

Improving Access to Space with Space Link Extension Services

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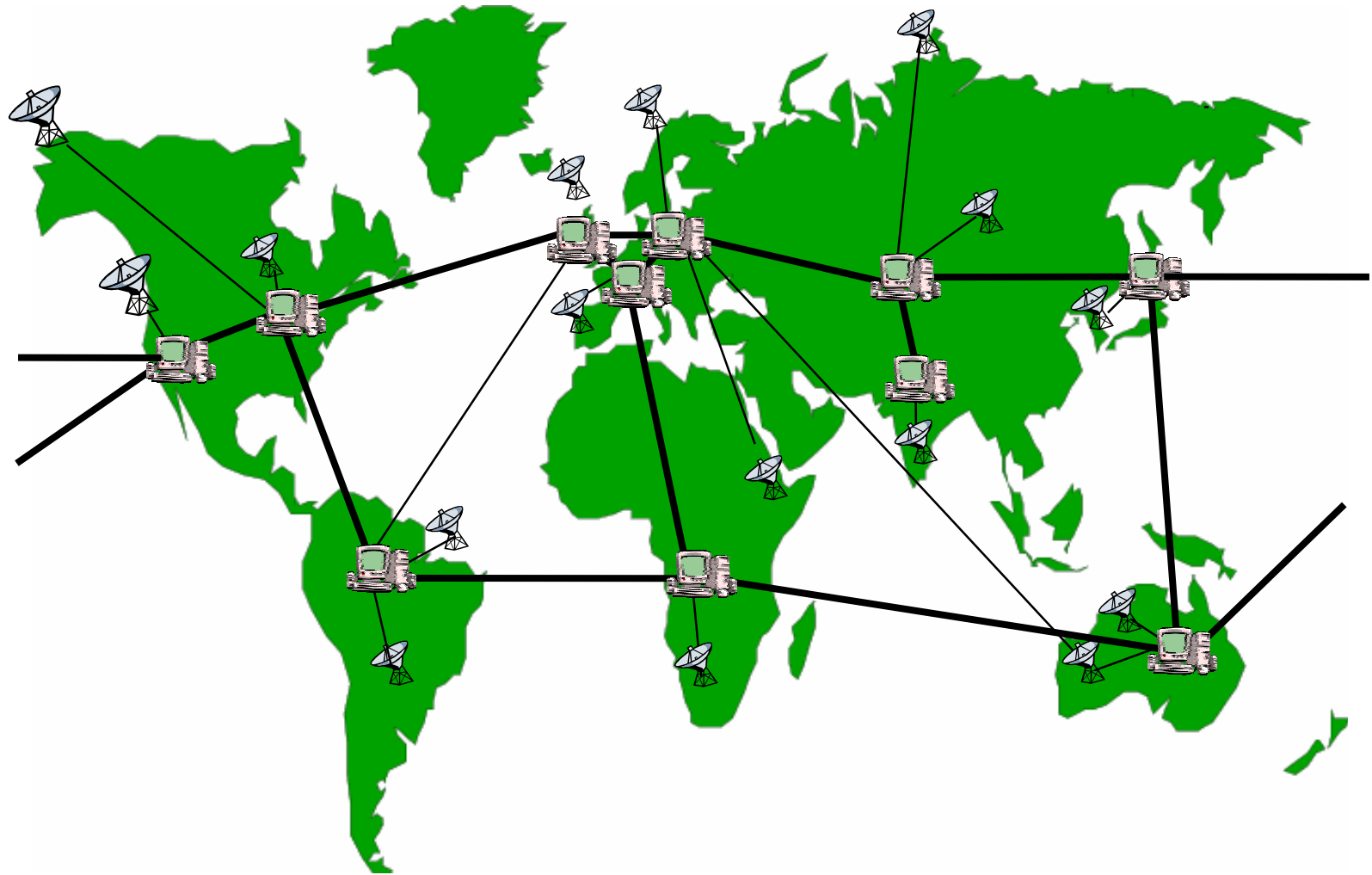


