Early Experiences with Resource Reservation

Norsk Regnesentral
ANVENDT DATAFORSKNING
Norwegian Computing Center/Applied Research and Development

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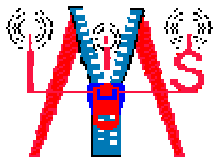

IMiS Kernel

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Sammendrag/Abstract:

As part of the IMiS Kernel project, an experiment was set up to gain valuable QoS experience. The goal of the experiment was to evaluate networked QoS support, and demonstrate the effect of resource reservation in a congested network. This note describes the experiences and results.

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Early Experiences with Resource Reservation

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January 26, 1999

Table of Contents

1 Background

As part of the IMiS Kernel project [1], an experiment was set up to gain valuable QoS experience. The goal of the experiment was to evaluate networked QoS support, and demonstrate the effect of resource reservation in a congested network. This note describes the experiences and results.

The idea of the experiment was to configure a network system with at least one host on either side of one or two routers, use a traffic generator, Mgen [2], to generate different combinations of 1 Mbps reserved and unreserved UDP flows between the end hosts until network congestion occured, and measure the effect (throughput) on the reserved flow(s).

2 Different network infrastructure attempts

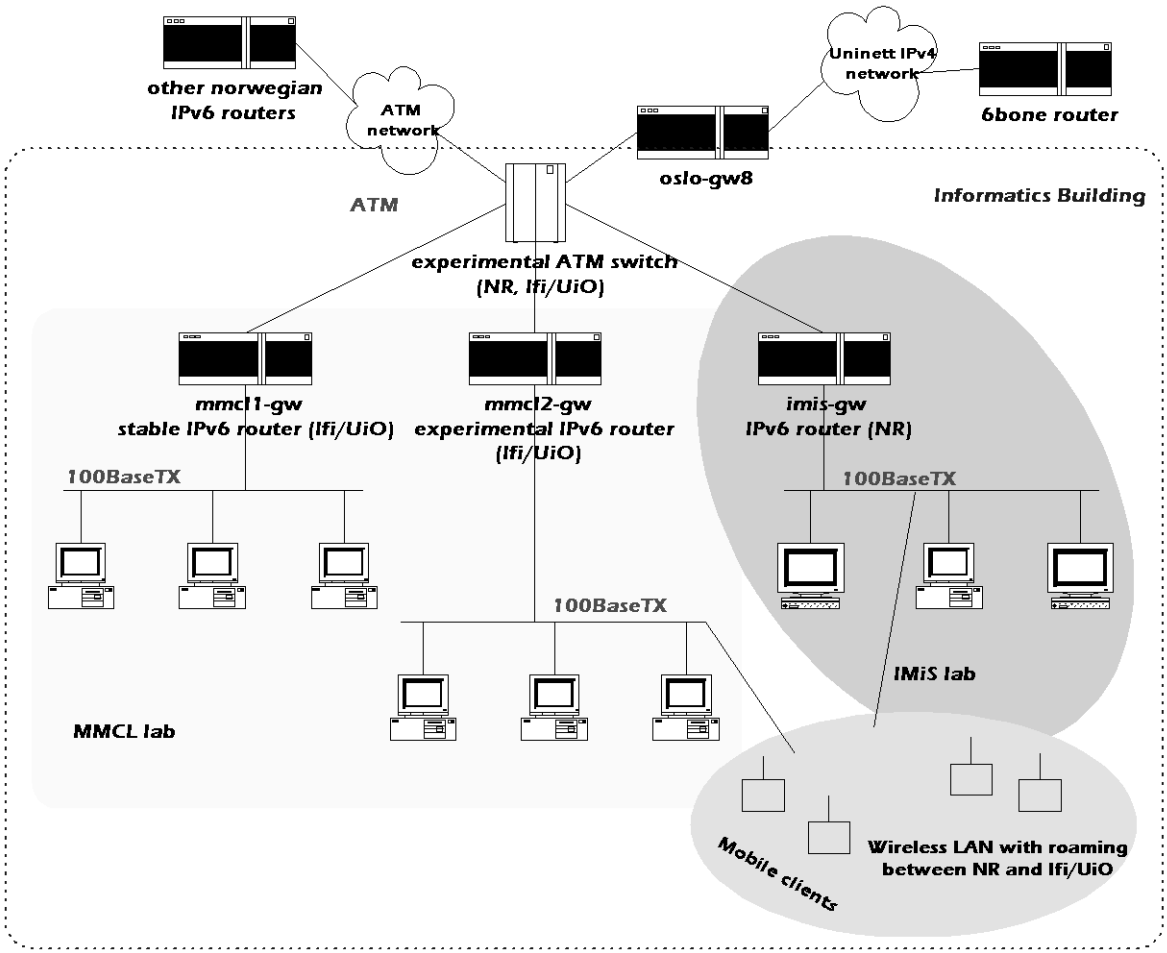

Figure 1 Original network infrastructure

The original intention was to use the IMiS/MMCL [3] network infrastructure in Figure 1. However, as it was discovered that there was no current support for the ATM interface card (PA-A2) in the IPv6 software (experimental IOS) for the Cisco 7206 router, this was not possible. Instead, it was decided to add an advanced temporary router, and use the intermediate 100BaseTX Ethernet network infrastructure at NR and Ifi/UiO in Figure 2 for the experiment.

