HYPER-LINKED COMMUNICATIONS

WebRTC enabled asynchronous collaboration

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OVERVIEW

1. Introduction
2. Related Work
3. Architecture
4. Implementation
5. Evaluation
6. Conclusions
7. Future Work

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INTRODUCTION

CONTEXT

Written communication could never replace face to face communication.

> “No computer in our lifetimes will ever rival a human voice’s capacity to conveying rich and complex social and emotional meaning”
>
> — Geddes, Martin

Today, we can achieve more.

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PROBLEM STATEMENT

Real-time communication applications can make a difference on business, education and health sectors.

An application that provides a collaborative environment and a way to remember our past communications would be a strong tool.

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THESIS GOALS

Allow multi party conference calls.

Record and playback interactive video.

Create a collaborative environment

Use only standard technologies like JavaScript, WebRTC, HTML5 and CSS3.

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RELATED WORK

STATE OF THE ART OVERVIEW

1. Connection Establishment
2. Streaming audio and video
3. Overlay communications with content
4. Collaboration Environment

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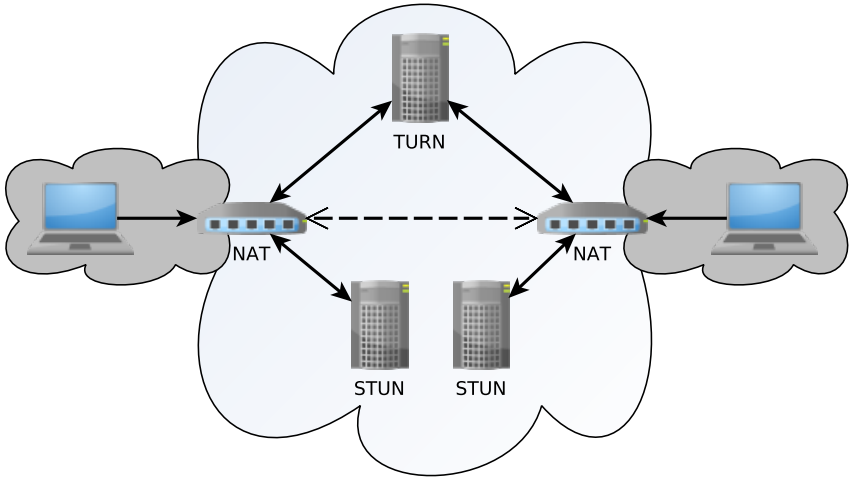
CONNECTION ESTABLISHMENT

- Network Address Translation
- STUN + TURN = ICE



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STREAMING AUDIO AND VIDEO

WebRTC (Web Real-Time Communications)

- Access to camera, microphone and screen*
- Peer to Peer file and stream sharing
- Standardized protocols
- No plug-ins required

* requires installing a plug-in yet.

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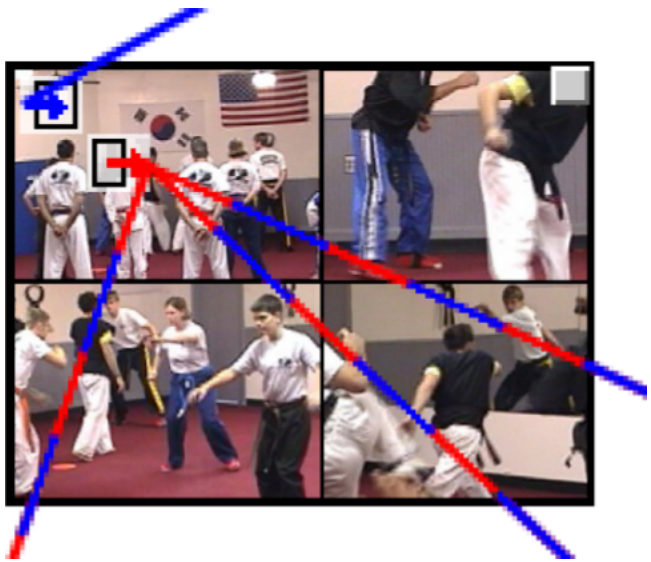
OVERLAY COMMUNICATIONS WITH CONTENT

- **Concepts:** HyperText & HyperMedia & HyperCommunications & Detail on Demand
- **Implementations:** HyperCafe & HyperHitchcock



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COLLABORATION ENVIRONMENT

Table: Comparision between Operational Transformation libraries

Library	Own Server	Own Storage	Operations
ShareJS	✓	✓	text+objects
TogetherJS	✓	✗	text+objects
Goodow	✓	✓	text+objects
Etherpad Lite	✓	✓	extendable
OT.js	✗	✗	text

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OVERVIEW

					
Name	Skype	Hangouts	Jitsi	Kurento	Our proposal
Technology	Proprietary	WebRTC[1]	WebRTC	WebRTC	WebRTC
Development	✗	✓[2]	✓	✓	✓
Audio/Video	✓	✓	✓	✓	✓
Text Messaging	✓	✓	✓	✗	✓
Collaborative Editor	✗	✓	✓	✗	✓
File sharing	✓	✓	✓	✗	✓
Recording & Playback	✗	✗	✗	✓	✓
Interactive Content	✗	✗	✗	✗	✓

