etc.. for the OPS teams

Safety

- Back-pack for medical safety equipment; maybe fixing the fire extinguisher at the backpack
- Maybe a second support person to carry stuff?
- New wireless RoboCam with dust proof cover

Misc

- Data entropy: make a single point of upload for all science and engineering data (maybe even a data officer), this person should also be responsible for managing the soil samples
- During Donning: create a support structure for the PLSS which supports the tester during the donning; better chair which also enables an access to the PLSS when the tester is suited.
- MyDMS needs to be reorganized – many outdated files, hard to find stuff, etc… procedures into the SVN

- GOOD: common briefings with MCC boost the morale of the CRW
- GOOD: team engagement, everyone helped; team coherence was superb

JOINT MCC & CRW Feedback & Lessons Learned / 25Apr2011

Preparations

- Dress rehearsal was one of the most important things we did for the mission, especially as the MCC was already set up – MCC was on “Earth”, CRW was really on “Mars”.
- Second dress rehearsal in a dislocated position, in order to avoid cheating or shouting in between stations
- Time between Dress Rehearsal and actual mission was too short – should be a little bit longer to allow for changing things
- Good: Sciencists went through the experiments with FCT
- BME: came to the crew very late – would have been better to involve the BME’s earlier, because there was quite some dynamics in the development of the experiments and monitoring infrastructure (e.g. online-ECG).
- Communication for 60 people in 2 different places was excellent given the border conditions; e.g. on Monday everything was hard, but it improved significantly.

MCC logistics

- Better chairs would have been nice (wooden chairs for 5 hours is tedious)
- Ground support should have been more involved from the beginning, in our case there was a lot of things where we had to improvise; lunches were pre-ordered, but we had 7 people more sometimes – so things had to be improvised. Lunches: for the MCC Crew (CapCom/BME/FD) it should be delivered. Chocolate in the morning when you check-in (GREAT IDEA!!!)

Sim

- Timing was perfect; the schedule was O.K. – e.g. EVA hours 5-7 hours, so that’s pretty acceptable (also a comment from Frits de Jong)
- Video were extremely helpful in judging the situation in Rio Tinto. Time delay was noticed between the individual cameras, so a constant reset was a procedure – was not a real issue.
- 08:00 briefing was always fully attended
- Daily debfriefings were usually around 18:00 (20:00 on Monday) – this was the end of the day for most people at the MCC
- Flight Plan: no issues from Jan’s side; it was very helpful – the tool was realy cool (nice colors ☺); there is some feedback to improve the OSTPV – especially how far the information goes.
- Google Maps tool: without altitude information turned out to be quite challenging; pictures would have been better, topographic maps would have been great.
- Google Maps tool from Nikolei: worked quite well, but the data/image flow was pretty slow. If we would have had better GPR data, we could have put that one online as well.
- Weather forecast was really bad. Rio Tinto was in between two weather systems – having a weather station on-site would have been great.
- Freie Uni Berlin – they asked about some details, they want to go to Rio Tinto, too.
- Medical Univ. Ibk was not present at any point.
- Nespresso was necessary and a great amenity.

Public day

- Evening event: 40 people, but that also includes the MCC people, so not that much attendance
- Press conference was superb – 20 people
- New Zealand: Fuchsi had contact, they got the VPN access. At some point during the night they had written a message and asked for a telecom at 22:00 no one could respond. But at least that's the furthest point we got the VPN working.

Safety

- No safety issues @ MCC
- On-line telemetry during the Sims was not really great – physician was on the wrong position; the safety should be a physician on-site. Questionnaire contributed greatly to the situational awareness.
- Thomas Luger turned off the monitor during the journalists visitors.

10. Appendix / Media Activities Overview

The MediaCom team was led by Alexander Soucek, seconded by Olivia Haider.

The media team of the Austrian Space Forum ensured a high public visibility of the mission. Their activities included the compilation of all mission related media inputs, crisis communication and handling media requests during the dedicated media day on the 20Apr2011. We also invited the general public to visit the MCC on that particular day for guided tours.

On the 20Apr2011, there was a guided VIP tour at 10:00, followed by a press conference at 11:00-11:30 which was ended by a live-link to Rio Tinto.

