



# **Call for Expressions of Interest**

## **JANET QoS Development Project - Phase 2**

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## 1. Introduction

The JANET Quality of Service (QoS) Development Project Phase 2 follows on from Phase 1, which commenced in 2002 and was completed by the end of 2004.

Expressions of interest are sought from JANET connected organisations who would like to work with UKERNA to develop a solution for end-to-end JANET QoS production services.

The project is open to all JANET connected organisations: Higher Education institutions, Further Education (FE) institutions, Local Education Authorities (LEA), schools, Research Councils and Regional Support Centres (RSCs). Organisations that wish to participate should do so in partnership with the Regional Network Operators (RNO) or the Regional Broadband Consortia (RBC) to which they are connected. Organisations such as Regional Networks and RBCs will be selected on the basis of their response to this Call for Expression of Interest and subsequent discussions. Organisations that do not have sufficient networking staff or physical networks in place are advised to participate in partnership with a JANET connected organisation: for example, an FE institution in partnership with an RSC or a school in partnership with an RBC/LEA.

Criteria for participating in the project are detailed in Section 5. Expressions of Interest must be submitted to UKERNA by Monday 18 July 2005 in the format outlined in Section 8.

## 2. Background

QoS (Quality of Service) is a technology that uses various mechanisms to decrease the negative effects of congestion and queues in packet-switched networks. At the same time it preserves the positive aspects of those networks, such as high utilisation and dynamic re-allocation of bandwidth between users. QoS is based on the differentiated processing of a range of different traffic classes during periods of congestion. A QoS-enabled network can transfer users' traffic with different levels of QoS characteristics such as packet delays, delay variation, loss and sustained information rate. Usually it is time-sensitive network applications like VoIP (Voice over IP) or videoconferencing that benefit from QoS, but QoS can also protect regular applications, e.g. web surfing or FTP, from bulky non-urgent traffic such as copying back-ups or transferring experimental data.

An alternative to QoS is an overprovisioned network, i.e. a network where on average only 20-40% of resources (links capacity, processor performance etc.) are used. An overprovisioned network is technically and in terms of maintenance the simplest way to meet the requirements of each traffic class, but it is not a universal solution for all occasions as the costs of permanently keeping all parts of a large network overprovisioned can be significantly high. The closer to the periphery of a large network, the more likely it is to find a congested network, and hence the more desirable is QoS deployment.

QoS is well-standardised, based on two types of models developed by the IETF: Differentiated Services (DiffServ) and Integrated Services (IntServ). The DiffServ model<sup>1</sup> is more scalable and thus more suitable for large IP networks such as JANET. This model was used during Phase 1 of the project to explore QoS services across JANET.

QoS should be provisioned as an end-to-end service because congestion at any router along the traffic path between two end nodes will result in service degradation even if all other routers along the path have the proper QoS configuration. A multi-domain environment makes QoS more difficult to implement as it needs coordination of all the networks involved, each of which is under separate

administrative control. JANET is a multi-domain network and hence requires an appropriate QoS solution.

Prospective QoS models that are likely to be explored and trialled during Phase 2 of the JANET QoS Development Project are described in more detail in the JANET QoS Services Architecture Model document at: <http://www.ja.net/development/qos/qos-services-architecture-models-0506.pdf>. The basics of QoS are described at: <http://www.ja.net/development/qos/overview.html>

### **3. JANET QoS Development Project – Phase 1**

#### **Project initiation**

The JANET QoS Development Project Phase 1 was set up in January 2002 and completed in December 2004. The requirement to investigate QoS was stated in the SuperJANET4 Development Programme<sup>ii</sup> ('to create a roadmap for the development of network QoS'), and the recommendations of the QoS Think Tank,<sup>iii</sup> made up of QoS expertise within the JANET community, which produced a report in July 2001 outlining the potential usefulness of QoS for several popular types of applications. Phase 1 also drew on the experience of other QoS-related academic activities, including the European Commission-funded SEQUIN project, the GÉANT IP Premium and LBE (Less-than-Best Effort) services such as the Internet2 Scavenger service.

#### **Objectives**

Phase 1 had the following objectives:

- to define an open, non-proprietary framework for QoS services that, as far as possible, will not exclude any Regional Network or JANET organisation;
- to assess the efforts required to deploy and manage QoS services on the production multi-domain and multi-vendor network;
- to evaluate the effectiveness of QoS services for the applications used by the JANET community;
- to evaluate the capability of modern routers supporting QoS services.

