

# INF5090/9090

## State Exchange in Distributed Applications

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**Abstract**—This assignment is part of the TRAMP Real-time Application Mobility Platform (TRAMP) project with focus on distributed multimedia applications with real-time requirements. The goal of the assignment is to design and implement at least two components (producer and consumer) of a real-time application (such as a media player) and evaluate the provided distribution framework with respect to delay, throughput and other relevant metrics. Above is an overview of the provided framework. Your objective is to design and implement the producer and consumer application parts (the two gray components). The producer/consumer duo can run locally on one machine or be distributed over a network. In addition, multiple consumers can subscribe to the same produced data and receive identical copies.

### I. INTRODUCTION

In our assignment we were to use the Real-time Application Mobility Platform (TRAMP). This is a project developed by the Distributed Multimedia Systems (DMMS) group at the University of Oslo.

This is a assignment given to us in the course INF5090 - Advanced Topics in Distributed Systems which is a course given by the University of Oslo, as well as Lancaster University in England and University of Mannheim in Germany. The teachers are Thomas Plagemann and Vera Goebel with their teaching assistants Piotr Kaminski and Hans Vatne Hansen. These are also the people that developed the TRAMP framework together with some other developers all from the University of Oslo.

The TRAMP project was started in early 2010, the goal of the framework is to “make a migration system for real-time applications, such as Spotify

and Skype, where users can take applications with them when they move.” [2]

Lets say you sit on your computer talking to a friend on skype. You need to go, but you got more to say to him/her. TRAMP will let you stream the conversation to your phone seamlessly and when you get to work, you can then transfer the conversation to your work computer.

### II. RELATED WORK

#### A. Skype

As we’ve mentioned earlier in the report Skype is one of the applications the developers of the TRAMP framework reference to. Skype was the first peer-to-peer voice over IP (VoIP) network, and requires minimal infrastructure in order to function. Skype came on market in late 2003 developed by Niklas Zennström and Janus Friis, the two main developer behind the filesharing system Kazaa. this was bought by eBay in late 2005 and again by Microsoft in May 2011. Since Skype is propriatory, the code is not available and this is therefore based on observations and partial reverse engineering of the protocol.

The skype architecture is designed around three entities: Supernodes, regular nodes and the login server (See Figure 1). Each regular node has a cache of the IP address and portnumber to all reachable Supernodes. The Supernodes are a subset of the regular nodes. If a node has high uptime, good bandwidth and is not restricted by firewalls or Network Address translation (NAT) it can be chosen as a Supernode[5]. This will ofcourse put some extra stress on the nodes not

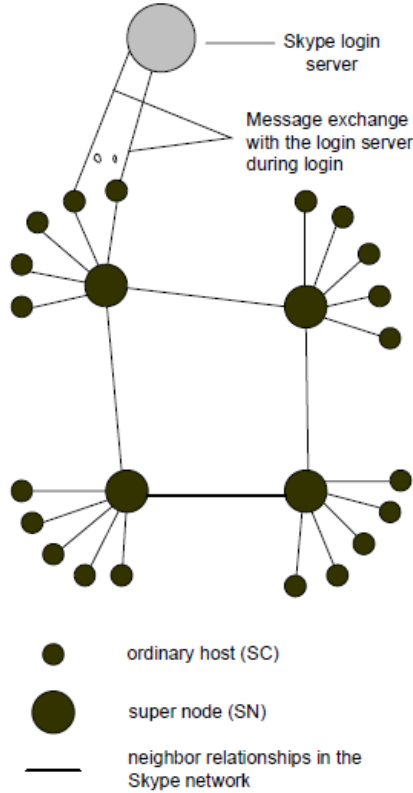


Figure 1. Picture of the skype architecture [5]

behind NAT, but also make Skype possible to work for free due to the little infrastructure needed in order to make the network work. Another issue for these Supernodes is that they are used as third party for UDP hole punching to connect clients behind NAT. UDP hole punching is done by letting the regular nodes behind NAT connect to the third party (the Supernode) thereby opening ports that they can use for direct traffic between the two regular nodes. This is only open as long as there is communication traffic going. If there is a prolonged absence of traffic Skype sends “keep alive” packets instead of closing the connection and then having to use the Supernode as a third party again redo the connection.[3]

This is something that might be implemented in TRAMP to scale up the network.