In the evening of the 20Apr 2011, 19:00, there was a public lecture at the largest book shop of Innsbruck, the Wagnersche Buchhandlung, we also arranged a live link and recorded messages to the newly established Mars Society chapter in New Zealand.

From 15th – 25th April 2011 most of the MediaCom activities took place at the MCC Innsbruck. During this phase a daily picture of the day was posted, 28 German articles and 18 English articles went online on the OEWF blog. 9 videos were made (online on youtube and vimeo), several Facebook entries per day were written and we had live coverage of the expedition on the OEWF Twitter channel. On the 20th April a public media took place at the MCC in Innsbruck with VIP tour and press conferences (ca. 12 journalists) in the morning, public guided tours through the MCC in the afternoon (ca. 40 people) and a multimedia show in the evening at the Wagnersche Thalia bookstore in Innsbruck (ca. 50 people).

Press coverage

We had a press release (German) one week before media day with the invitation to the press conference, one press release (German) on 22Apr2011 and we were mentioned in the T-Mobile Austria press release which took place on the same day. On 25Apr2011 the international press release through the Europlanet channel took place.

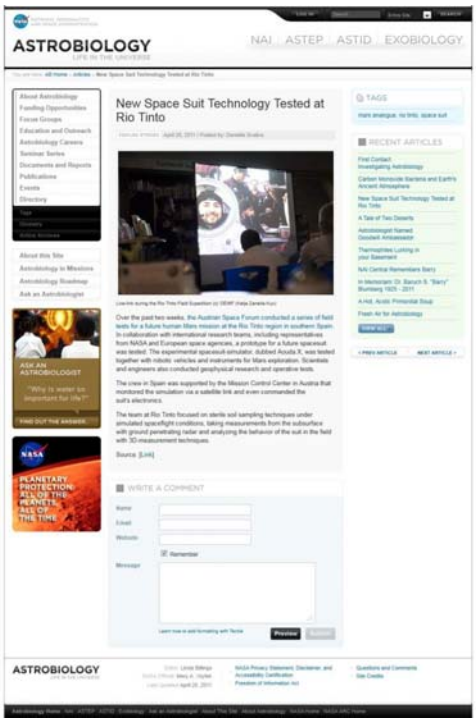
Top 3 Science Websites

2011 May 02

ESA Frontpage & ESA Human Spaceflight frontpage channel. Link to article:

http://www.esa.int/esaCP/SEMT1DZGRMG_index_0.html

http://www.esa.int/esaHS/SEMQPCZGRMG_research_0.html



2011 Apr 26

Astrobiology.nasa.gov: Frontpage

http://astrobiology.nasa.gov/articles/new-space-suit-technology-tested-at-rio-tinto/

2011 Apr 25

Science Daily Frontpage

http://www.sciencedaily.com/releases/2011/04/110425081301.htm

Top 3 TV/Media Channels:

