To: orozco,yang,ionescu
From: "Gregor v. Bochmann" <bochmann@site.uottawa.ca>
Subject: Planning the AIAS Lab research orientation and equipment
Cc: georganas
Bcc:
Attached:

As I told you the other day, we had foreseen the creation of the AIAS Laboratory in the SITADEL proposal submitted to Nicolas to the Ontario Challenge Fund during last February. You find at the end of this message the text which we prepared at that time and which gives on overview of the lab's activities. Now Nicolas is preparing the revised documentation for the corresponding CFI proposal which should provide funds for infrastructure (equipment etc.), but not salaries for research personnel.

This lab, and the others planned in the same context, will serve for the research projects of all those professors in SITE (including those to be hired in the near future) who are interested in the particular area supported by the lab. For the AIAS lab, I guess, this will initially include Bochmann, Georganas , Orozco, Yang, and Ionescu, and possibly Dubois (although Eric will also be involved in another lab planned under the NCIT initiative).

In this context, the AIAS lab has an initial allocation for 1 000 000 $ of lab equipment to be bought over two years. Nicolas wants a preliminary proposal before Christmas, and we have to send the final proposal mid of January.

I have started to write up a description of the planned research and a very preliminary list of equipment items (including a very rough estimation of the equiment costs involved). The addition of this preliminary list comes to about $620k. Either I underestimated the costs or we can ask for additional equipment.

Now I would like to ask you to help me to refine (a) the description of the AIAS research, and (b) the selection of equipment for the lab. Please send me your comments immediately by e-mail. I plan to send a revision of the text below to Nicolas on Dec. 24. In particular, is the selected equipment OK, of what do you need more. Do you have any information about the particular version of hardware or software which we should buy, and from whom (we need quotations for mid of January). Are my cost estimates correct ? (please indicate more precise numbers).

As Nicolas says, this is a life-time opportunity. Please let us prepare a proposal which is consistent and well justified in order to have all the chances on our side to win in this game.

Sincerely

Gregor

PS. Please find below the following:
- description of AIAS research thrusts
- description of AIAS equipment
- description of InTech research thrusts (The InTech Lab is one of the labs planned in our NCIT initiative (also spearheaded by Nicolas). It complements AIAS by concentrating more on the problems internal to the network.
- place-holder for the InTech equipment description
- An annex from the SITADEL proposal describing the AIAS lab (dated Febr. 98).

Advanced Internet Applications and Systems Research Laboratory (AIAS)
(in the context of the SITADEL funding proposal to CFI)

People involved : Bochmann, Orozco-Barbosa, Georganas, Yang, Ionescu, Dubois ?

Research thrust :

It is expected that the Internet, in addition to the best-effort service presently available, will in the future provide communication services with specified quality of service (QoS), probably at some additional cost. This means that the user can select the communication quality (and the associated costs) for a given application. Such qualified service will be the basis for the new media-oriented communication services over the Internet, such as

Internet-phone and teleconferencing facilities.

The technologies required for providing qualified communication services over the Internet are studied in the SITE "Internet Technologies Research Laboratory" (InTech). In this laboratory on "Advanced Internet Applications and Systems", we study technologies that facilitate the development of Internet applications that take advantage of these new QoS features of the Internet and other high-speed networks, such as ATM.

The Internet's most rapidly growing service, the World Wide Web, is rapidly becoming an indispensable vehicle for human interaction (messaging, real-time communications) and business transactions (tele-banking, tele-advertising, tele-publishing, electronic commerce, and many others). Of particular importance and growth potential for the economy is Internet's increasing role in electronic commerce and distance training. In addition, traditional communication services, such as telephony and teleconferencing, are also expected to be provided over Internet in the future.

Initially, each research project performed in the AIAS Laboratory will be aimed in one of the following thrusts:

(1) Video transmission over networks with varying QoS: Various coding standards have been defined for transmission of video over networks, such as MPEG-1, MPEG-2, MPEG-5. However, it is presently not well understood what coding parameters and transmission protocols (e.g. RTP and RTCP) are best suited to obtain a given subjective video quality for the user when the available network transmission quality is limited or varying in time. Time varying transmission quality may either be due to network congestion or, in the case of mobile communication, to a changing network access channel.

