APPENDIX 1 TECHNICAL APPENDIX ADDITIONAL

1. Project Management of technical aspects

1a) Management and reporting structure

The Principal Investigators will manage the project in consultation with named staff and academics. Primary direction will be through a management group consisting of the Principal Investigators, Research Fellow and Postgraduate researcher that meets regularly.

An Advisory Board will meet every six months to guide the overall direction of the project and ensure that the project fulfils its objectives. The Advisory Board meetings will be facilitated through the use of the Access Grid. Membership will include:

Professor John Haldon, Professor of Byzantine History, Princeton (Military history)
Dr Lutgarde Vandeput, Director, British Institute in Ankara (Regional specialist)
Dr Warren Eastwood, Geography and Environmental Science, Birmingham (Palaeoenvironment)
Dr Robert Fletcher, White Rose Grid and member of Expert Panel for the Support of Arts and Humanities panel of Experts for Arts, Culture and Humanities e-Science, Trans European Research and Education Networking Association. (E-Science)
Professor Steve Turner, Nanyang Technological University, Singapore. (Simulation and HLA, GRID)
Dr Stuart Dunn Arts and Humanities E-Science Support Centre (E-Science)
Dr Simon Esmonde-Cleary, University of Birmingham (Archaeologist/Military Historian)
Professor Aaron Sloman, Birmingham (Cognitive models and Agent-Based Systems)

There will also be a local technical committee to provide IT support and GRID resources through the University Information Services and will include:

Professor Vincent Gaffney
Dr Georgios Theodoropoulos
Mr Paul Hatton, Birmingham Information Services, leading High Performance Computing and with responsibility for the new Large Cluster and GRID services at the University of Birmingham
Mr Steve Wilkes, HP VISTA, technical support
Mr Simon Thomson, Computer Science, technical support
Project Research Fellow
Postgraduate Researcher
Midlands E-Science Centre representative

Section 1b Project Timetable

Work Package List And Responsibilities
(RF: Research Fellow, PGS: Postgraduate Student)

The project consists of the following work packages (WP) and tasks (T): See also diagrammatic work plan below for interrelationships of work packages, tasks and deliverables.

WP0: PhD student training ***(PGS, with the help of RF)***

WP1: Creation of GRID enabled database
T1.1 Collating and transforming data for use within an HLA framework *(RF, PGS)*
T1.2 Grid enabling data and creation of interface to HLA *(RF)*

WP2: Creation of model environment

T2.1 Develop a basic environmental model *(RF, PGS)*

T2.2 Enriching the environment model *(PGS)*

WP3: Creation of behavioural and cognitive models *(PGS, with help from RF)*

T3.1 Development of an initial agent-based army model

T3.2 Optimal Foraging Theory

T3.3 Cavalry horses and pack mules

T3.4 Exploration of other theoretical approaches to enrich the behavioural models