Presentation Overview

- Scope of the SLE Services
- Scope of the UK Implementation
- Implementation Overview
- SLE Service Management Layer
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- SLE Security
- Future Developments
- Conclusion



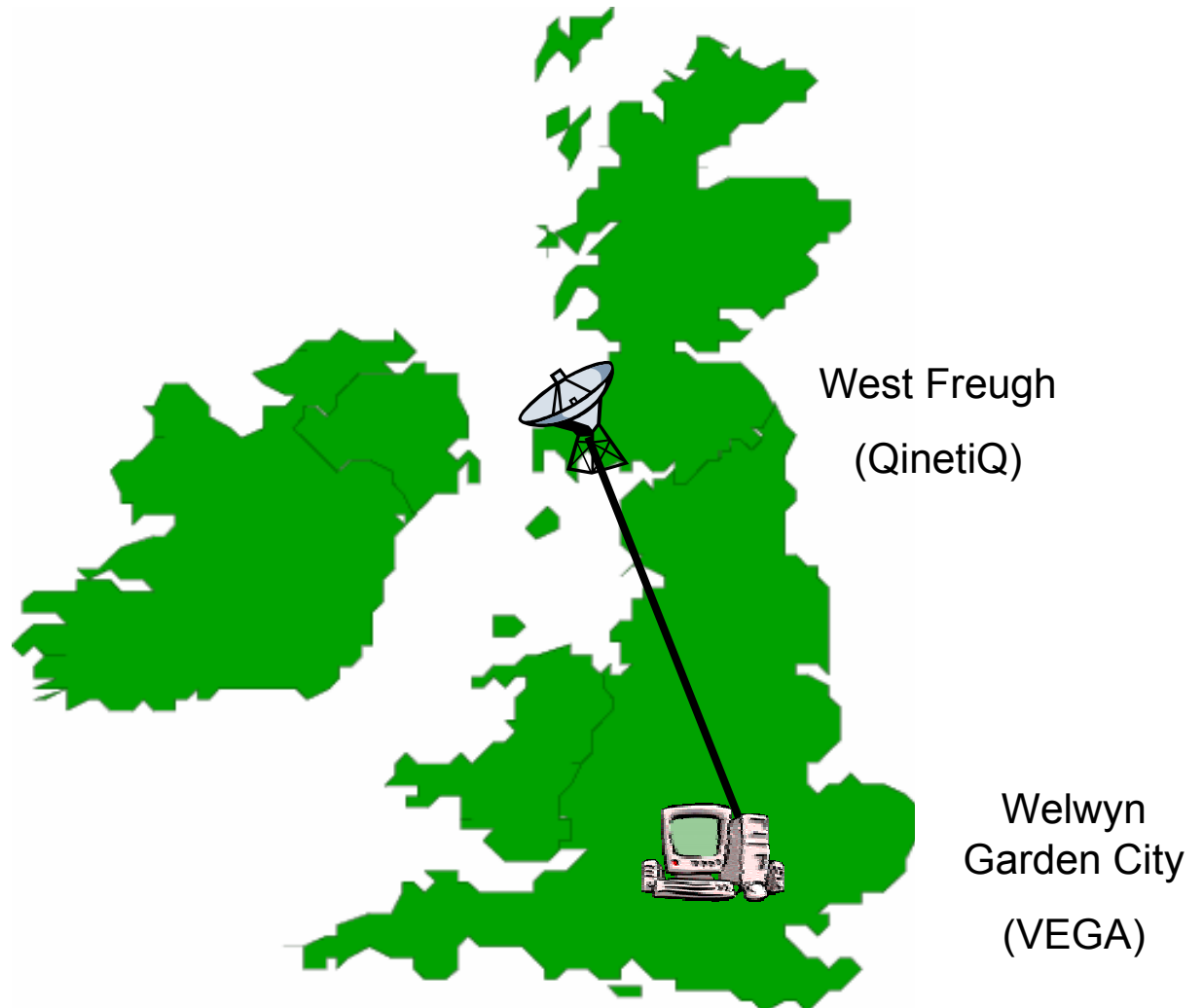
Scope of the SLE Services



The aim: a world-wide SLE network by GSAW 2005



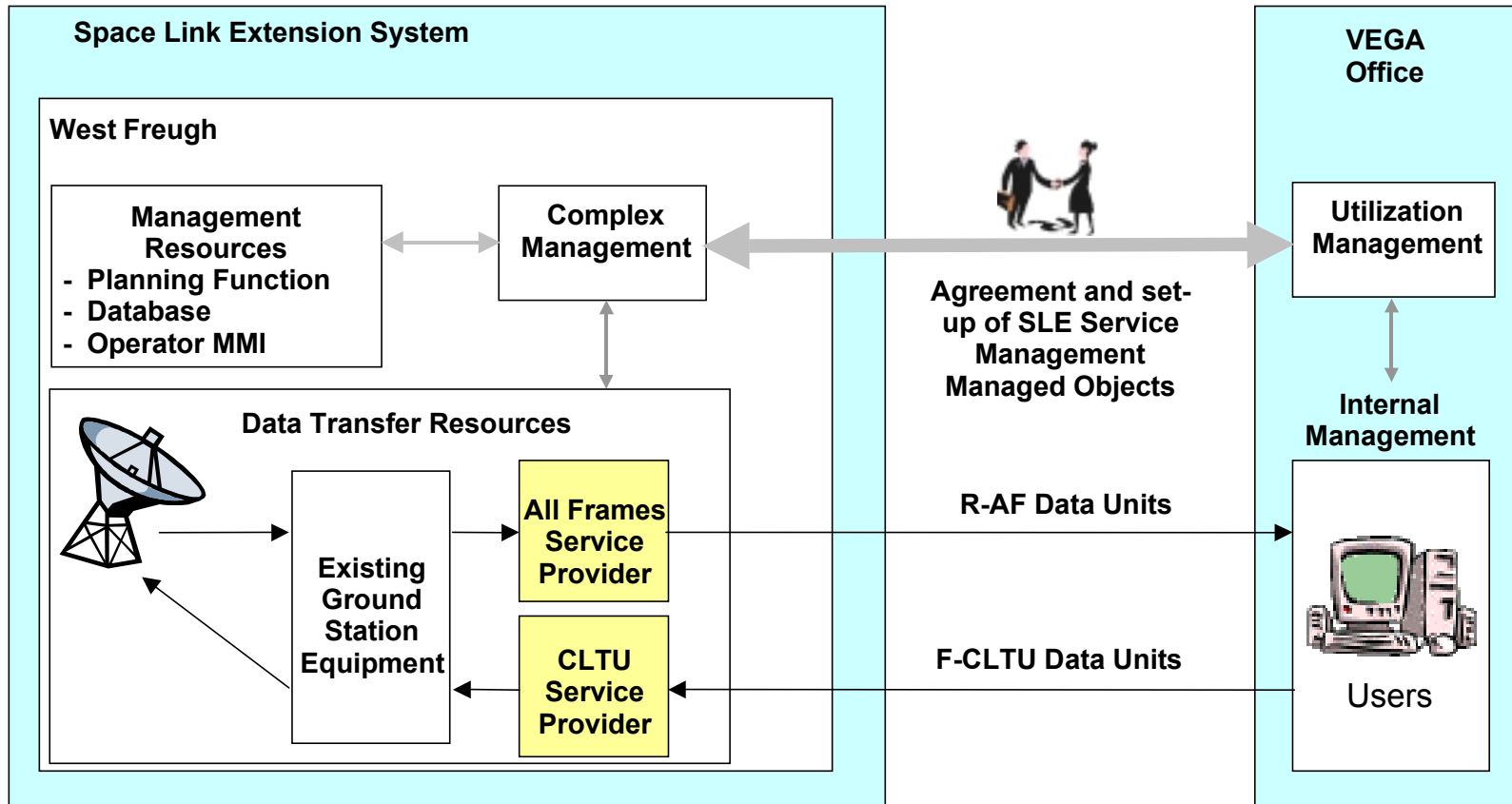
Scope of the UK Implementation (1 of 3)