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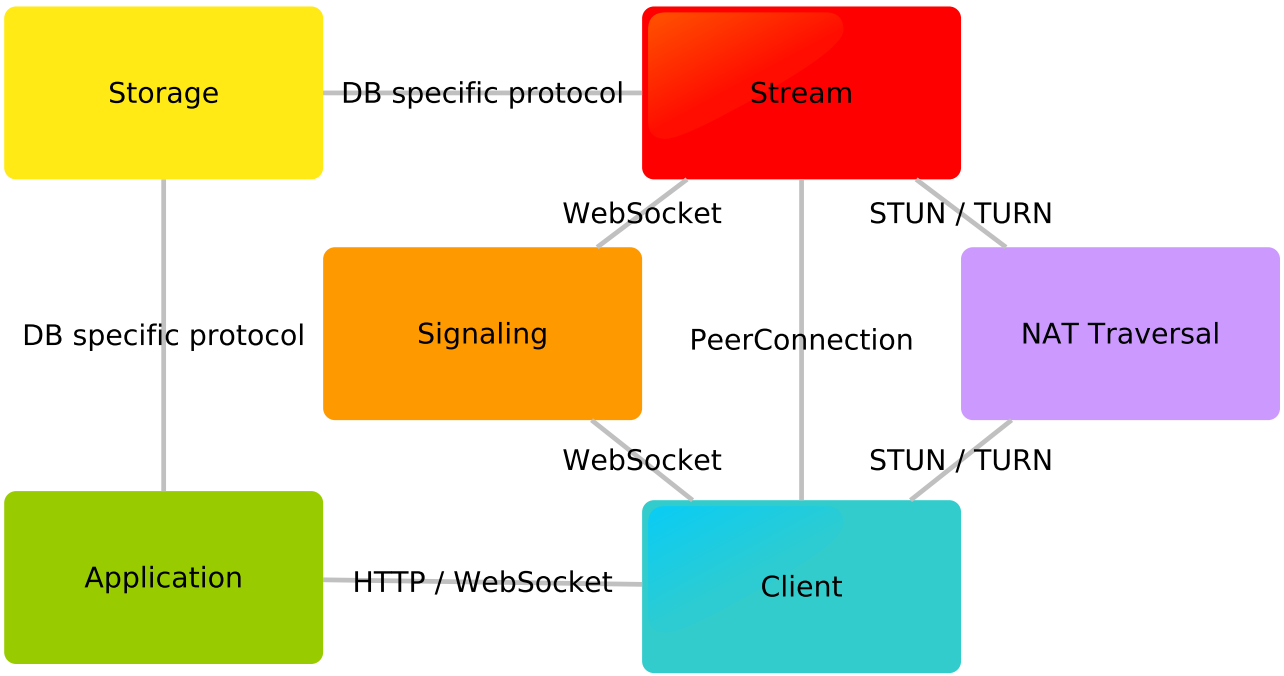
[1] requires installing a plug-in on non chrome web browsers.

[2] allows the development of extensions.

ARCHITECTURE

MODULES



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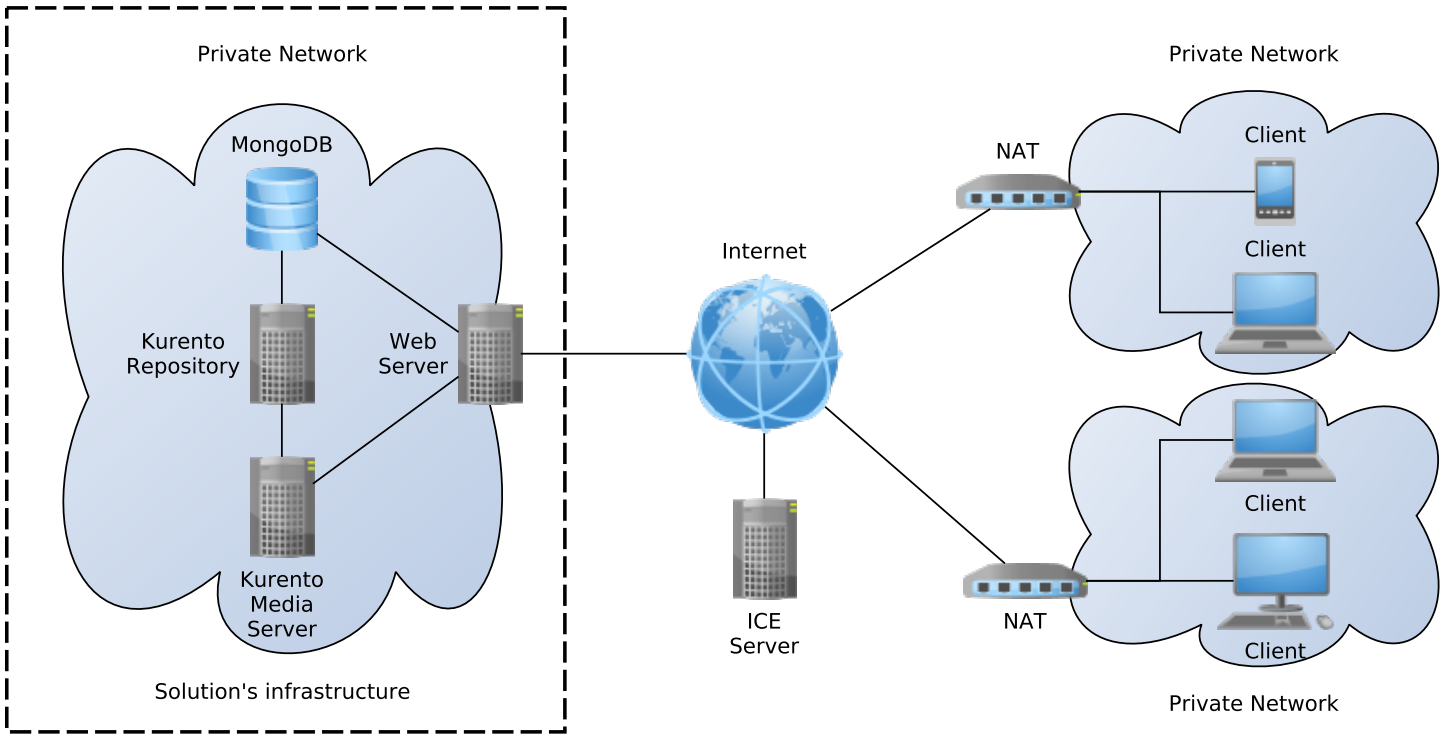
SYSTEM INFRASTRUCTURE