T3.5 Exploration of cognitive models for complex decision making

WP4: Integration and infrastructure development *(RF, with the help of PGS)*

T4.1 Implementation of the models as HLA federates

T4.2 Integration of the Federates and the data in a single Federation

WP5: The Manzikert Case study and Evaluation

T5.1 Development of the Manzikert case study. *(PGS)*

T5.2 Application of "What if" scenarios *(PGS, RF)*

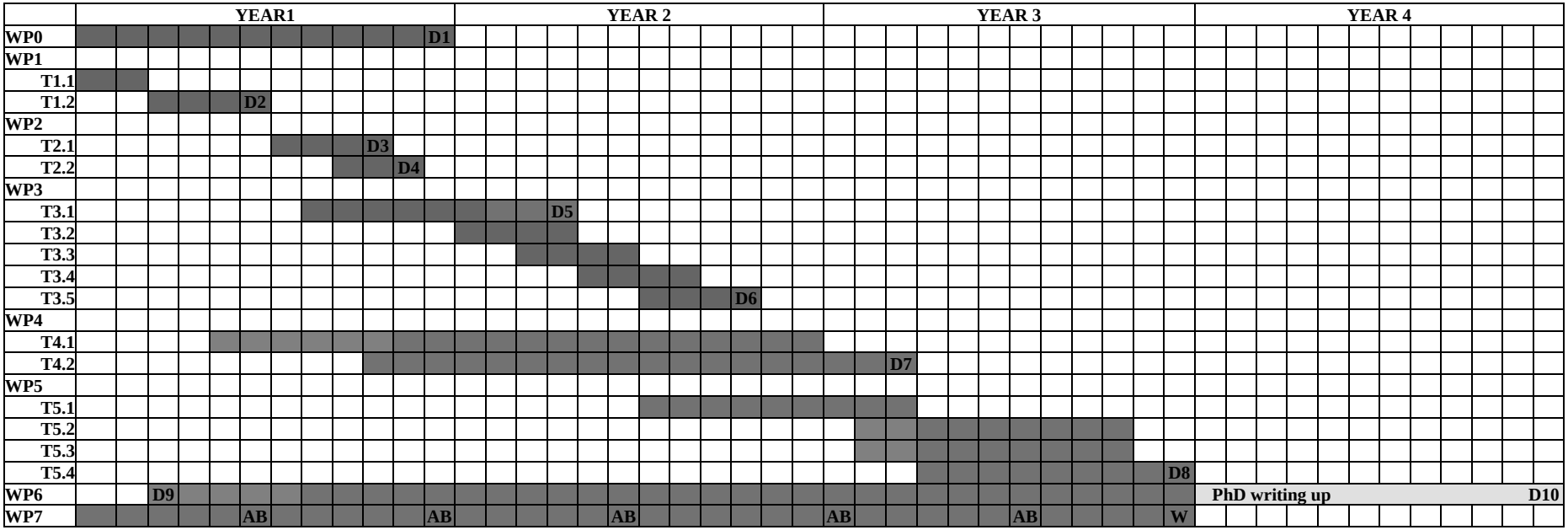
T5.3 Evaluation of "What if" scenarios against primary and secondary sources *(PGS,RF)*

T5.4 Evaluation of system and model against results and revisions *(RF,PGS)*

WP6: Dissemination, reporting and Exploitation *(all)*

WP7: Project management

PROJECT DIAGRAMMATIC PLAN



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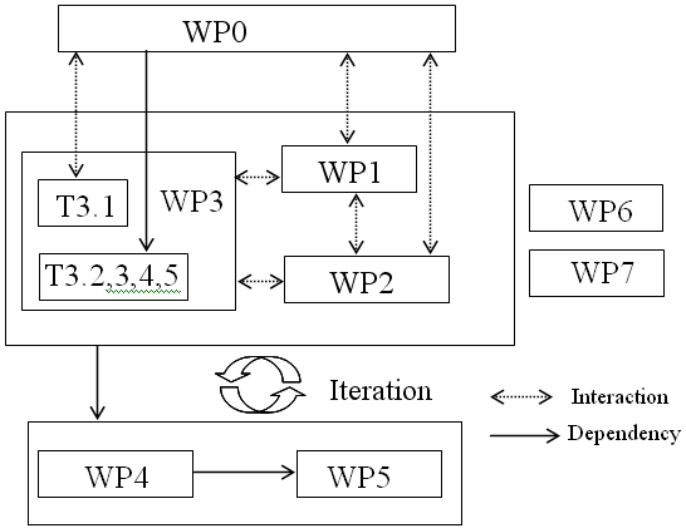
MAJOR DELIVERABLE S

D1 Student training completed
D2 Grid-enabled, HLA-compliant Anatolian datasets
D3 Environment Model
D4 Enriched enviromental models
D5 Basic behavioural model
D6 Enhanced behavioural models
D7 Federated models and Grid-enabled infrastructure
D8 Manzikert Federation and Evaluation report
D9 Project's www site
D10 PhD Thesis

MAJOR ACTIVITIES

AB: Advisory Board meeting
W: Workshop

MAJOR RELATIONS BETWEEN WORKPACKAGES



1c) Project deliverables:

Major Deliverables

D1 Student training completed
D2 Grid-enabled, HLA-compliant Anatolian datasets
D3 Environment Model
D4 Enriched environmental models
D5 Basic behavioural model
D6 Enhanced behavioural models
D7 Federated models and Grid-enabled infrastructure
D8 Manzikert Federation and Evaluation report
D9 Project's www site
D10 PhD Thesis and Report