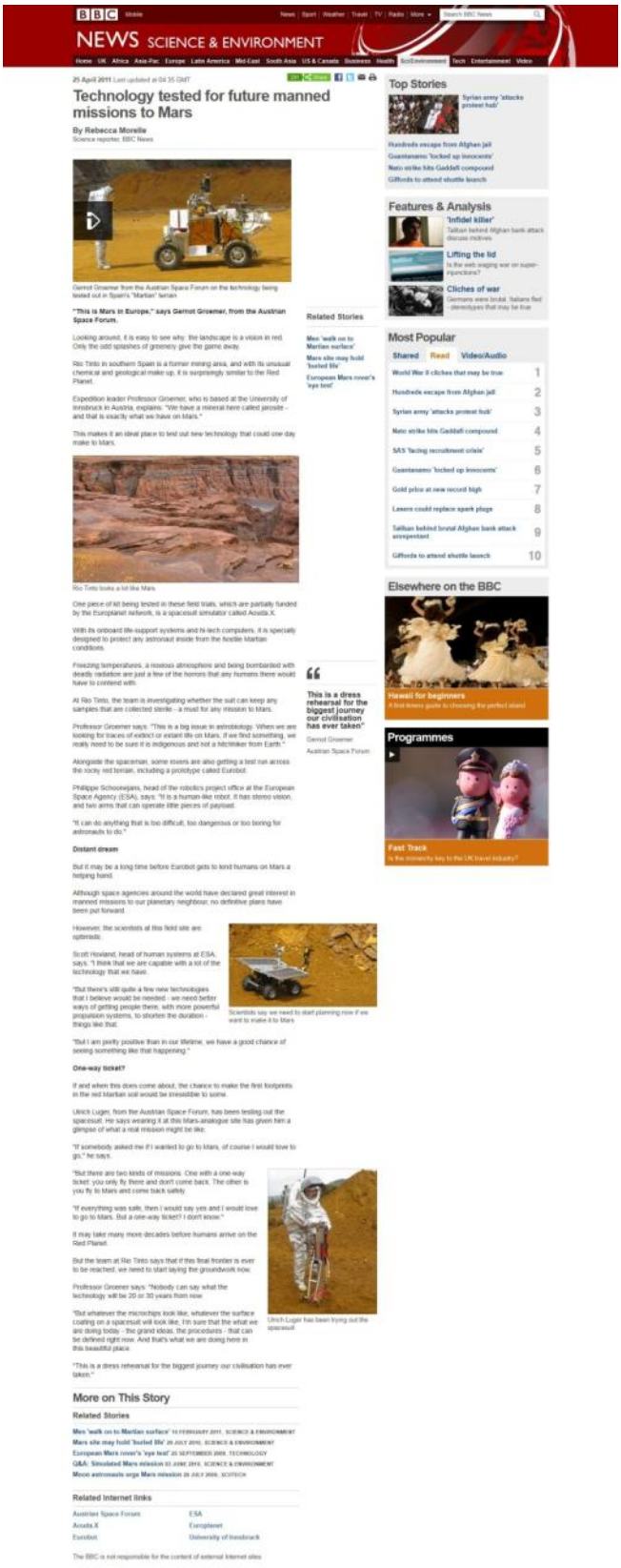
2011 Apr 25

BBC radio, tv and online (frontpage science & environment) with video clip

http://www.bbc.co.uk/news/science-environment-13161635

BBC Mundo

http://www.youtube.com/watch?v=sfvQejJVnfw



Planned (no confirmed broadcast date)

Discovery Channel

http://www.discoverychannel.ca/

2011 May 14

ORF Newton Special

http://tv.orf.at/newton

22 min special

Top 3 Newspapers:

DER STANDARD

Intensives Mediencoaching für VP-Hoffnung Kurz

Multi-Künstler Jan Fabre im Kunsthistorischen

MITTWOCH, 4. MAI 2011 | ÖSTERREICHS UNABHÄNGIGE TAGESZEITUNG | HERAUSGEGEBEN VON OSCAR BRONNER | € 1,20

US-Senatoren stellen Milliardenhilfe für Pakistan infrage

Bin Laden lebte jahrelang in seinem Haus

Präsident Zardari beschwört Partnerschaft

Österreich probt für den Mars

HEUTE

ZUM THEMA

2011 May 04

DerStandard (print) 1st page & article in science section

The Telegraph

Rio Tinto becomes Mars mission testing ground

2011 Apr 26

The Telegraph

http://www.telegraph.co.uk/science/space/8474288/Rio-Tinto-becomes-Mars-mission-testing-ground.html

Cosas de la vida

elPeriódico

CIENCIA

ZONA DE LA SIMULACIÓN

Una expedición científica simula Marte en Río Tinto

El estudio pone a prueba un nuevo traje espacial y el robot europeo Eurobot

EL TRAJE AQUA.X

Periódico

2011 Apr 21

El Periodico (print and online)