The present day: the UK contribution



Scope of the UK Implementation (2 of 3)



SLE Service Management & Data Transfer Interfaces



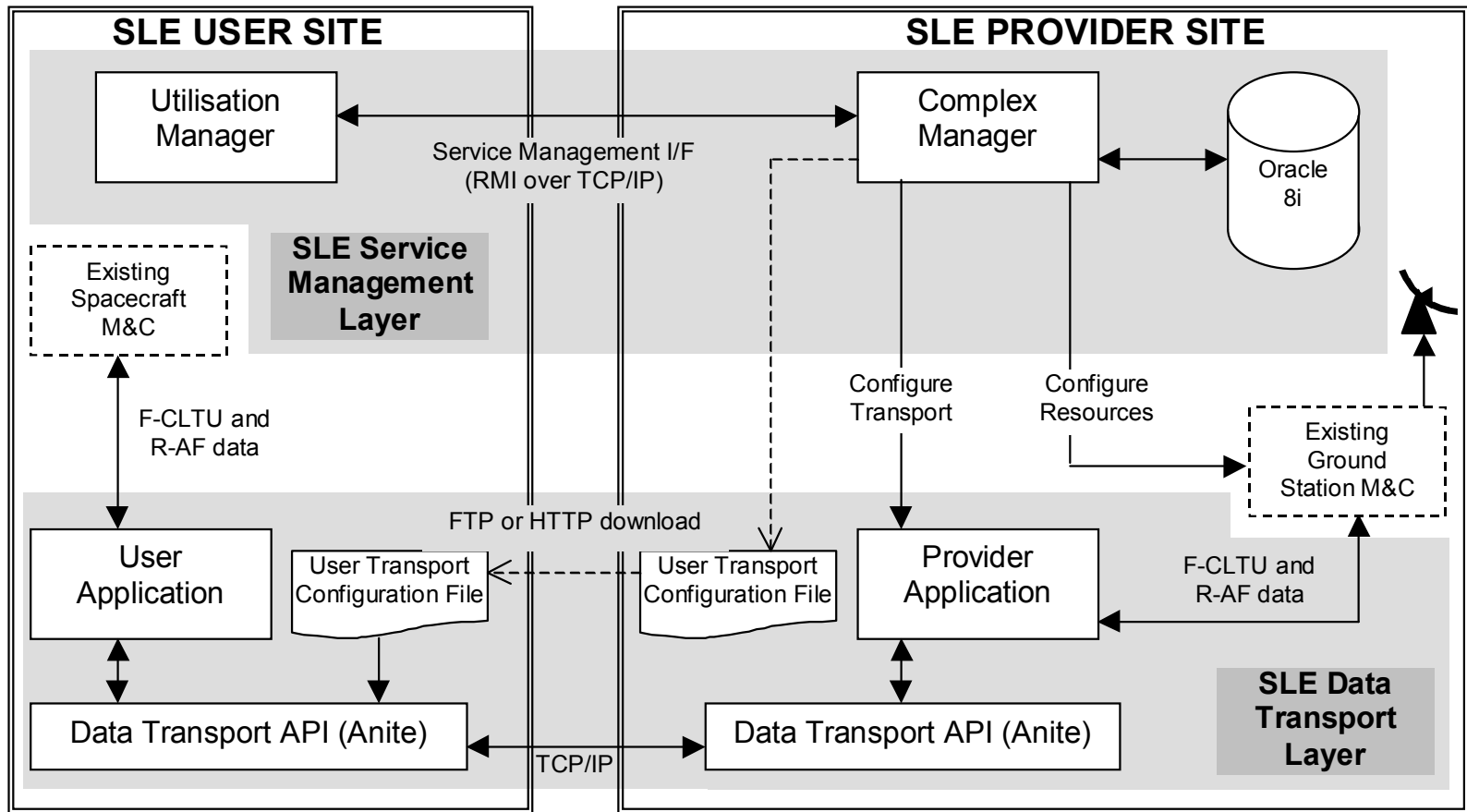
Scope of the UK Implementation (3 of 3)