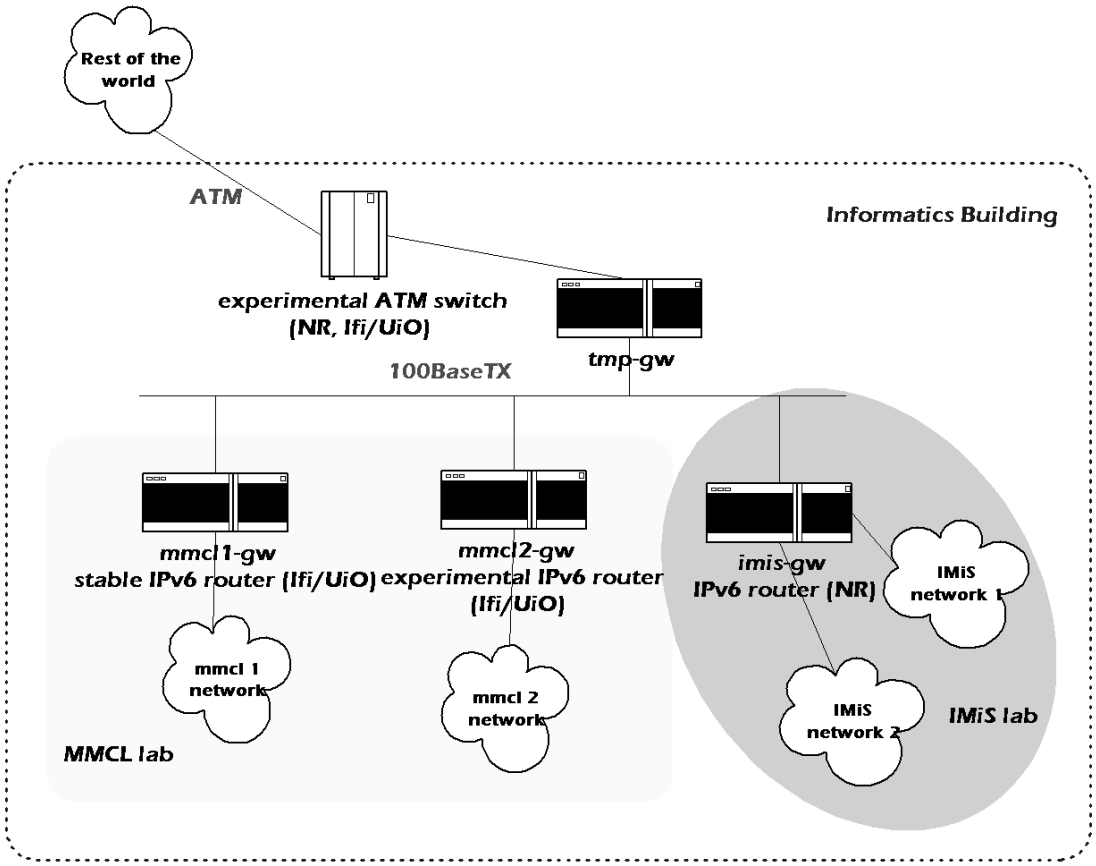

Figure 2 Intermediate network infrastructure with temporary router network

RSVP (ReSerVation Protocol) [4] was chosen as the QoS signalling protocol. However, new problems were discovered when trying to deploy RSVP in the IMiS network nodes. Most importantly, the IPv6 router software had no support for RSVP signalling either (even though the commands were legal!). Additionally, it was strongly recommended that the RSVP host daemon (SolarisRSVP.0.5.0 [5]) on Solaris 2.5 should have all OS patches installed, which conflicted with the non-patched OS requirements in the IPv6 software (SUNWipv6 package). Installing the IPv6 software on a patched kernel was never really tested, though. There were no problems installing the RSVP host daemon (ISI rel4.2a4 [6]) on FreeBSD 2.2.5 with IPv6 support (INRIA). A description of all the IMiS network nodes is in Table A.