- **Signaling Server & Web Server**: Play Framework
- **Stream Server**: Kurento Media Server
- **Storage**: MongoDB & Kurento Repository
- **NAT Traversal**: Public STUN Servers

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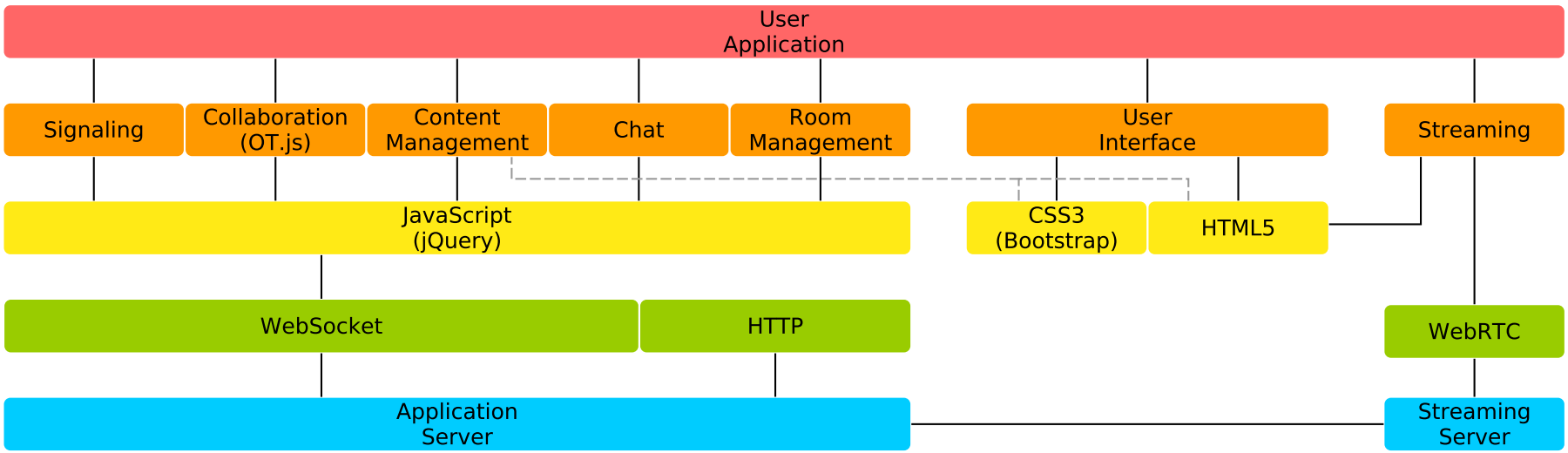
APPLICATION ARCHITECTURE