- The VEGA/QinetiQ implementation includes both the SLE Service Management and SLE Data Transfer for the on-line F-CLTU and on-line R-AF services.
- In addition, it includes a web-based user interface for the creation of a Service Agreement and a ground station schedule enquiry tool.
- It does not yet include some features required for an operational system such as off-line services, multiple resource configuration, security, schedule conflict resolution or billing.

The F-CLTU and R-AF services has been successfully tested and work is beginning on the development of an operational system.



Implementation Overview (1 of 3)



SLE High Level Architecture



Implementation Overview (2 of 3)

- Service Management overview:
 - ◆ the Utilisation Manager (UM) provides a user interface for the creation of SLE service packages, containing F-CLTU and R-AF service instances.
 - ◆ In this implementation, the UM is provided as a web interface by the Complex Manager (CM), in order to allow users to access the service without the need to develop or buy their own SLE software.
 - ◆ The service packages created by the UM are checked by the CM and stored in the Oracle 8i database on the Provider Site.
- Data Transfer overview:
 - ◆ For each service instance, the CM creates a transport layer configuration file for the user to download.
 - ◆ When the service instance is due to start the CM configures the provider's transport layer and ground station hardware ready to provide the service via IPC messages.
 - ◆ The user configures its transport layer with the previously supplied configuration data and executes the BIND, START and TRANSFER_DATA operations that result in the data units flowing between the spacecraft M&C and the space link.