Name	Operating System	Hardware Type	IPv4 Address
varda	SunOS 5.5	Sun Sparc Ultra	128.39.11.130
tulkas	FreeBSD 2.2.5	PC, i486	128.39.11.131
ulmo	Windows NT 4.0	PC, i486	128.39.11.132
manve	SunOS 5.5	Sun Sparc Classic	128.39.11.146
nienna	FreeBSD 2.2.5	PC, i586	128.39.11.147
imis-gw	IOS 11.3/ experimental IOS	Cisco 7206	FE0/0: 128.39.11.129 FE3/0: 128.39.11.145 FE4/0: 128.39.11.220

Table A: Description of the nodes in the IMiS network

In order to do any resource reservation experimenting at all, it was decided to re-install the IPv4 router software with RSVP support (IOS 11.3) in the IMiS network, and perform the experiment on the IPv4-only network infrastructure in Figure 3.

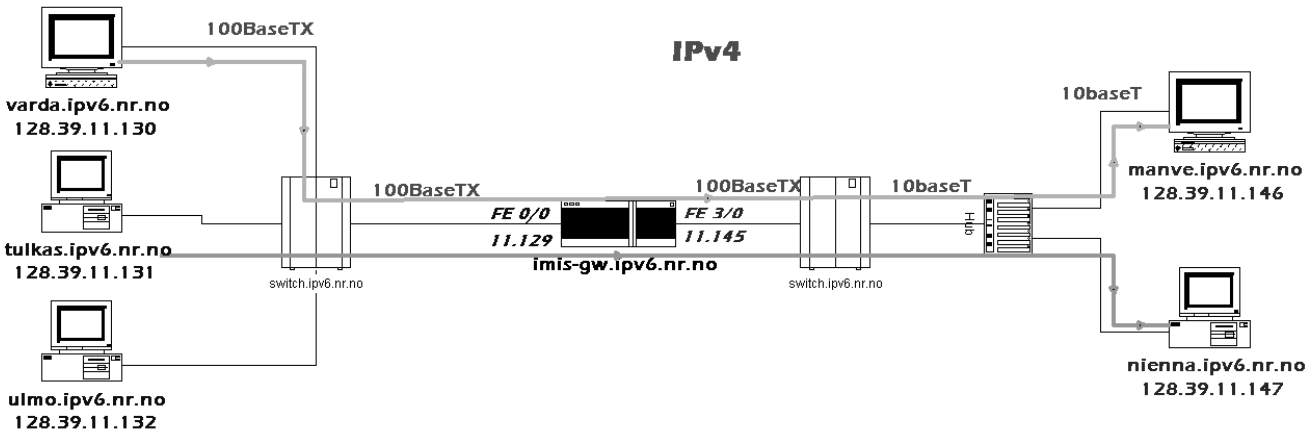

Figure 3 The IMiS network for testing QoS with RSVP.