### B. P2P streaming

P2P streaming works by having all nodes in the network relay the stream to other nodes,

thereby reducing the upload link needed by the sourcenode, as it does not need to upload the stream to all connected nodes. SopCast is such a application.

SopCast is a P2P streaming application developed as a student project at Fundan University in China in 2005 and has become a very popular way to watch live video streams. The name SopCast is short for “Streaming over P2P Cast”, and the protocol used is built by the SopCast team.[4]

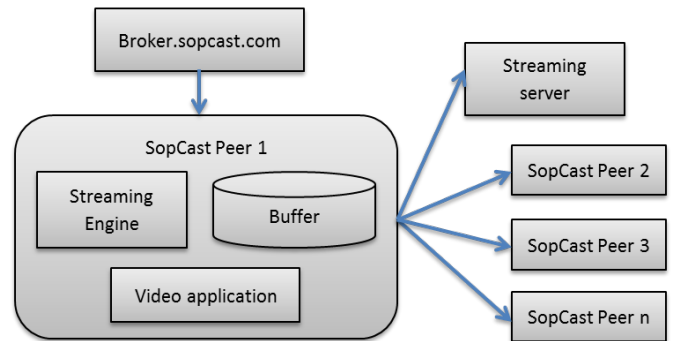


Figure 2. SopCast Architecture

## III. SYSTEM DESIGN

The TRAMP platform is a platform designed to stream real-time data from a device to other devices connected to the session, mobility is the keyword. Lets take the example given in the introduction; You are on a skype call with some of your friends when you find out you need to go out of the house. Traditionally you then had to end the skypecall and call them up using your phone. The goal for TRAMP is to be able to seamlessly enter the conversation without your friend noticing you just changed device.

In TRAMP this is done by having a TRAMP daemon running on each device, with a consumer and a producer. The producer produces data, putting it into the shared memory, the TRAMP daemon then pushes the data to all other daemons connected to this session. When a TRAMP daemon gets data it puts it into the shared memory so the consumer can read it. All nodes has a TRAMP