http://www.elperiodicodearagon.com/noticias/noticia.asp?pkid=665032

Coverage Online & Radio

2011 Apr 06-20

1. Fm4.orf.at (online, broadcast; range: national) http://fm4.orf.at/stories/1680628/
1. Tirol.orf.at (online; range: regional): http://tirol.orf.at/stories/509587/
2. Catalysts (range: special interest) http://www.catalysts.cc/rio-tinto-expedition/
3. Kronehit Radio (online & radio broadcast (morning news); Range: national)
4. University of Innsbruck Facebook Fanpage (several wall posts; Range: regional) http://www.facebook.com/uniinnsbruck
5. T-Mobile Austria Facebook Fanpage (range: national) http://www.facebook.com/note.php?note_id=10150156230024440
6. O1.orf.at (online & radio broadcast; Range: National) http://oe1.orf.at/artikel/274950
7. Kurier (online): http://kurier.at/techno/2091970.php print version on 20.04.2011
8. University of Innsbruck ipoint (frontpage: event public day)
9. DerStandard (range: national): http://derstandard.at/1303291062561/Simulierte-Expedition-Mars-an-Innsbruck-Alles-Roger
10. Kleine Zeitung (range: regional): http://archiv.kleine.at/nachrichten/sunnseitn/2725918/tiroler-weltraumforum-simuliert-marsmission.story
11. Tiroler Tageszeitung (range: regional): http://www.tt.com/csp/cms/sites/tt/%C3%9Cberblick/Chronik/ChronikTirol/2612785-6/weltraumforum-in-tirol-steuert-mars-simulation-in-spanien.csp
12. APA (Austrian Press Agency): http://www.zukunftwissen.apa.at/cms/zukunft-wissen/fti-und-wissenschaft/topnews_einzel.html;jsessionid=E0F0359C2751DD35F67C426DEFD1F081.cms1?id=CMS1303307007971
13. Vienna.at: http://www.vienna.at/weltraumforum-in-tirol-steuert-mars-simulation/apa-1143971145
14. Wirtschaftsblatt (online; range: national) http://www.wirtschaftsblatt.at/home/oesterreich/branchen/oesterreichisches-weltraumforum-steuert-mars-simulation-468935/index.do?_vl_backlink=/home/index.do&_vl_pos=11.2.DT
15. Pr-Inside.com (PR agency; range: international) http://www.pr-inside.com/de/weltraumforum-in-tirol-steuert-mars-simulation-r2548958.htm
16. Nachrichtenanzeiger.at (range: national) http://www.nachrichtzeiger.at/naachr/osterreichisches_weltraumforum_steuert_m-589200

2011 Apr 22

1. University of Innsbruck Ipoint (range: regional) http://www.uibk.ac.at/ipoint/news/2011/austronauten-auf-dem-weg-zum-roten-planeten.html.de
2. IT Press (range: national; via via T-Mobile press release) http://www.it-press.at/presseaussendung/IKT_20110422_IKT0001/t-mobile-partner-des-oesterreichischen-weltraum-forum-mars-expeditions-simulation-im-netz-der-zukunft-bild
3. Unternehmerweb (range: national; via via T-Mobile press release) http://www.unternehmerweb.at/news_apa.php?id=201104220070
4. Pr-Inside.com (range: international; via T-Mobile press release) http://www.pr-inside.com/de/t-mobile-partner-des-oesterreichischen-weltraum-r2553152.htm
5. Pressemeldungen.com (range: national; via T-Mobile press release) http://www.pressemeldungen.com/2011/04/22/t-mobile-partner-des-osterreichischen-weltraum-forum-mars-expeditions-simulation-im-netz-der-zukunft-bild/
6. APA / OTS.at (range:national; via T-Mobile press release) http://www.ots.at/presseaussendung/OTS_20110422_OTS0070/t-mobile-partner-des-oesterreichischen-weltraum-forum-mars-expeditions-simulation-im-netz-der-zukunft-bild
7. QuEdit (range: national) http://www.quedit.com/detail/oesterreicher-simulieren-mars-landung-7859820.html?LID=291&tmp=user
8. Medianet (range: national; via T-Mobile) http://www.medianet.at/technology/article/telefongespraeche-mit-dem-roten-planeten/