In this system configuration RSVP signalling (PATH and RESV messages) between hosts and router was successful, and RSVP state was properly maintained on the router. However, because of the configuration, limiting the downstream traffic in the router was impossible, as during congestion packets were naturally dropped in the switch, and not in the router. A possible solution would have been to replace the downstream 100BaseTX Ethernet card with a 10BaseT Ethernet card, but this was unavailable for the project.

Instead, it was decided to insert another router (Cisco 2503) in the network, and limit the traffic by solely using the asynchronous serial line (with maximum throughput 39 kbps) for communication between the two routers. The resulting network infrastructure is in Figure 4.

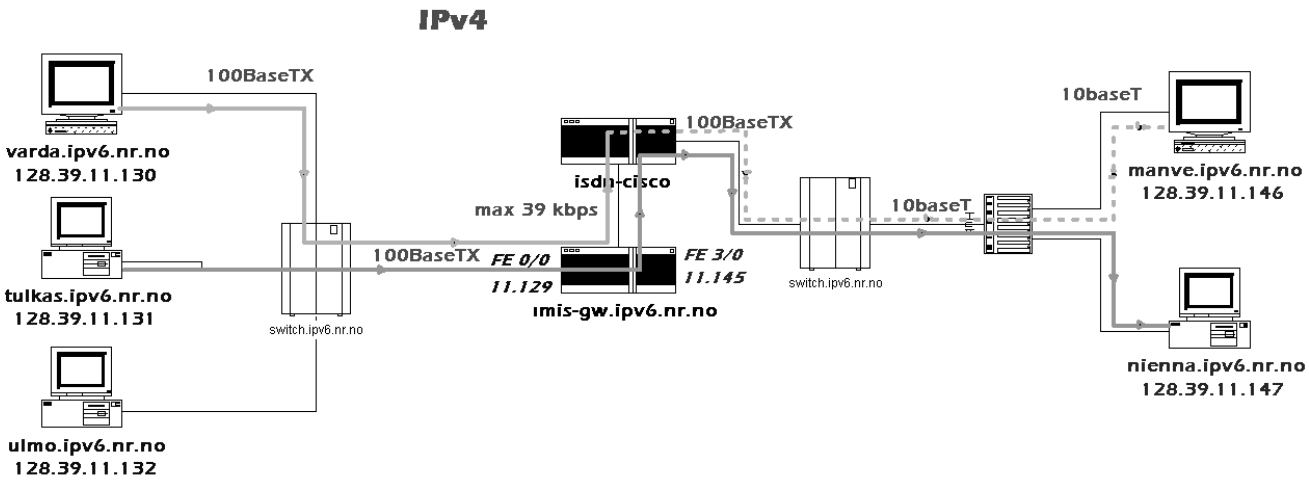

Figure 4 The IMiS network with two routers to limit the traffic.

Again, in this system configuration RSVP signalling was successful, and RSVP state properly maintained. However, because there was no RSVP support in the new router, the end-to-end QoS principle did not apply, as only downstream (one-way) traffic reservation was possible. Also, the slow serial line meant that one of the Solaris hosts (manve) would time out during booting, and fail to restart properly. Additionally, a similar RSVP experiment using a serial line had already been completed in Norway [7], therefore this IMiS Kernel experiment should preferably focus on something different, like using ATM as the core technology.

Although none of the above objections would prevent experiment accomplishment, it was decided to change the network infrastructure once more. Now that the IMiS network was IPv4-only, support for the ATM interface card in the router existed, and the originally intended IMiS/MMCL network infrastructure over ATM was again possible. Thus, IPv4 router software with RSVP support (IOS 11.3) was re-installed in the MMCL network, too. A 2 Mbps permanent virtual connection (PVC) was established between NR and Ifi/UiO, and the RSVP host daemon (ISI rel4.2a4) was installed on FreeBSD 2.2.6 at Ifi/UiO. The resulting infrastructure is in Figure 5, while a description of the MMCL2 network nodes is in Table B.