(2) Audio transmission over networks with varying QoS: Similarly, this research thrust deals with the question of providing audio transmission a given subjective audio quality when the network transmission quality is limited or varying in time.

(3) QoS management at the application level for teleconferencing applications with large number of users: In this context, we consider the use of a multi-casting network service, such as provided by Mbone or some other future facility. Present teleconferencing systems assume that all users will obtain the same end-to-end QoS. However, this may sometimes not be feasible or not be desirable (since different users may desire different qualities - and costs). The QoS management in this context involves the issues investigated under Thrusts (1) and (2), the management of network resources, bridges, and user end-systems, as wll as general systems management issues and economic models.

(4) Management issues for electronic commerce applications: In the context of Internet shopping, possibly through a virtual mall, there are a variety of issues related to the application management, such as management of server performance, multimedia presentations over the network for certain types of catalogues, security issues and issues related to the quality of the information provided. We are presently working on server performance management for very large user populations. Other issues are expected to be studies as new researchers will join us in the future.

(5) Integrating the management of heterogeneous networks and applications: Various standards have been developed for the management of heterogeneous networks and applications systems, such as SNMP and CMIS, and different platforms (so-called middleware) for programming distributed object systems, such as CORBA or COM, can be used in this context, possibly in conjunction with certain protocols for distributed transaction processing, such as TIP. The future applications running over the Internet will involve, in many cases, heterogeneous networks and end-systems. Their management will therefore also require some standard communication protocols and application programming interfaces (APIs) provided suitable middleware platforms. The applications considered under the above thrusts require in many cases the joint management of network and end-system resources. The aim of this thrust is to provide some uniform management framework for such type of applications.

Equipment required: (note: all prices are rough estimates, to be refined …)

Stable networking infrastructure: Three separate LANs (100 Mbits Ethernet), interconnected through a high-speed IP switch and also connected to the Internet through the SITE Internet switch.

Ethernet hubs [3 x $500 ?? =]
Cisco switch ?? with 6 interface cards [1 x $ 20 000 ??]

Experimental networking infrastructure (for doing experiments concerned with network management and QoS): Three additional LANs, three IP switches for experimenting with a lattice network, an ATM switch for experimenting with native ATM communication. A network and protocol analyzer for monitoring network and application performance.
Ethernet hubs [3 x $500 ?? =]
Cisco switch ?? with 4 interface cards [3 x $ 20 000 ??]
Newbridge ATM switch ?? with 4 native OC3 ?? , two IP over ATM and 4 native ?? (lower speed ?) interfaces [1 x $ 30 000 ??]
ATM interface cards for computers [2 x for SUN, 4 x PC Windows NT ??? : $6 000 ?]
?? network analyzer [1 x $ 120 000]
High-speed access to Canarie-III (using one of the above switches)

In addition, the experimental networking infrastructure of the InTech Lab may be used for experiments with applications over various networks with various QoS availabilities.

Server computers:
Powerful SUN workstations (under Solaris) [3 x $20 000 = 60 000]
PC servers (under Windows NT)) [5 x $4 000 = 20 000]

Client workstations:
PC workstations under Windows NT [10 x $3 000 = 30 000]
PC workstations under Linux [5 x $3 000 = 15 000]
Specialized cards for video I/O [which ones ?? how many ?? price??]

Basic software: operating system, productivity software (e.g. MS Office, etc.), compilers and development environments for C, C++, Java
[for above machines: 25 x $1 000 = 25 000]

Specialized software: Orbix (Iona) OTM 20$US
4 DB
5 Security
CORBA development licenses from *** [3 x $20 000 = 60 000]
CORBA execution licenses from *** [5 x $2 000 = 10 000]
Environment for developing CMIS management applications [1 x $50 000 = 50 000]
Software for traffic generation
Software for network performance monitoring and management ???
Audio and video encoding and decoding software for various coding schemes ???
Teleconferencing software [$20 000]
ObjectStore database software: SUN server license, several client licences (1 SUN, 3 Windows) [$8 000]
DB2 database software: server license for 4 parallel servers (Windows NT) [research license, $2 000 ??]