2011 Apr 25

1. Europlanet (range: international), press release: http://www.europlanet-eu.org/outreach/index.php?option=com_content&task=view&id=328&Itemid=1, http://www.alphagalileo.org/ViewItem.aspx?ItemId=101501&CultureCode=en
2. Science Daily (range: international) http://www.sciencedaily.com/releases/2011/04/110425081301.htm
3. BBC (online, TV & radio broadcast; range: international) http://www.bbc.co.uk/news/science-environment-13161635
4. BBC El Mundo (TV broadcast) http://www.youtube.com/watch?v=sfvQejJVnfw, http://www.bbc.co.uk/mundo/noticias/2011/04/110425_tecnologia_marte_espacio_mes.shtml
5. Mars Exploration (range: international, via science daily) http://www.marsexplorernews.com/www__Dsciencedaily__Dcom/_news_Austrian-Space-Forum-Successfully-Tests-Mars-Suit-.php
6. Wireless Federation (range: international; via T-Mobile press release) http://wirelessfederation.com/news/71802-t-mobile-launches-lte-data-sticks-to-austrian-mars-simulation/
7. RedOrbit (range: international) http://www.redorbit.com/news/space/2035351/aoudax_mars_spacesuit_successfully_tested_in_spain/
8. Science News (range: international) http://www.science-news.eu/space-exploration-news/cluster75827/
9. Cadenaser (range: national; Spanish) http://www.cadenaser.com/sociedad/articulo/centro-astrobiologia-simula-futuras-expediciones-marte-rio-tinto/csrcsrpor/20110425csrcsrsoc_20/Tes
10. Terra Peru, Columbia (range: international; Spanish) http://noticias.terra.com/noticias/espana_terreno_de_prueba_para_misiones_a_marte/act2817187
11. El Mercurio (range: national; Chile) http://www.emol.com/noticias/tecnologia/detalle/detallenoticias.asp?idnoticia=477992
12. Middle East Network (range: middle east) http://www.middnet.net/index.php?option=com_content&view=article&id=2536%3Atechnology-tested-for-future-manned-missions-to-mars&catid=68%3Afeatures-analysis&Itemid=74&lang=en

13. Nanopatents and Innovations Blog (range: blogs)http://nanopatentsandinnovations.blogspot.com/2011/04/latest-in-martian-fashion-and-vehicles.html
14. Space & Earth Science News: (range:international) http://www.news-about-space.org/space-exploration-news/cluster9326721/
15. Turkish MSNBC (range: national; Turkish) http://www.ntvmsnbc.com/id/25206279/
16. Spaceflight Latest (range: international; via Space Daily) http://spaceflightlatest.com/www__Dsciencedaily__Dcom/_Austrian-Space-Forum-Successfully-Tests-Mars-Suit-.php
17. El Pais Costa Rica (range: national; Costa Rica) http://www.elpais.cr/articulos.php?id=44885
18. Latercerca (range: international; Spanish) http://www.latercera.com/noticia/tendencias/ciencia-tecnologia/2011/04/739-360978-9-prueban-traje-y-vehiculo-espacial-para-misiones-en-luna-y-marte.shtml
19. La Segunda online(range: national; Spanish) http://www.lasegunda.com/noticias/cienciatecnologia/2011/04/643115/experimentan-con-nuevo-traje-y-vehiculo-espacial-para-misiones-a-marte
20. Univision.com (range: national; Spanish) http://feeds.univision.com/feeds/article/2011-04-25/prueban-en-espana-un-traje?refPath=/noticias/mundo/noticias/
21. ADN.es (range: regional; Spanish) http://www.adn.es/tecnologia/20110425/NWS-1021-Riotinto-Prueban-Marte-Luna-misiones.html
22. Canarias 7 (range: regional; Spanish) http://www.canarias7.es/articulo.cfm?id=211124
23. Cope (range: regional; Spanish) http://www.cope.es/ocio/25-04-11--prueban-en-riotinto-un-traje-y-un-vehiculo-espacial-para-misiones-en-la-luna-y-marte-240320-1
24. El Digital de Madrid (range: regional; Spanish) http://www.eldigitaldemadrid.es/ep/general/SOCIEDAD/20110425192031
25. El Dia Es (range:national; Spanish) http://www.eldia.es/2011-04-25/SOCIEDAD/22-Prueban-Riotinto-traje-vehiculo-espacial-misiones-Luna-Marte.htm
26. La Voz Libre (range: national; Spanish) http://www.lavozlibre.com/noticias/ampliar/243956/prueban-en-riotinto-un-traje-y-un-vehiculo-espacial-para-misiones-en-la-luna-y-marte-
27. Diario Siglo XXI (range: national; Spanish) http://www.diariosigloxxi.com/texto-ep/mostrar/20110425192031/prueban-en-riotinto-un-traje-y-un-vehculo-espacial-para-misiones-en-la-luna-y-marte-
28. Epsocial (range: national; Spanish) http://www.europapress.es/epsocial/noticia-prueban-riotinto-traje-vehiculo-espacial-misiones-luna-marte-20110425192015.html
29. Anadulucia Informacion (range: regional; Spanish) http://www.andaluciainformacion.es/portada/?a=175247&i=83&f=0
30. El Economista (range: national; Spanish) http://ecodiario.eleconomista.es/espana/noticias/3014453/04/11/Prueban-en-Riotinto-un-traje-y-un-vehiculo-espacial-para-misiones-en-la-Luna-y-Marte.html
31. 20 minutes (range: national; Spanish) http://www.20minutos.es/noticia/1029893/0/
32. Gente en Huelva (range: regional; Spanish) http://www.gentedigital.es/huelva/noticia/549387/prueban-en-riotinto-un-traje-y-un-vehiculo-espacial-para-misiones-en-la-luna-y-marte/
33. Tech-gals (range: specific interest) http://www.tech-gals.com/whats-new/latest-in-martian-fashion-and-vehicles-austrian-space-forum/
34. One News Page (range: international; via redorbit) http://www.onenewspage.com/news/Science/20110425/21710240/Aouda-Mars-Spacesuit-Successfully-Tested-In-Spain.htm
35. Newsletter AIAA (range: international) http://mailview.custombriefings.com/mailview.aspx?m=2011042501aiaa&r=4713280-7090