Name	Operating System	Hardware Type	IPv4 Address
fixus	FreeBSD 2.2.6	PC, i586	128.39.11.67
mmcl2-gw	IOS 11.3/ experimental IOS	Cisco 7206	FE0/0: 128.39.11.219 FE4/0: 128.39.11.65

Table B:Description of the nodes in the MMCL 2 network

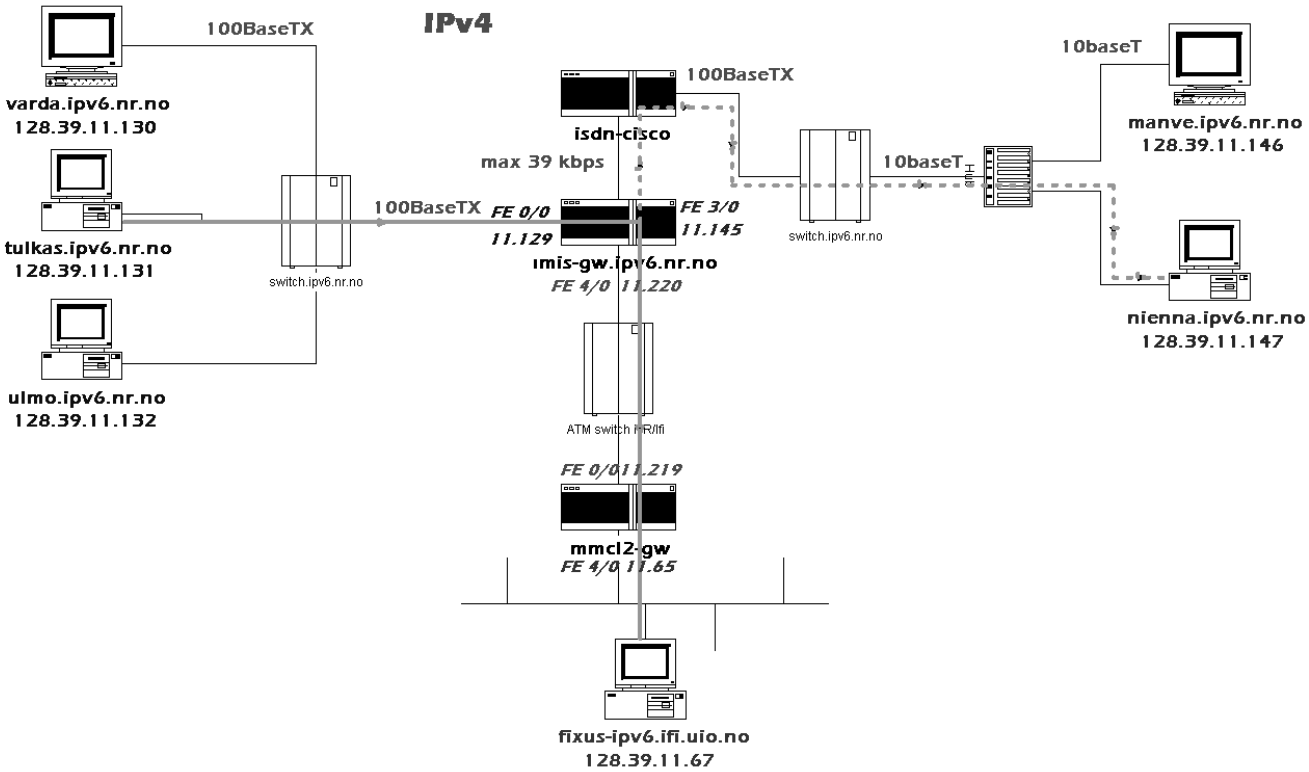

Figure 5 Test network infrastructure including both the IMiS and MMCL networks.