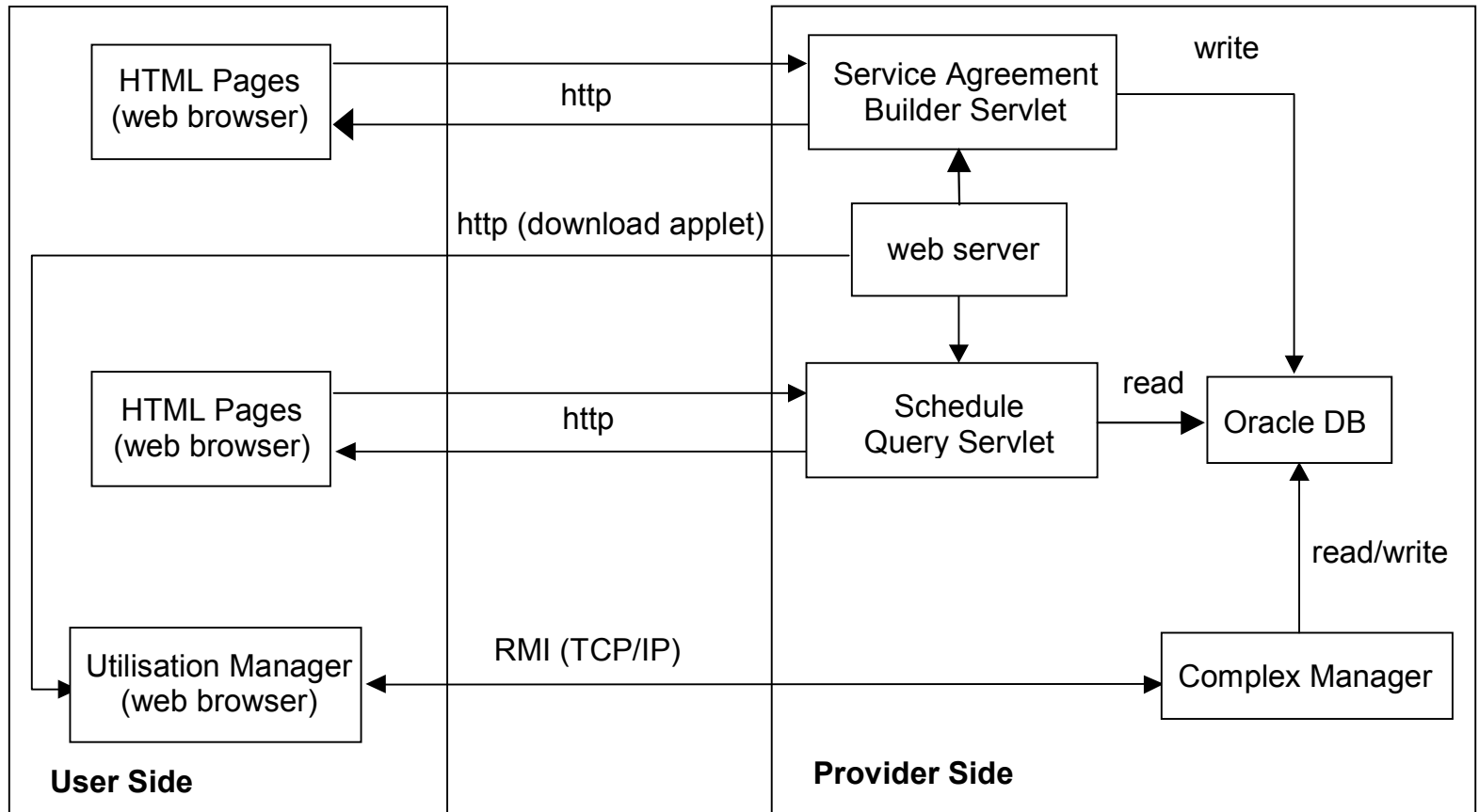


Implementation Overview (3 of 3)

- “SLE-lite”
 - ◆ Providers with existing management systems can adopt an entry level version of the software - “SLE-lite” - that does not interface directly with the provider resources.
 - ◆ SLE-lite includes:
 - the full SLE software;
 - a cut-down version of the Utilisation Manager GUI that provides a scheduling interface for service instances;
 - a Complex Manager GUI that informs the provider what is going on and when;
 - the full SLE data transfer capability, including the User and Provider Applications that automate the data transfer process.
 - ◆ Once Providers want the full SLE capability, the only additional software required is the “glue” software interfacing the Complex Manager to the ground station resources.



SLE Service Management Layer (1 of 4)



SLE Service Management Layer



SLE Service Management Layer (2 of 4)

- The SLE Service Management Layer:
 - ◆ provides a user with the means to access all the SLE service management features via a standard web browser, thereby eliminating the need for SLE-specific software on the user side.
 - ◆ covers the complete life cycle of a TTC service, from the generation of a top level Service Agreement to the execution of an individual Service Package e.g. the commanding of a satellite during a specified pass.
- The Service Management layer comprises three main parts:
 - ◆ *Service Agreement Builder Servlet*
 - this sets up all the high level parameters needed by the service, such as the spacecraft name and RF characteristics.
 - this feature is essential for an operational system but not defined by SLE as space operations organisation could prefer to continue to use a paper-based system.

The idea of the servlet is to simplify the agreement process and drastically reduce the time needed to book TTC services.



SLE Service Management Layer (3 of 4)

- ◆ *Schedule Query Servlet*
 - this enables users to find out when the ground station is already booked by the user or has vacant slots.
 - the Complex Manager in the current implementation allows users to book slots at specific times. This represents the final stage in a ground station planning system, covering the weeks or days before the service is required.
- ◆ *Utilisation Manager/Complex Manager Interface*
 - this provides the detailed service management interfaces between the SLE managed objects and is the core of the SLE service.
 - this interface enables the user to define services down to the most detailed levels permissible in the SLE standards, including exact pass times, provision of orbit state vectors and requests for notifications.