2011 Apr 26

1. The Telegraph (range: national; british) http://www.telegraph.co.uk/science/space/8474288/Rio-Tinto-becomes-Mars-mission-testing-ground.html
2. OE3 radio broadcast (national radio/Austria, clip downloadable at the internal PolAres eGroupware-Tool) http://lunarsat.uibk.ac.at/egroupware/mydms/op/op.Download.php?documentid=545&version=1
3. La Vanguardia.com (range: national; Spanish) http://www.lavanguardia.com/ciencia/20110426/54144865707/las-minas-de-rio-tinto-son-marte-en-la-tierra.html
4. Hechos de Hoy (range: international; South America) http://www.hechosdehoy.com/las-futuras-misiones-a-marte-se-entrenan-en-espana-7985.htm
5. Abc digital (range: national; Spanish) http://www.abc.com.py/nota/prueban-en-espana-equipo-para-misiones-en-marte/
6. La informacion.com, futurtech (range: national; Spanish) http://blogs.lainformacion.com/futuretech/2011/04/25/pruebas-riotinto/
7. ABC Sevilla (range: national; Spanish) http://www.abcdesevilla.es/20110426/andalucia/sevi-prueban-riotinto-traje-vehiculo-201104261525.html
8. Spanish People Daily (range: national; Spanish) http://spanish.peopledaily.com.cn/92121/7361997.html
9. El Dia (range: national; Argentinia) http://www.eldia.com.ar/edis/20110426/prueban-traje-para-ir-marte-informaciongeneral30.htm
10. Huelva Informacion (range: regional; Spanish) http://www.huelvainformacion.es/article/provincia/959826/la/fundacion/defiende/interes/cientifico/la/zona.html
11. Scientific Computing (range: international) http://www.scimag.com/news-austrian-space-forum-successfully-tests-mars-suit-042511.aspx
12. A breaking news (range: international) http://abreakingnews.com/aouda-x-austrian-space-forum-testing-successful-mars-suit-in-spain-maiden-voyage-for-eurobot-mars-rover-28227.html
13. Breaking News (range: international) http://breakingnews24hrs.net/science/mars-education/
14. Typically Spanish (range: regional; Spanish) http://www.typicallyspanish.com/news/publish/article_30239.shtml