1d) Monitoring process

Day-to day monitoring will be the responsibility of the PIs, following approved research procedure as directed by the University and respective School Research Committees. Primary monitoring will be undertaken by the Advisory Committee meeting formally every six months to guide the overall direction of the project and ensure that the project fulfils its objectives. The use of the Access Grid will also enable more frequent informal meetings with individuals or the group as appropriate. Specialist guidance will be provided on the following basis:

Regional and Military History Issues

Professor John Haldon, Princeton (Military history)
Dr Lutgarde Vandeput, British Institute in Ankara (Regional specialist)
Dr Simon Esmonde-Cleary, Birmingham (Archaeologist/Military Historian)

Palaeoenvironment and Archaeology Issues

Dr Warren Eastwood, Birmingham (Palaeoenvironment)
Dr Simon Esmonde-Cleary, Birmingham (Archaeologist/Military Historian)

Simulation and Grid Issues

Professor Steve Turner, Nanyang Technological University, Singapore. (Simulation and HLA, GRID)
Professor Aaron Sloman, Birmingham (Cognitive models and Agent-Based Systems)
Dr Robert Fletcher, White Rose Grid. (E-Science)

E-Science Strategy

Dr Robert Fletcher, White Rose Grid. (E-Science)
Dr Stuart Dunn Arts and Humanities E-Science Support Centre (E-Science)

The project will report to the AHRC every 6 months.

2. Data Development Methods

2a) Content selection

The project has full access to the digital environmental and historic databases relating to Anatolia collated by staff at the Universities of Birmingham as part of the work of the Birmingham/Princeton Medieval Logistics Group. these include -

Raster Mapping:

1. Seven multispectral satellite mosaics of Turkey including an NDVI mosaic
2. Derived vegetation map provided following detailed analysis of satellite imagery

3. Geology maps for the region at various resolutions giving full area coverage
4. The *Tabula Imperii Byzantini* historical maps of the early and late Byzantine incorporating detailed topography, contemporary communication routes and itineraries and demographic data
5. Full area coverage Digital Elevation Model (50x50m pixel resolution)
6. Climate zones

Vector Mapping:

1. Vector data has been generally obtained from VMAP level 1 data. VMAP data from National Geospatial Intelligence Agency was initially collected from a 1:250,000 map source and digitised using WGS84 datum. Vector files in Decimal degrees are available over the full project area. This data includes: elevations at 100m contours; coastline, hydrology (rivers, lakes, canals/aqueducts, tributaries and miscellaneous water sources); political data, population, reference or other attribute data (country and state labels); transport detail (road, rail and tracks) and generalised vegetation data (grassland, arable land, wooded land, swamp).
2. The campaign route for Manzikert has been digitised from the Tabula Imperii Byzantini maps together with modern road and population centre layers and a 40m-route buffer has been generated from this.
3. Geology and Vegetation digitized from the above raster maps.

Other Databases

1. Interactive database for calculation of resource requirements of user-selected dispositions of troops in respect of consumables and transport

2b) Data / file formats

- Initial data storage and manipulation is in ARCGIS using standard raster and vector formats.
- Data on military loading and resource requirements exists in a scripted Microsoft Access database.
- Primary development will occur as GRID enabled software components (java-based) and environmental data sets (ASCII)

2c) Documenting the resource:

Primary data documentation will follow ADS guidelines for metadata (http://ads.ahds.ac.uk/project/goodguides/g2gp.html), and specifically those relating to;

- GIS (http://ads.ahds.ac.uk/project/goodguides/gis/) and,
- Satellite imagery (http://ads.ahds.ac.uk/project/goodguides/apandrs/).