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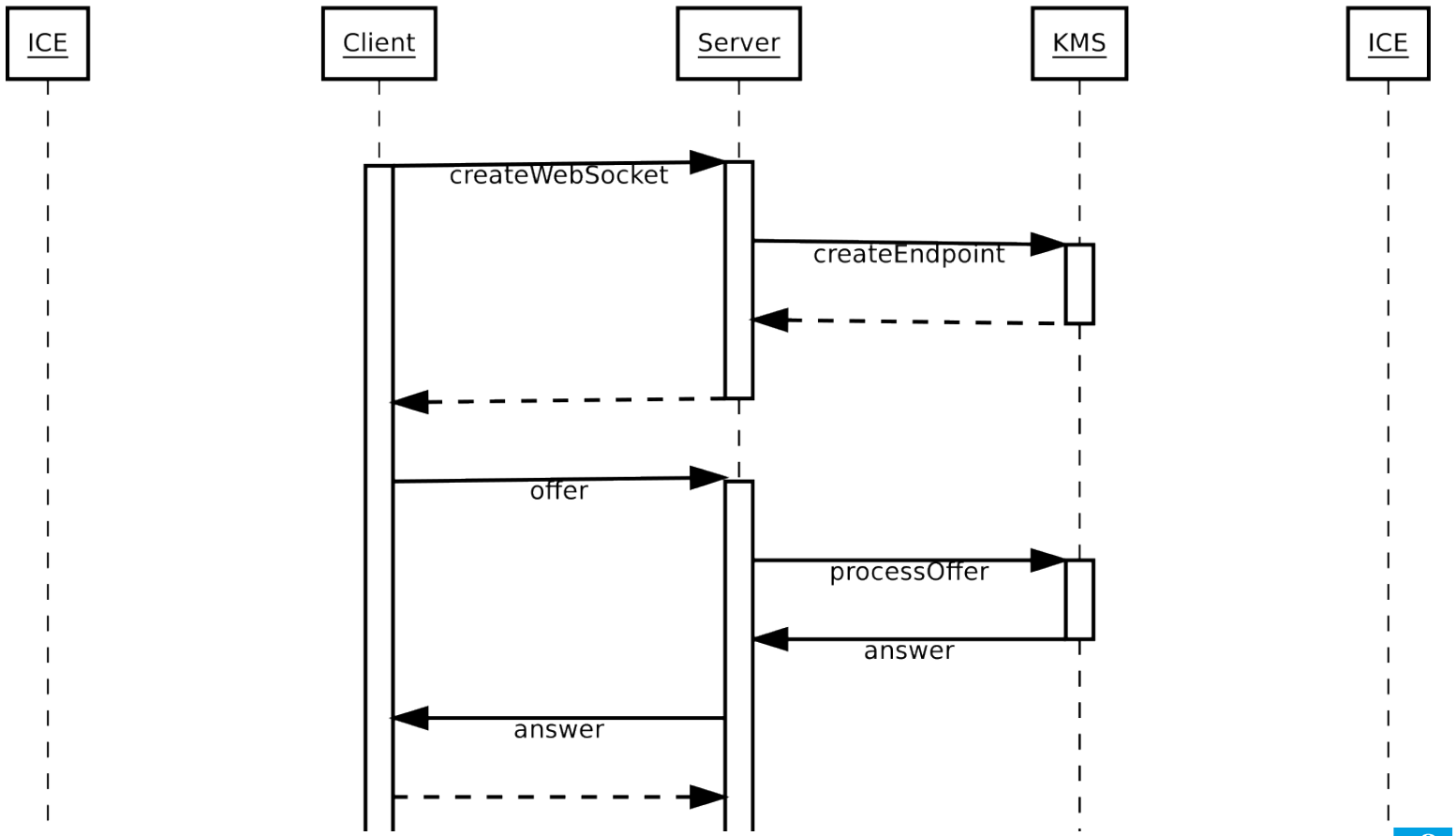
IMPLEMENTATION

SIGNALING PROTOCOL - PART 1



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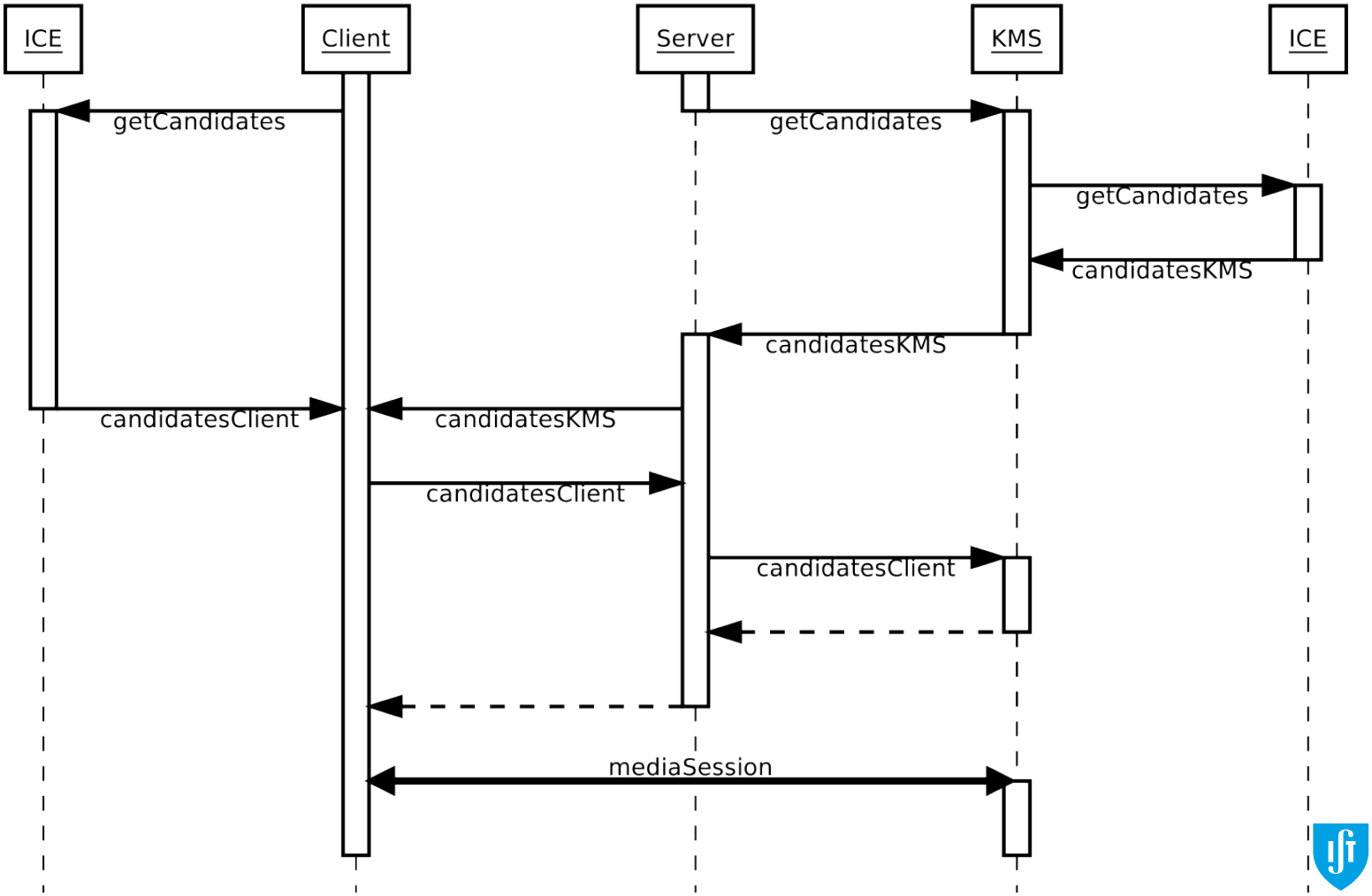
SIGNALING PROTOCOL - PART 2