2011 Apr 27 – 2011 May 03

1. El Pais (range: national; Spanish) http://www.elpais.com/articulo/andalucia/Ensayo/marciano/rio/Tinto/elpepuespand/20110427elpand_2/Tes
2. ABC (range: national; Spanish) http://www.abc.es/20110427/ciencia/abci-traje-espacial-riotinto-201104271614.html
3. Azorobotics (range: specific interest) http://www.azorobotics.com/Details.asp?newsID=1442

4. Olive Press (range: national; Spanish) http://www.theolivepress.es/spain-news/2011/05/01/european-space-agency-spain/
5. Science Today (range: international) http://www.sciencetodaynews.com/austrian-space-forum-successfully-tests-mars-suit-%E2%80%98aouda-x%E2%80%99-in-spain-maiden-trip-for-esas-mars-rover-%E2%80%98eurobot%E2%80%99.html
6. Red Orbit (range: international) http://www.redorbit.com/news/space/2039092/mars_tech_tested_at_rio_tinto/
7. Science News (range: international) http://www.science-news.eu/space-exploration-news/cluster75827/
8. Space & Earth Science News (range: international) http://www.news-about-space.org/space-exploration-news/cluster9326721/
9. Interspace News (range: international) http://interspacenews.com/FeatureArticle/tabid/130/Default.aspx?id=6511
10. Scientific American (range: international) http://www.scientificamerican.com/article.cfm?id=exploring-rio-tinto-eurobotically
11. WTM News (range: national; Greece) http://www.wtmnews.gr/academia-07/6823-Exploring-Rio-Tinto-Eurobotically.html
12. El Mundo (range: national, Spanish) http://www.elmundo.es/elmundo/2011/05/03/ciencia/1304416021.html, http://www.elmundo.es/multimedia/index.html?media=1S4b0PnXjSc
13. Daily Mail (range: national, british) http://www.dailymail.co.uk/sciencetech/article-1383096/To-Andalusia--Mars-spacesuits-unmanned-rover-given-dry-run-Spanish-mining-desert.html
14. Ideal.es (range: national; Spanish) http://www.ideal.es/agencias/20110503/mas-actualidad/andalucia/eurobot-pasa-satisfactoriamente-primera-mision_201105031325.html
15. Reuters Prototype Mars spacesuits (range: international) http://www.reuters.com/article/2011/05/03/life-idUSRTR2LYEC
16. Parabolic Arc (range: blog) http://www.parabolicarc.com/2011/05/03/esa-explores-mars-spain/
17. Mars Daily (range: specific international) http://www.marsdaily.com/reports/Exploring_Rio_Tinto_Eurobotically_999.html
18. Der Standard (range: national; Austria) http://derstandard.at/1304428435243/Im-Spezialanzug-Forscher-simulierten-Mars-Mission
19. Europapress (range: regional; Spanish) http://www.europapress.es/andalucia/sevilla-00357/noticia-elige-cauce-rio-tinto-simular-mision-marte-20110503115855.html

2011 May 04-07

1. Reuters Editors Choice, best photos from last 24 hours (type: international) http://blogs.reuters.com/fullfocus/2011/05/04/editors-choice/#a=23
2. CBC News (range: national; Canada) http://www.cbc.ca/news/technology/story/2011/05/04/f-mars-spacesuit-simulator-aoudax.html
3. International Business Times (range: international) http://www.ibtimes.com/articles/141228/20110504/nasa-space-suit-mars-mars-rover-esa.htm
4. ECN (Electronic Engineering Professionals) (range: specific interest) http://www.ecnmag.com/News/2011/05/Europe/Exploring-Rio-Tinto-Eurobotically/
5. Newstrack India (range: international) http://www.newstrackindia.com/newsdetails/218058
6. News Tonight (range: international) http://newstonight.net/content/study-examines-aoudo-x-spacesuit-space-research-mars
7. The engineer (range: national; British) http://www.theengineer.co.uk/sectors/aerospace/news/spacesuit-allows-astronauts-to-feel-as-if-theyre-on-mars/1008528.article
8. Frankfurter Rundschau (range: national; Germany) http://www.fr-online.de/wissenschaft/raumfahrt/marsmission-light/-/1473248/8415492/-/
9. The Independent (range: national; British) http://www.independent.co.uk/news/science/life-on-mars-no-but-its-the-next-best-thing-2280365.html