Obj. Store 60k

CMIP from SUN 1800

Summary:
Networking hardware: 120k
Network and protocol analyzer: 120k
Computer hardware: 125k
Software licenses: 180k
Total: 620k

CMIP Netman sys. Grenoble
dev. system from
50KUS

Internet Technologies Research Laboratory (InTech)
(in the context of the NCIT?? funding proposal)

People involved: Bochmann, Orozco-Barbosa, Yang , Georganas, ??

Research thrust:

ObjectTime licences 15.5$US

It is expected that the Internet, in addition to the best-effort service presently available, will in the future provide communication services with specified quality of service (QoS), probably at some additional cost. This means that the user can select the communication quality (and the associated costs) for a given application. Such qualified service will be the basis for many new media-oriented communication services over the Internet, such as Internet-phone and teleconferencing facilities.

The research challenges involved in the development of these new applications, are studied in the SITE "Advanced Internet Applications and Systems" (AIAS) Laboratory. In this laboratory on "Internet Technologies" we study the questions related to the development of network technologies which are able to provide Internet communication services, including services with a given QoS.

In the Internet community, there are presently several approaches that are being discussed for the provisioning of QoS: (a) Integrated Services, including the reservation of resources for logical connections or IP streams, possibly using the RSVP protocol, (b) Differentiated Services which does not include per-connection QoS management, but has better scaling properties, and (c) the recent Multi-Protocol Label Switching (MPLS). Different transmission and switching technologies are considered, such as (a) fast IP switching, (b) ATM networks, (c) IP over ATM, (d) IP over SONET and (e) IP over wave-division multiplexing (WDM), to mention only a few. It is clear that there are a large number of technical possibilities.

Another issue is the question what kind of quality-oriented communication service can economically be provided. The present Internet charges are per network access and depend on the maximum throughput and number of hours of usage. Other charging schemes are conceivable, such as private virtual networks (possibly involving IP over FrameRelay), or charging per information flow. Also the possible transition to the new IPv6 protocol is of relevance here.

The research issues are also related to the internal protocols used within the network for routing and congestion control, and to network access control mechanisms which may restrict the access to the network in case of decreasing QoS.

*** to be elaborated ***

Equipment required:

*** Similar to AIAS Lab. Less computers and software, more networking.

Appendix (from the SITADEL OCF application, Febr. 1998)

SITADEL: School of Information Technology ADvanced Engineering Research Laboratories

Detailed Description

Objective

This proposal focuses upon a request for matching funds in support of the creation of SITADEL, the School of Information Technology ADvanced Engineering Research Laboratories. This facility will be home to the following new research laboratories, led by professors of international stature which are already actively involved in industrially relevant research but are hampered in their efforts due to a lack of research space:

- Nortel Advanced Software Research & Training Laboratory
- Bell Canada Advanced Research Laboratory
- Distributed Collaborative Virtual Environments Research Laboratory (DISCOVER)
- Advanced Internet Applications and Systems Research Laboratory (AIAS)

Background and Rationale

The University of Ottawa has created in 1997 the new School of Information Technology and Engineering (SITE), with a unique in Canada merging of the former Departments of Electrical and Computer Engineering, and Computer Science. Science has currently approximately 45 professors and 1000 undergraduate students.