There are a number of issues related to HLA-compliant data as these are novel entities for Humanities archive organisations. Particular issues relate to GRID enabled software components that are java-based as these appear to transcend, the interface, as currently defined by the Archaeology data Service, between data and software. Discussion with the ADS has concluded that they will work with the project to investigate the appropriate documentation solution for the project (See also ADS response in section 4 A)

2d) Advice sought on planning your proposed project

This project benefits from the results of more than three years planning. It is supported by the activites of the Birmingham/Princeton Medieval Logistics Study Group and underpinned by the output of two international workshops on regional logistics involving some 40 leading specialists from Britain, the US, France, Italy, Austria, France and Turkey. These have included Byzantine historians, archaeologists, palaeoenvironmentalists, computer scientists, geographers and military logisticians. The PIs has been able to consult widely on the general principles underlying the work and have benefitted from the publicatio of a volume on the subject based on the results of the first logistics workshop at Birmingham, "*General issues in the study of medieval logistics: sources, problems, methodologies*" (Edited by John Haldon, 2005).

The commitment of participating groups including the Tabula Imperii Byzantini is demonstrated in the access given to data and by the support of key institutions including the British Institute in Ankara who are represented on the advisory committee.

Technical advice has been provided through existing acvademic links with the HLA community and particularly through Professor Steve Turner (Nanyang Technological University, Singapore). Dr Rob Fletcher has been actively supporting the development of UKLight connectivity between the White Rose Grid and Birmingham and has provided substantial support for implementing theis project using this larger GRID connectivity. Both Professor Turner and Dr Fletcher have agreed to sit on the advisory committee to assist in these technical issues.

2e) Consultation with projects using similar methods

Locally, the Birmingham team has a strong track record in technical development and collaboration pertinent to this project (simulation and agent-based modelling using the GRID), and will use the experience and external linkage of these projects to the advantage of this application. It should be noted that Professor Steve Turner, Nanyang Technological University), a world leader in HLA-GRID applications is included on the advisory committee to provide further experience and linkage.

Local Projects include:
PDESMAS – Distributed simulation of Agent-Based Systems EPSRC Project Number GR/R45338/01 (with Nottingham University)
AN Integrated Framework for Verification and Distributed Simulation of Asynchronous Hardware EPSRC Project No GR/S11091/01 (with Manchester University)
DS-GRID Large scale Distributed Simulation on the GRID, E-Science Sister Project GR/S82862/01 (with Nanyang Technological University)
AIMSS Adaptive Intelligent Model Building for the Social Sciences using Symbiotic Simulation. ESRC Project No. RES149251053 (with Leeds University and the Manchester National Centre for E-Social Science)

Given the rarity of GRID applications in the Humanities we are not aware that there are truly comparable historical computing projects. However, linkage in historical terms is provided through the Birmingham / Princeton Military Logistics Group:
(http://www.iaa.bham.ac.uk/research/fieldwork_research_themes/projects/logistics1/logistics.htm).

Over the preceding five years this group has expanded into an international network of experts supporting researching in this area and exchanging ideas and data. This includes specialists from Britain, the US, France, Italy, Austria, France and Turkey and incorporates Byzantine historians, archaeologists, palaeoenvironmentalists, computer scientists, geographers and military logisticians. Together this group have collaborated in providing the general methodological context for this study and will continue to give substantial support.

3. Infrastructural Support

3a) Hardware, software and relevant technical expertise available

The project is based within the HP Visual and Spatial Technology Centre (HP VISTA) in the Institute of Archaeology and Antiquity and the Department of Computer Science at the University of Birmingham. These groups, with the University Information Services and the Midlands E-Science Centre, provide an exceptional environment for joint GRID applications and provide.

- 2 full Insors Access Grid Studio Nodes
- Dedicated gigabit cabling to workstations
- Dedicated fibre to NAS residing in University Server farm.

- HP VISTA is the University "point-of-presence" for UKlight enabling high speed, low latency connectivity to external strategic partners for distributed computing. The White Rose Grid will be the primary external development partner through Dr R. Fletcher (see advisory committee)
- 8 TBytes of local NAS storage (expanding to 100Tbytes shared storage during as part of the new University compute cluster)
- MeSC 64 node compute cluster
- From early 2007 the University will have a 1000 node compute cluster for distributed or parallel applications. .
- Fakespace Stereo Powerwall and RoVR for full stereo visualisation
- HP SV7 Scaleable Visualisation System
- HP VISTA supplies standard softwares for primary analysis or display including ARCGIS, AMIRA, MAYA, 3DS MAX, Blueberry terrain editor
- Software components produced, as part of the project will be Java-based, HLA compliant Repast models.