After increasing the hold queue to 200 packets on each ATM interface, also in this system configuration RSVP signalling between hosts and routers was successful, and RSVP state properly maintained in both routers. However, as it was discovered that there was no traffic control support (e.g. Weighted Fair Queuing) for the ATM interface card in the router software, no admission control and packet differentiation could be performed. This meant that the effect of resource reservation could not be demonstrated, as more than just RSVP signalling is necessary for QoS guarantees to be made in the network, which is illustrated in the throughput measurements in Figure 6.

A	Flow Size (appr in Mbps)	Reservation	Throughput (in Kbps)
Flow 1	1	No	583
Flow 2	1	No	581
Flow 3	1	No	596

Table C: Throughput measurements with no reservations on any flows (packet size 14oo bytes, duration 120 seconds)

B	Flow Size (appr. in Mbps)	Reservation	Throughput (in Kbps)
Flow 1	1	No	588
Flow 2	1	Yes	583
Flow 3	1	No	588

Table D: Throughput measurements with rsvp reservation on flow 2 (packet size 1400 bytes, duration 120 seconds)

Figure 6 Measurements indicate no difference in the throughput distribution between the unreserved flows in Table C, and the flows (one of three reserved) in Table D.

Now, the intermediate 100BaseTX Ethernet network infrastructure is again the present configuration, with IPv6 router software re-installed, but without RSVP and ATM support in the routers, as shown in Figure 3 with IPv6 instead of IPv4.

The problem with the current network infrastructure:

- incompatible software (IPv6) and hardware (ATM) on the routers
- no support for simultaneous use of IPv6 and RSVP in routers and on some hosts
- too large datalinks (100BaseTX Ethernet) for network congestion to occur

3 Discussion

The goal of the the experiment was to evaluate networked QoS support, and demonstrate the effect of resource reservation in a congested network. Although, no successful resource reservation has been completed, valuable insight in QoS configuration has been gained, and correct RSVP signalling and state maintenance achieved. Some misassumptions have been made in the process, but many lessons about network system configuration and RSVP have also been learnt.

In hindsight, the choice of a relatively inexpensive router (Cisco 7206) has proved to be a bad one. If a more advanced product from the Cisco 7000 router family had been chosen, many of the incompatibility problems would probably have been avoided.

A short technological conclusion based on the current network infrastructure:

- IPv6+ATM = incompatible (the IPv6 router software (experimental IOS) does not support the ATM interface card (PA-A2))
- IPv6+RSVP = incompatible (the IPv6 router software (experimental IPS) does not support RSVP, and IPv6 and RSVP host software on Solaris 2.5 require different patched kernels)
- IPv4+ATM = compatible
- IPv4+RSVP = compatible
- ATM+RSVP = incompatible (the IPv4 router software (IOS 11.3) does not support traffic control for the ATM interface card (PA-A2))

In short, the technology platform in the IMiS/MMCL network is not yet mature for next generation QoS support, when that includes both IPv6, RSVP and ATM.

4 References

[1] Infrastructure for Multimedia applications in Seamless networks (IMiS Kernel), Norwegian Computing Center, `http://www.nr.no/imis/imis-k/`

[2] The “Multi-Generator” (MGEN) tool, `http://manimac.itd.nrl.navy.mil/MGEN/`

[3] Multimedia Communication Laboratory (MMCL), Department of Informatics at University of Oslo, `http://www.ifi.uio.no/~mmcl/`

[4] Braden, R. et al., Resource ReSerVation Protocol (RSVP) - Version 1 Functional Specification (RFC 2205), September 1997, `http://info.internet.isi.edu:80/in-notes/rfc/files/rfc2205.txt`

[5] Downloading site for the Solaris RSVP daemon, `ftp://playground.sun.com/pub/rsvp/`

[6] Downloading site for the ISI RSVP daemon, `ftp://ftp.isi.edu/rsvp/release/`

[7] The project “RSVP Technology for UNINETT Multimedia Services” at Molde College, `http://www.himolde.no/~kd/rsvp/` (A project report is available at `http://www.himolde.no/~kd/rsvp/pilot/rmain/rmain.html`)