SITE's first initiatives include: i) the first approved BASc program in Software Engineering in Canada; ii) the O-Vitesse 16 month programme in conjunction with Carleton University and Mitel, Nortel, Newbridge, SHL Systemhouse, and Cognos, which retrains engineers and scientists in IT and software technologies; iii) professional update courses offered by SITE professors on industry location, for example, Software Quality Engineering and RF Engineering; iv) the ConGESE Master's program in collaboration with five other universities in Ontario which leads to a Master's degree with specialization in Software Engineering; v)

the new 5-year Computing Technology program, which enables engineers in non-IT programs to upgrade their qualifications in the IT area and earn two degrees in five years; vi) the Certificate program in Software Technology with the co-operation of the Faculty of Administration, which provides education in software engineering, systems management, and small business entrepreneurship; vii) the Informatics Institute which retrains employees in the civil service in concepts and methods of Software Engineering; viii) joint Graduate programs with Carleton University in Communications Engineering, Computer Engineering, Computer Science, and Electrical Engineering in which students are encouraged to take courses from both universities.

SITADEL will be a key resource to support the above programs and to particularly support the delivery of software engineering (SE) knowledge via tutorials and experience with industrial-strength SE tools in the domain of Communications, Internetworking, and Real-Time Systems. In these domains, systems are so large and complex that traditional means of teaching are not adequate for imparting to students a realistic experience.

There are several SITE professors who are internationally recognized as leaders in Telecommunications Protocols and Software Engineering. These include Professors Bochmann , Georganas, Ionescu, Logrippo, Petriu, Probert, Ural, and others. The research of these professors is supported by CITO (Communications and Information Technology Ontario), CITR, NSERC, NRC, Nortel, Mitel, Newbridge, and many other organizations to the level of millions of dollars per year. These professors supervise the work of over sixty graduate students and researchers. They will lead the development of the new SITADEL.

SITADEL Plan

SITADEL will be housed in a 40,000 sq.ft new building, together with offices of 20 new SITE professors to be hired within the next three years, and graduate student offices. The University of Ottawa has just approved $3.2 million over three years towards construction of SITADEL and hiring of 20 new professors in SITE.

The following describes the major research laboratories in SITADEL:

Nortel Advanced Software Research & Training Laboratory

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Bell Advanced Research Laboratory-Ottawa (BARLO)

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Distributed Collaborative Virtual Environments Research Laboratory (DISCOVER)

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Advanced Internet Applications and Systems Research Laboratory (AIAS)

Internet, and particularly its most rapidly growing service, the World Wide Web, is rapidly becoming an indispensable vehicle for human interaction (messaging, real-time communications) and business transactions (tele-banking, tele-advertising, tele-publishing, electronic commerce, and many others). Of particular importance and growth potential for the economy is Internet's increasing role in electronic commerce and distance training.

Electronic commerce, in its most general definition, refers to selling and buying on the net. In this context, it is not an entirely new activity; its genesis is traced back to the Electronic Data Interchange (EDI) activity in the 1960's. EDI refers to the set of activities that are related to the electronic facilitation of the transactions between vendors (merchants) and buyers (customers) (purchase orders, waybills, manifests and schedules). The current context of EC, sometimes referred to as "Internet commerce" due to its dependence on the Internet as the underlying platform, is significantly wider. Electronic commerce activities will involve a range of end-user equipment (from low-end PCs to powerful workstations) that is connected to a range of access network technologies (from wireless link to high-speed attachment).
Distance training- and education-on-demand have been considered by many people, the most influential one being the Chairman of the Oracle Co, as applications of much higher economic potential than video(movies)-on-demand. Corporations spend a very large amount yearly for training their people and provision of such service by Internet means is highly interesting

for them.
A very fast network infrastructure (vSBN, Internet2) is rapidly changing Internet's performance to that of dedicated communications services. In Canada, CA*net II will be the equivalent of Internet2 and will provide very fast networking and application development and testing.
AIAS will initially focus its activities in the above two application areas, initially funded by Federal Centres of Excellence and industry.
The Canadian Institute for Telecommunications Research (CITR) is funding two University of Ottawa projects (Profs Bochmann and Georganas) in research oriented towards Electronic Commerce. The first project has also support from IBM Canada and the second from Mitel.
Research on Distance Training and TeleLearning is currently funded by Newbridge and the TeleLearning-NCE (Prof. Georganas).

Research on the characterization of Internet traffic is funded by Nortel. and CANARIE (Prof. Georganas).