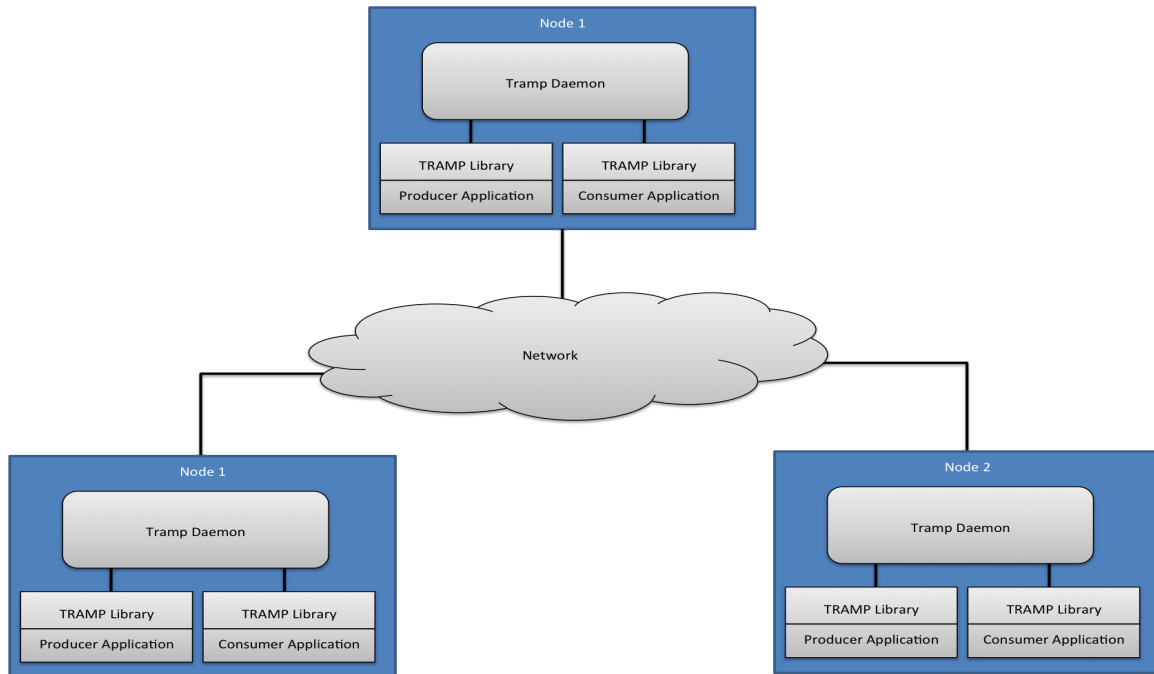


Figure 3. The TRAMP Architecture

daemon, a producer and a consumer running. The shared memory of all nodes in the session are in synch.

#### IV. THE CHOICE OF STREAMER

When we got this assignment we had to look at what we would implement in order to test the TRAMP platform. In the sample code there was implemented a simple chat program, so we decided to implement something that streamed a lot of data. There are several ways to do this; we could make a file sharing system, an audio streaming application (like Skype) or a video streaming application. We decided on looking into FFMPEG.

FFMPEG is a complete cross-platform solution to record, convert and stream video and audio. It is a free software licensed under the LGPL or GPL (dependent on the configuration), and is the leading multimedia framework today.[1] FFMPEG provides tools for converting, streaming, playing and analysing multimedia, as well as a full developers library with the possibility to create almost anything you want. Big projects such as

QStream, VLC, GStreamer and Google Chrome has used the framework.

Due to time constraints we decided we did not have enough time to implement this framework. Instead we implemented a streamer that copied over one big file by chunking the big file into small bits, sending them and putting them back together on the other side. This will in our eyes show the capabilities of TRAMP just as well as a more sophisticated streamer like the FFMPEG solution we had planned.

##### A. Our implementation

To explain what we have done to the code, we must first talk about how the sample chat program work. We decided to use this as a base, as it had a lot of the code we needed anyways. HERE WE MUST TALK ABOUT THE IMPLEMENTATION VINAY DID

#### V. PROPOSED OPTIMIZATIONS

##### A. Shared Memory problem

REWRITE NEEDED Shared memory is memory that can be used to pass data between cores,



Figure 4. Packet header for the chat application



Figure 5. Packet header for the file sending addon

or to other applications. As the applications or cores can access the data just as any other data in the Random Access Memory (RAM) its a very fast way of passing data between the applications, compared to regular message passing or software implementations such as UNIX domain sockets or CORBA. But it is less powerful, as all the processes has to run on the same machine.

At the moment TRAMP is using shared memory for inter-process communication (IPC). It allocates 32mb of memory, but the problem we've found is that we get a lot of packetloss due to the producer being faster than the consumers. This problem occurs when we are trying to send a file over the platform. The problem with the file sending is ofcourse that the platform tries to send it as quickly as possible, where usual real-time applications such as skype sends a video stream that is not the total bandwidth, but 400kbps-1mbps (voice streams will be lower than this).

At the moment TRAMP is using shared memory in order to transfer data. TRAMP allocates 32mb major security problems[6]

### B. Data transfer rate

Pushing more data than the recieving nodes can pull

### C. Network topology

atm mesh network, should be something else

### D. UDP vs TCP or both

TODO: Real time transport protocol (RTP)

## VI. EVALUATION

## VII. CONCLUSIONS

## REFERENCES

- [1] Ffmpeg-project homepage. April 2012.
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- [6] K. G. Sarita V. Adve. Shared memory consistency models: A tutorial. Technical report, Western Research Laboratory, September 1995.