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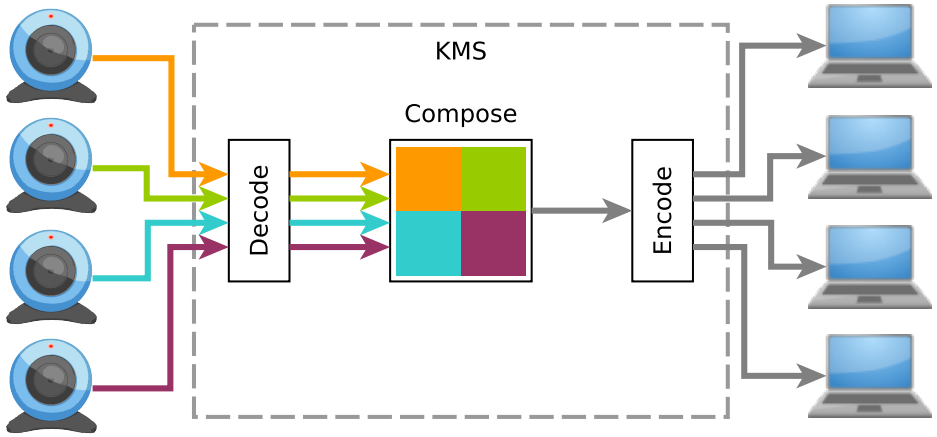
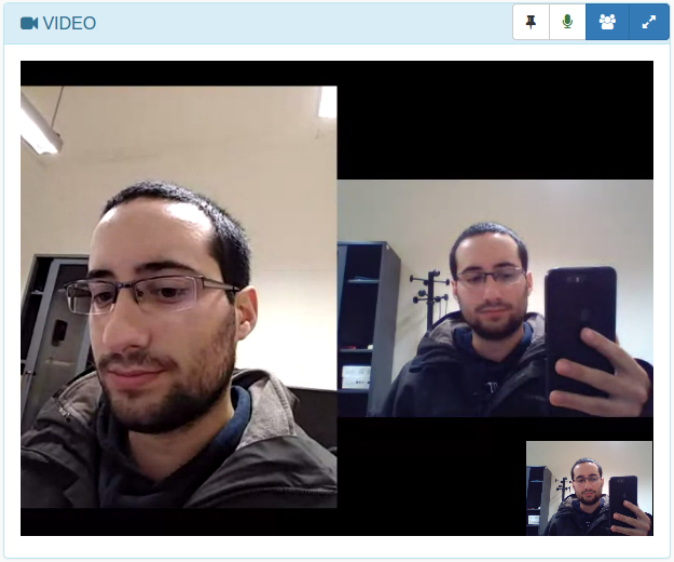
STREAM OPERATIONS

- Server-side recording to database (Kurento Repository).
- Server-side stream composition.





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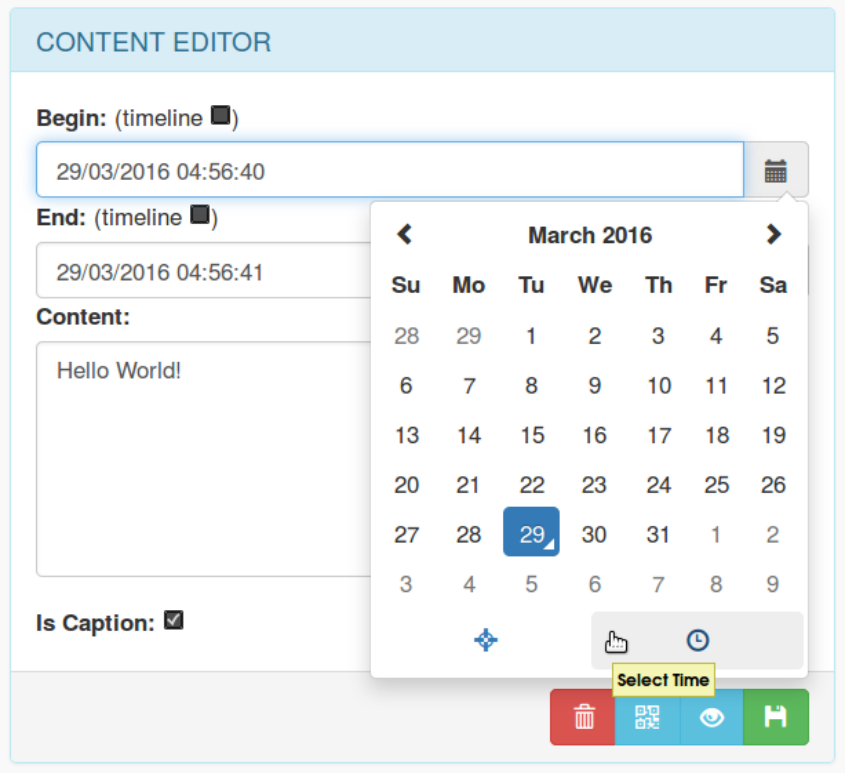
HYPER-CONTENT