#### **Participants**

UKERNA initiated Phase 1 of the project by issuing a call for expressions of interest, inviting members of the JANET community to participate. The call was published on the JANET website at the beginning of 2002.

More than ten UK universities, in partnership with the Regional Networks to which their campus networks are connected, expressed an interest in participating. Six universities<sup>iv</sup> confirmed their participation and committed resources to the Project.

#### **QoS Services**

Three types of QoS services were selected for exploration: IP Premium, to serve VoIP and videoconferencing applications; BE (Best Effort) for common Internet applications; and LBE for bulky elastic traffic that is useful for a range of GRID applications which could run on the network during periods of low activity from other applications.

#### **QoS Trial**

The main series of QoS tests on JANET were carried out between March and May 2004, by six universities and their respective Regional Networks,<sup>v</sup> and UKERNA.<sup>vi</sup> The results showed that the IP

Premium service had significant benefits for both VoIP and videoconferencing applications during congestion periods, especially at times of severe congestion. The LBE service also showed positive results, using all the remaining bandwidth left available on the network after IP Premium and BE traffic is processed.

### **Recommendations**

Based on the successful results and experience of running QoS across a selection of multi-vendor domains, the Project partners recommended that work in the QoS area be continued by establishing Phase 2 of the JANET QoS Development Project.

## **4. JANET QoS Development Project – Phase 2**

### **Aim and Objectives**

**The aim** of Phase 2 is to develop a generic multi-domain end-to-end QoS model that can be deployed as a JANET production service. The model should cover the requirements of all main JANET applications such as videoconferencing, VoIP, GRID, e-learning, web surfing, e-mail and others, in terms of required bandwidth and limitations, i.e. packet delays, jitter and loss.

Phase 2 is envisaged to last approximately two years.

**The objectives** of Phase 2 are to:

1. Develop service reservation scenarios (for example, in-advance booking, on-demand booking and static reservations) for a multi-domain environment. These scenarios should be based on the policy rules of inter-domain procedures. The implementation of reservation procedures could be manual or automatic. A Service Level Agreement (SLA) for production QoS services should be developed.
2. Explore and deploy admission control mechanisms and systems, which may be part of automated booking systems.
3. Extend the range of applications which require QoS services, and formulate specific requirements for those applications that have a need for QoS.
4. Extend the range of QoS solutions towards peripheral parts of JANET, including schools and FE institutions. These solutions should reflect the specific features of FE and school networks such as the relatively low speed of their access links, desirable low cost of additional software and hardware, and the need for a 'zero maintenance' solution because of the shortage of networking staff with appropriate experience.
5. Produce administrator and user guides for the JANET community, incorporating best practice experience gained from the project.
6. Develop solutions and procedures for the interaction of QoS mechanisms with customer edge equipment like firewalls, compression devices and Virtual Private Networks gateways.
7. Explore interoperability of QoS with other new technologies that are supported by modern IP networks, such as IP Multicast, IPv6 and others.

8. Deploy a monitoring system that can provide network administrators and end-users with the relevant QoS metrics, allowing them to check how the service conforms against the SLA requirements.

## **Phase 2 Scope**

It is within the scope of Phase 2 to carry out the following tasks:

- Successful development and deployment of a generic QoS model for the JANET multi-domain environment (both for SuperJANET4 and 5).
- Successful resolution of issues to do with the interoperability of QoS with new technologies, such as IP Multicast and IPv6 etc.
- Successful development of multi-domain reservation procedures and tools for booking end-to-end QoS services across JANET.
- Successfully conduct a large-scale trial of end-to-end multi-domain QoS services across JANET including peripheral networks such as school and FE networks.
- Development of guidance documentation outlining the deployment of the proposed generic QoS model for the JANET community.

## **Project Deliverables**

- QoS services specification. The specification will include the IP Premium, Best Effort and Less-than-Best Effort services that were explored during Phase 1 of the project. Other QoS services, e.g. IP Plus, could be included in the specification as a result of the Phase 2 findings.
- Policy for QoS service allocations in a multi-domain environment. This deliverable should describe the principle procedures of network resource allocation for a given QoS service.
- QoS trial results.
- Guidance documentation for QoS production services deployment.