This standard interface provides the interoperability between different spacecraft operations organisations.



SLE Service Management Layer (4 of 4)

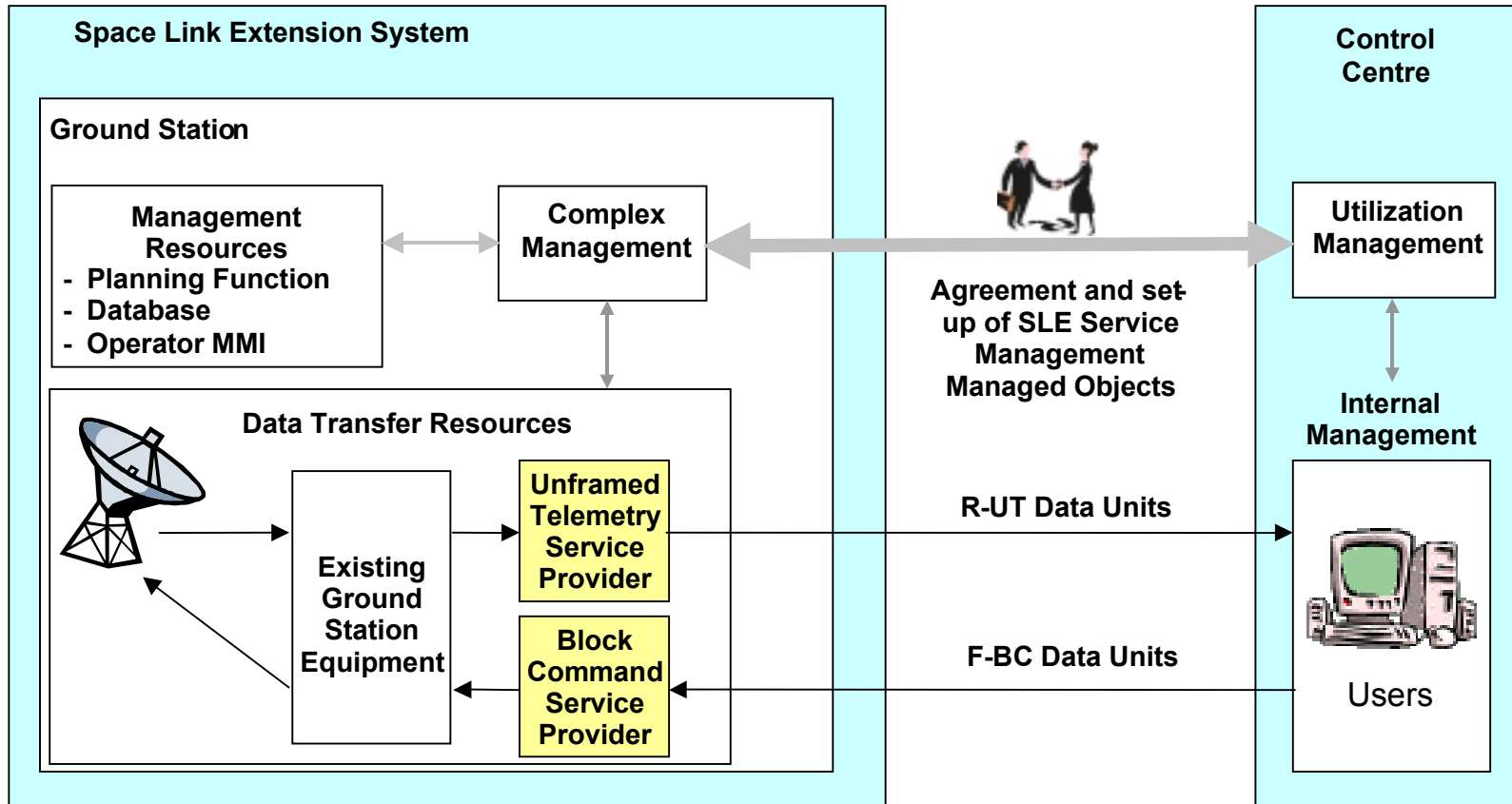
- The information provided by the user is stored in an Oracle 8i database on the provider side for validation and later use by the provider.

