UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2003

MEng Honours Degree in Information Systems Engineering Part IV
MEng Honours Degrees in Computing Part IV
MSc in Advanced Computing
PhD
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute

PAPER C428=I4.52

GRID COMPUTING

Thursday 15 May 2003, 14:30
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators not required

Section A *(Use a separate answer book for this Section)*

1 Component software technology plays an important role in allowing e-Science applications to be constructed easily but mapped efficiently to complex Grid distributed hardware infrastructures.

a) Define what is meant by a (software) component and discuss the properties of components that allow them to contribute to an effective method for e-Science application construction and mapping.

b) Trace the life cycle of a component in the ICENI system from its creation to eventual deployment as part of an executing e-Science application. Be sure to identify the information provided by the following contributors to the component's design and use and explain how this information is used.

i) End-user

ii) Scientist

iii) Implementor.

c) What is a Performance Model? Explain why the use of performance models is necessary to achieve the efficient mapping of e-Science applications onto Grids. In what way can a performance model that does not accurately predict absolute performance still be useful in a Grid context?

All parts carry equal marks.

2 The development of an open (commercial) market in Grid Services potentially represents the important next step in the development and application of Grid technology.

a) In the OGSA framework explain what capabilities have to be added to a Grid Service (GS) to convert it to a Chargeable Grid Service (CGS).

b) Within a Chargeable Grid Service explain the functionality of the Grid Economic Service Interface (GESI) and the manner in which it interacts with the other elements of the Grid market.

c) What advantages to both owners and users of computational resources could accrue from the development of an open commercial market in Grid Services? Illustrate you answer by discussing the role the following service providers could play in such a market.

i) Software Provider

ii) Brokering Service Provider

iii) Computational Cycles Reseller

All parts carry equal marks.

Section B *(Use a separate answer book for this Section)*

3a Information relating to resources and applications are critical in making effective decision making within Grid Computing.

i) Describe the *architecture* of the information system and *structure* of the information with the Globus Toolkit and Condor as they are used to describe the resources and their user's requirements.

ii) Explain the grid scheduling process of matching user requirements to available resources. Specify some of the information that needs to be provided by the user or their applications to enable optimal mapping of applications to resources.

b In sharing high value compute and data resources, authentication and authorization are two key issues.

i) Describe the architecture of the Gird Security Infrastructure (GSI) used within the Globus toolkit. Consider in your answer the processes that a new user would need to go through, either through their own explicit actions or implicit actions taking place on their behalf, for their job to successfully be run in a Grid built using Globus.

ii) The current GSI has significant scalability issues as the number or resources and users increases. Explain these problems and the solutions being developed within the Grid community to resolve them. In describing the possible solutions include details of the architecture drawing upon two of the following: Community Authorisation Service, Akenti, Virtual Organisation portals, and Group Accounts.

All parts carry equal marks.

4 The Open Grid Services Architecture (OGSA) represents the 'next generation' of Grid infrastructure being leveraged on existing web services.

a) Describe the service orientated architecture used within web services comparing and contrasting it to Globus Toolkit v2.0.

b) Within the Web Services Description Language (WSDL) there are several XML elements relating to the structure of the service interface. Discuss the structure and content of these elements. Detailed description of the XML syntax is **not** required.

c) The OGSA provides stateful transient service management to the web service infrastructure by providing mechanisms to instantiate services and to discover the state of these services. Explain these mechanisms illustrating your answer with an example.

d) OGSA is being proposed as an integrating solution for the management of large distributed computing infrastructures found within research grids and commercial data centers. Discuss the higher brokering services that would need to be implemented to provide 'Autonomic Computing' and any extensions that may be needed to the current OGSA model.

All parts carry equal marks.