## **Project Team**

An external project team will be established which will consist of a QoS Architecture Group and a number of Working Groups (WG) as shown in Figure 1. The QoS Architecture Group will steer the project and coordinate the activity of the WGs.

Each WG will correspond to a project activity area that will address the project objectives:

- Application Requirements WG: objective 3 (as defined above);
- Policy & Management WG: objectives 1, 2 and 4;
- Technological Interworking issues WG: objectives 4, 6 and 7;
- Monitoring & Measurement WG: objective 8;
- Implementation & Deployment WG: objectives 1, 2, 4 and 5.

It should be emphasised that the number of WGs and their objectives are subject to approval at the first meeting of the Architecture Group and thus could change. Another important consideration is that the lifecycle of a WG might differ from the lifecycle of the project itself. For example it is very likely that the Policy & Management WG will have its job done earlier than others as its outcome will be an input

for the other WGs. At the same time the Implementation & Deployment WG is likely to start later than the others because guides and documents for the JANET community should be based on the trial results. Also, a new WG or WGs may be created at some stage of Phase 2 if circumstances show such need.

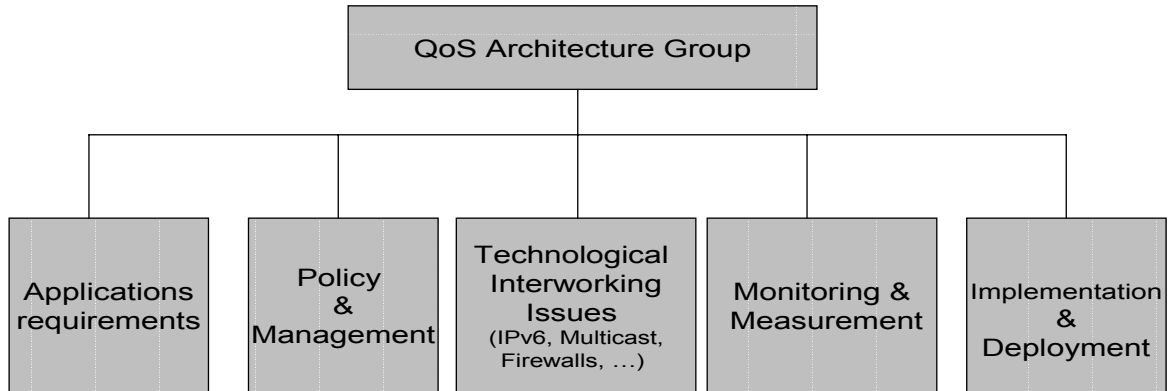


Figure 1. QoS Architecture Group structure.

Each WG will consist of:

- A leader, who will have the relevant experience for that particular WG area.
- Active members, who are expected to contribute a minimum of five man-months during the project's two-year term.
- Supporting members. These can participate in the WG activity, contributing a minimum of one man-month's worth of effort during the project's two-year term.

The QoS Architecture Group is intended to be a steering body for the project. It will consist of the leaders of the WGs, community experts, UKERNA and JANET NOSC.

The funding awarded to the project participants will depend on their level of effort and participation within the QoS Architecture group and/or a Working Group. Funding details can be found in Section 7, 'Funding Available'.

## **5. Criteria for Participation**

### **Joint Participation**

Expressions of interest are welcomed from UK universities, FE institutions and schools who anticipate that QoS can benefit their networks' performance or who would like to enhance their existing QoS service. To have consistent end-to-end QoS services it is essential to have all the networks along the path, i.e. between end users, either QoS-enabled or overprovisioned. To meet this requirement, organisations who participate in the project should do so in cooperation with their network service providers, i.e. their respective RNOs (for universities and FE institutions) or RBC (in England) / or equivalent organisations in other countries of the UK (for schools). This partnership will not only provide end-to-end QoS service but allow the organisation to share its QoS experience with the network service provider.