The user has no direct access to the provider resources so the provider retains control over how the resources within the ground station are used.

- After the service is set up, the user is able to interrogate the provider database from a standard web browser to check or modify service parameters, or to view notifications issued during the execution of the service.
- Technology used:
 - ◆ GDMO, ASN.1 and UML for defining the SLE managed objects.
 - ◆ Java, to implement the MOs.



How to Adapt SLE for Heritage Protocols (1 of 3)



Service Management and Data Transfer Interfaces



How to Adapt SLE for Heritage Protocols (2 of 3)

- A new “unframed telemetry” service will be needed for the telemetry stream, similar to the R-AF service.
- A new “command block” service, similar to the F-CLTU service, will be required.
- The SLE service management concept is applicable to the service. New managed objects will be required to handle the new services.
- Evolution to standard CCSDS SLE services will be straightforward once an SLE infrastructure is established.

The SLE concept is applicable to heritage systems and provides an evolutionary path to full CCSDS compatibility.



How to Adapt SLE for Heritage Protocols (3 of 3)

Regarding service management ...

- The service management parameters of the R-AF and F-CLTU services have meanings that are particular to these services. They need to be compared with the heritage system to see:
 - ◆ how many parameters map directly from the heritage system to the SLE system, albeit with a change in the name of the parameter;
 - ◆ which parameters in the SLE system do not have an equivalent in the heritage system;
 - ◆ which parameters in the heritage system do not have an equivalent in the SLE system.

- The R-AF and F-CLTU service management could be used with few changes if the SLE parameters are a superset of all the heritage parameters, otherwise a specific R-UT and F-BC service management will need to be developed, based on R-AF and F-CLTU.



SLE Security (1 of 2)

■ Service Management Security

◆ Authentication

- authentication is required to control management access to legitimate users only. The service management specifications currently define a simple user name / password approach.
- VEGA is studying more advanced authentication mechanisms that may be employed in the SLE Service Management, for instance smart cards or biometrics.

◆ Encryption

- during the next few months, we will be looking at a solution for the VEGA Service Management software that encrypts all application level data flowing between the UM and the CM, providing low cost point to point confidentiality of the management data without the need to resort to commercial Virtual Private Networks (VPNs).



SLE Security (2 of 2)

■ Data Transport Security

◆ Authentication

- authentication is required to ensure that only legitimate users can bind to a given service data stream,
- the existing transport APIs provide a basic user name / password authentication.

◆ Encryption

- depending on mission security requirements, encryption is required so that the data is transmitted confidentially across the communication media.
- encryption of the transport would be incorporated into the communications network to be used with COTS products such as Virtual Private Networks (VPNs).



Future Developments

- **Ground Station Planning**

The current implementation assumes a simple ground station planning interface. A standard interface definition (probably in XML) is needed to allow different scheduling systems to communicate with each other.

- **Tracking Services**

Missions also require spacecraft tracking services. Again, a standard interface for the interchange of tracking data is required. This will need to accommodate the existing tracking data formats.

- **Security**

SLE allows for standard security protocols to be used. However, there needs to be agreement on which protocols to use, followed by implementations that support them.



Conclusion

- The first fully-compliant F-CLTU and R-AF services have been implemented in the QinetiQ TT&C Ground Segment, using the latest issues of the CCSDS SLE transfer service and service management specifications.
- A web-based interface will enable users to interact with the QinetiQ ground segment to book F-CLTU and R-AF services.
- The new SLE software is designed such that the bulk of it can be re-used without modifications in other TT&C ground systems, including the entry level “SLE-lite” version.

The full implementation is available on a laptop for demonstration to interested parties.