- Create & Search content
- Scheduler
- QR codes
- Security concerns



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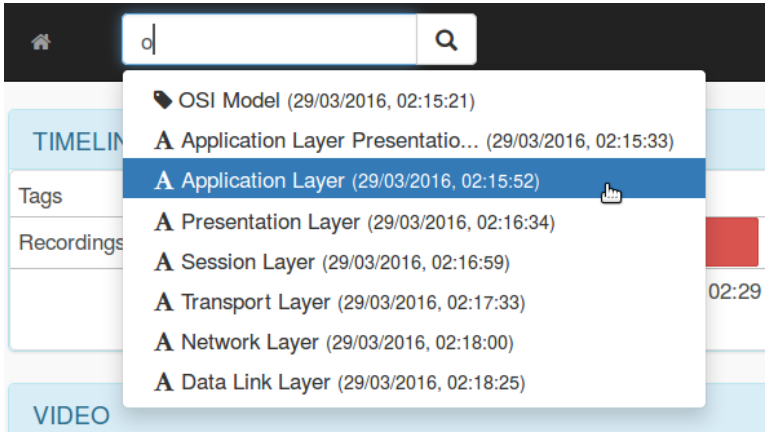
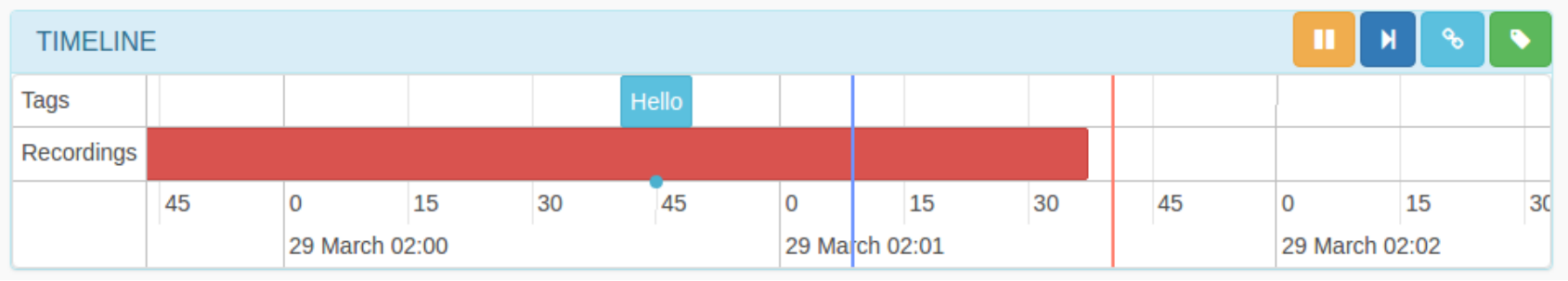
TIME MANIPULATION

- Playback recordings
- Create & Search annotations
- Time Hyper-links





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CHAT & COLLABORATIVE ENVIRONMENT

- Instant text messaging
  - WebSockets
- File sharing
  - HTTP file upload
  - stored in the database
- Collaborative text editor (OT.js)
  - retain
  - insert
  - delete