### **Flexibility**

Organisations can participate in the project in different ways. An organisation can have one or several participants with different roles (WG leader/Architecture Board member, WG active member, WG supporting member), as well as participate in more than one WG. For example (please see Figure 2 for clarification), a university can participate together with its RNO, having in its team a leader of WG1 (who will also automatically be a Member of the QoS Architecture Group, as all WG leaders are members by default) and two supporting members of WG2. At the same the RNO team can also include an active member of WG1. Another example could be a school participating in the project together with its LEA and RBC. The school can have a supporting member in WG3 and the respective LEA and RBC can each also have an active member in WG3.

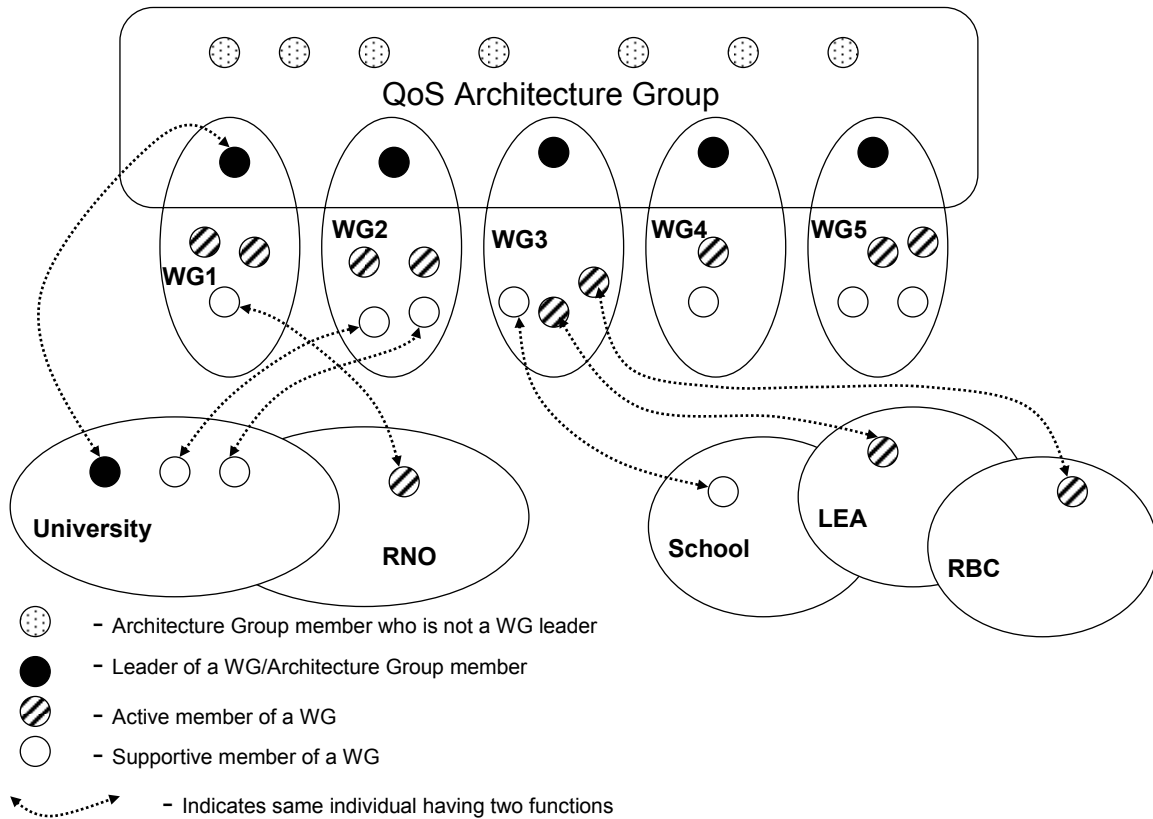


Figure 2. Example of participants.

### Applications as a Driver

Institutions and organisations wishing to participate in the project must currently be supporting at least one application, or be in the process of deploying or developing an application, that requires QoS services other than the existing IP Best Effort. Well-known examples of applications which could benefit from QoS services are:

- Voice over IP (VoIP) and videoconferencing. These are interactive time-sensitive applications which need very low levels of delay and loss.
- Streaming (non-interactive) multimedia applications like web broadcasting. These applications also require low level delay and loss but their requirements are not so strict as for VoIP and videoconferencing. Guaranteed bandwidth is also very desirable for streaming applications – for example, non-real time bulky GRID applications which transfer terabytes of scientific experiments’ results across a network. Such applications could be served by a QoS service which has lower priority than regular best effort IP traffic.