The availability of technical support is provided through the HP VISTA Centre, archaeology division (http://www.iaa.bham.ac.uk/Computing/HP_VISTA/Staff/Staff.htm), a group, led by Professor Gaffney, and with extensive experience in archaeological computing and modelling. Dr Georgios Theodoropoulos' group has considerable expertise in modelling and distributed simulation, Grid and cluster computing whilst he is a founding director of the Midlands e-Science Centre of Excellence. Project technical support will be through a local technical committee including Mr Paul Hatton (Information Services, High Performance Computing and with Large Cluster and GRID services) and with respect to HP VISTA and MeSC services , Mr Steve Wilkes and Mr Simon Thomson.

3b) Additional hardware, software and relevant technical expertise, support and training that is likely to be required and how it will be acquired

No additional software is required for this project. However, the Research Fellow (RF) and Postgraduate Researcher (PR) will require two workstations to manipulate the spatial data sets and derived data layers held by the project.

Specific expertise relating to the maintenance and implementation of Cluster and Grid services resides in the technical PI with the support of Mr Paul Hatton from Information Services at Birmingham and supported by Mr Steve Wilkes and Mr Simon Thomson in relation to HP VISTA and MeSC/Computer Sciences resources specifically.

The RF will be proficient in HLA and GRID computing and will be tasked with transfer of experience and knowledge to the PR. Access to appropriate techncial training courses during the the first year of postgraduate training will depend on the xperience of the succesful candidate but can include GIS and Imaging modules provided through the Geomatics masters at HP VISTA and appropriate software modules (Java and visualisation) identified by the PI within Computer Science.

3c) Describe the backup procedures that your project will use to safeguard your electronic resource during its development

All data and supporting infrastructure will be stored on the HP VISTA NAS, and later the new SRIF3 100Tbyte university storage facility. These services will be provided with a incremental, daily back up service by the University Information Services. All University backups are held in a secure, off site facility. Confirmation of this position was provided at a meeting of the University Infrastructure Specialist Group on the 25/10/06.

4. Data preservation and sustainability

4a) Please detail advice sought on the preservation of the electronic resources(s)

Dr Stuart Jeffrey, User Services Manager at the Archaeology Data Service, confirmed that the ADS would be happy to act as the archive for the data outputs from the simulation project (including grid enabled data). ADS have ensured us that they are willing to investigate the appropriateness and practicalities of archiving HLA simulation modules where they are specific to the archaeological components of the project. Although this is on the understanding that ultimately the ADS may not be the most suitable location for their long-term preservation, the ADS feel that the novel relationship between the project software modules and the data may be so intimate that the best way to archive both for the long term demands further investigation. Such an investigation would also be important to inform future ADS archiving policy with regard to these "new and exciting types of project outputs". Dr Jeffrey has confirmed that a figure of around £7500 would cover both the data archiving and any investigation into archiving other archaeology related outputs.

4b) Please indicate what plans you have to preserve the data and make it available with the AHDS and/or through some alternative mechanism:

These data are novel entities for Humanities archive organisations, particularly in relation to java entities, which appear to transcend the boundaries of software and data as defined by the Archaeology Data service. However, these are clearly important issues in relation to the development of GRID computing in the Arts and Humanities and discussion with the ADS has concluded that they will work with the project to investigate the appropriate solution for this and related projects (See ADS response in section 4 A).

4c) Please indicate what plans you have to ensure that the electronic output will become a sustainable resource

An important output of the project will be dissemination of information on the project, the technologies used and data outputs to the historical and technological communities. Dissemination will be aimed at championing the use of distributed simulation and the reuse of GRID tools in similar projects.

In this context it is important to emphasise that a central tenet of the project is that the primary tools or entities created for use within the project simulations will be HLA-compliant. Compliancy ensures the potential of reuse and therefore sustainability beyond the life of the project. Tools can therefore be made available to the Arts and Humanities communities as data entities and through the ADS (see comments on the intimacy of data and software components in section 4a) but also made available as software tools to the GRID community through the Open Middleware Infrastructure Institute GRID software repository (http://www.omii.ac.uk/).