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DEMONSTRATION

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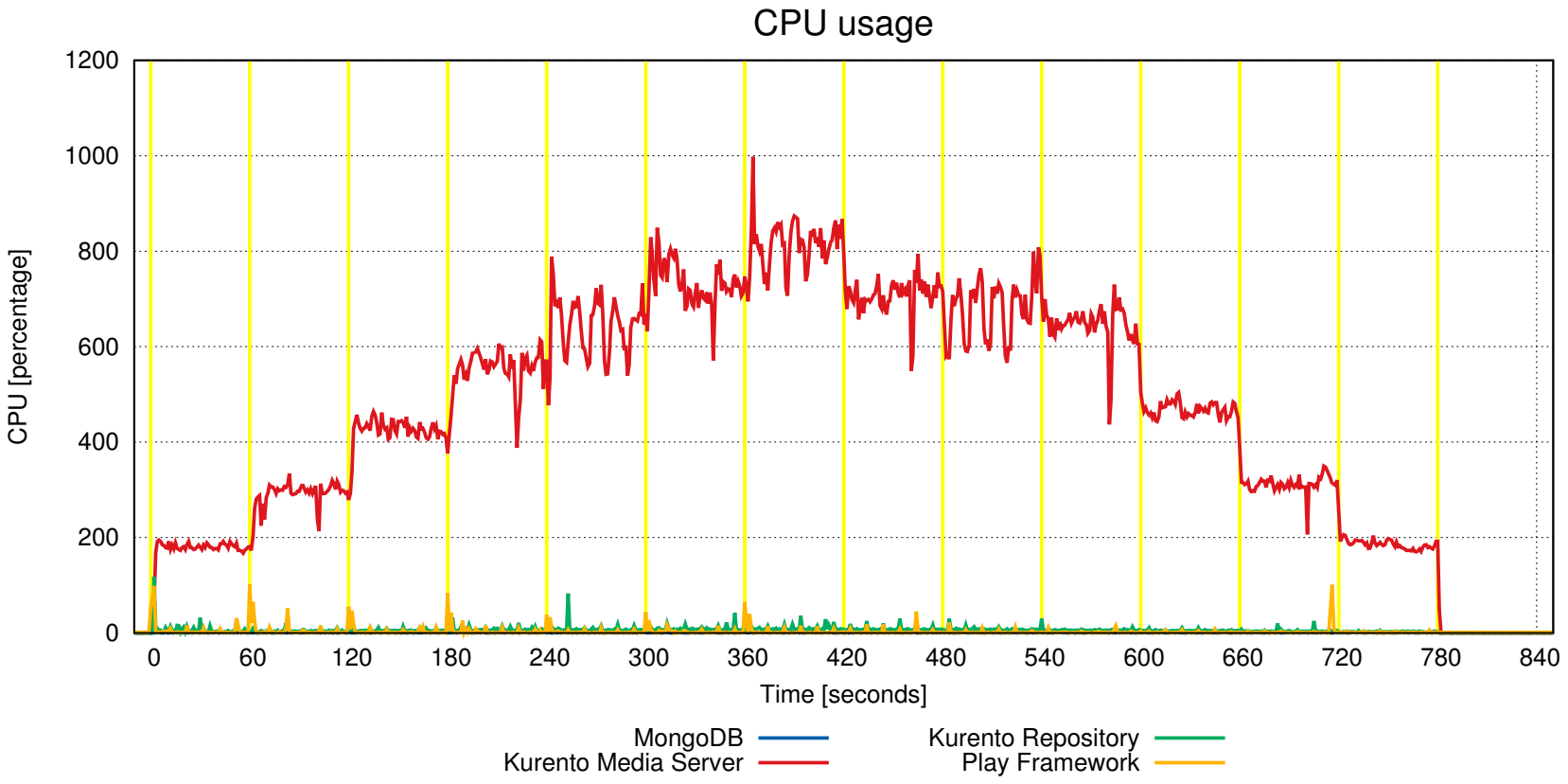
EVALUATION

PERFORMANCE TESTS AT SERVER - CPU USAGE



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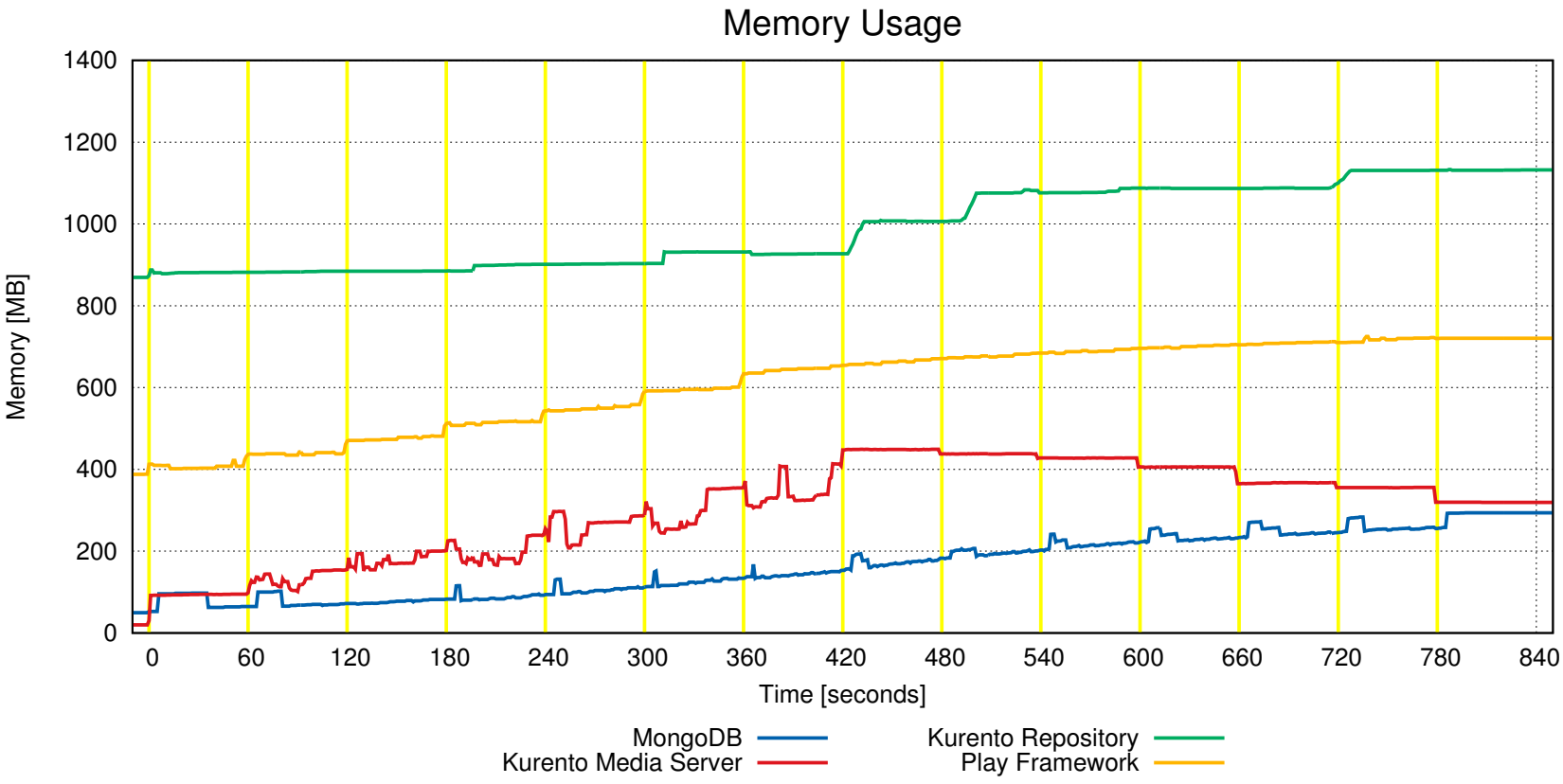
PERFORMANCE TESTS AT SERVER - MEMORY USAGE