## 6. Project Timescales

High Level Milestones	Scheduled End Date
<b>Stage 1:</b>	
Call for Expression of Interest	22 June 2005
Deadline for response to the Call	18 July 2005
Successful applicants informed	August 2005
Establishing the QoS Architecture group and Working Items	September 2005
Development of the generic QoS model(s)	November 2005
Development of the Booking Authority procedures	December 2005
Development of the monitoring infrastructure	February 2006
Conducting a large-scale QoS pilot across JANET	January-June 2006
<b>Stage 2:</b>	
Development of QoS guidance documentation for the JANET community	November 2006
Produce the recommendations on the deployment of QoS production services	December 2006

## 7. Funding Available

Funding areas are as follows.

1. Funding for effort at each participating organisation will be made according to its level of participation:
  - A. A WG leader/QoS Architecture Group member will be funded £10,000 in total during the whole project term.
  - B. A member of the QoS Architecture Group who is not a WG leader will be funded £2000 in total.
  - C. A WG active member will be funded £5000 in total.
  - D. A WG supporting member will be funded £2000 in total.
2. Minor upgrades to existing network infrastructures in order to deploy QoS services (this will be reviewed by UKERNA on a case by case basis).
3. Implementation of any QoS monitoring tools for sites, Regional Networks, RBCs and the JANET backbone.

## 8. Response to this Call for Expression of Interest

A single response to this call is expected from an educational institution that wishes to participate in this project (university, FE institution or school) together with the organisation that provides its JANET connectivity (RNO for universities and FE institutions; RBC for schools).

For an FE institution, a response should also include a section from its respective RSC who has agreed to be responsible for the organisation's participation in the project.

For a school, a response should also include a section from the respective LEA who has agreed to be responsible for the organisation's participation in the project.

As expressions of interest only require a short response, a maximum of two pages of A4 paper should be sent in the following format:

- A. Participating organisation's details – to include the educational institution itself and all supporting organisations according to the recommendations given above (i.e. RNO, RBC, RSC and/or LEA). A supporting organisation should produce a letter stating its intention to participate in the project together with its respective educational institution.
- B. Statement of reasons for participation in the JANET QoS Development project.
- C. Equipment deployed in the site network and the Regional Network to which the site network is connected, including whether the equipment can support QoS or not.
- D. Details of network applications that require QoS support and the type of QoS support needed, i.e. IP Premium or Less-than-Best Effort.
- E. Readiness of network infrastructures to implement QoS techniques.

For items D and E, the QoS JANET QoS Services Architecture Model<sup>vii</sup> and Phase 1 documents<sup>viii</sup> should be taken into account.

Expressions of interest must be submitted by e-mail to the UKERNA Project Manager, Victor Olifer, by Monday 18 July 2005 (see details below).

## 9. Further Information

Questions and/or clarifications related to this Call for Expressions of Interest should be directed to the UKERNA Project Manager, Victor Olifer. Victor's contact details are as follows:

- E-Mail: V.Olifer@ukerna.ac.uk
- Phone: 01235 822243
- Fax: 01235 822399

Should Victor not be available an alternative contact is Rina Samani, Network Development Manager at UKERNA. Rina's contact details are as follows:

- E-Mail: R.Samani@ukerna.ac.uk
- Phone: 01235 822260

- Fax: 01235 822399

## 10. References

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- <sup>i</sup> Blake, S., Black, D., Carlson, M., Davies, E., Wang, Z. and W. Weiss, "An Architecture for Differentiated Services", December 1998
- <sup>ii</sup> SuperJANET4: Development of Network Support for Applications in Learning, Teaching and Research, <http://www.ja.net/development/programme.pdf>
- <sup>iii</sup> QoS Think Tank, [http://www.ja.net/development/qos/qos\\_tt\\_report.pdf](http://www.ja.net/development/qos/qos_tt_report.pdf)
- <sup>iv</sup> <http://www.ja.net/development/qos/participants.html>
- <sup>v</sup> <http://www.ja.net/development/qos/partners-deliverables>
- <sup>vi</sup> [link to the Test Results]
- <sup>vii</sup> [JANET QoS Services Architecture Model - link to the web-site]
- <sup>viii</sup> <http://www.ja.net/development/qos/documents1.html>