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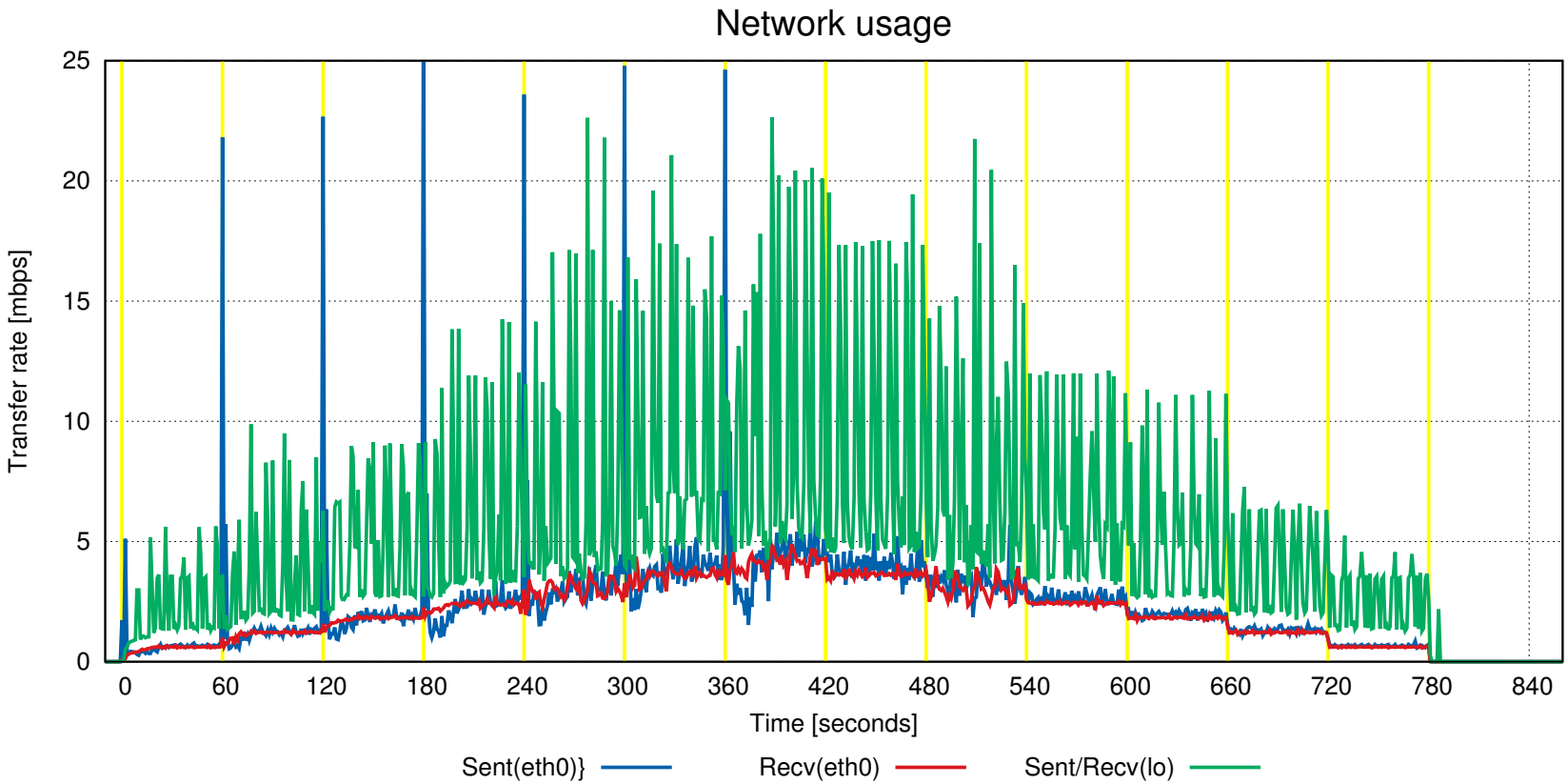
PERFORMANCE TESTS AT SERVER - NETWORK USAGE



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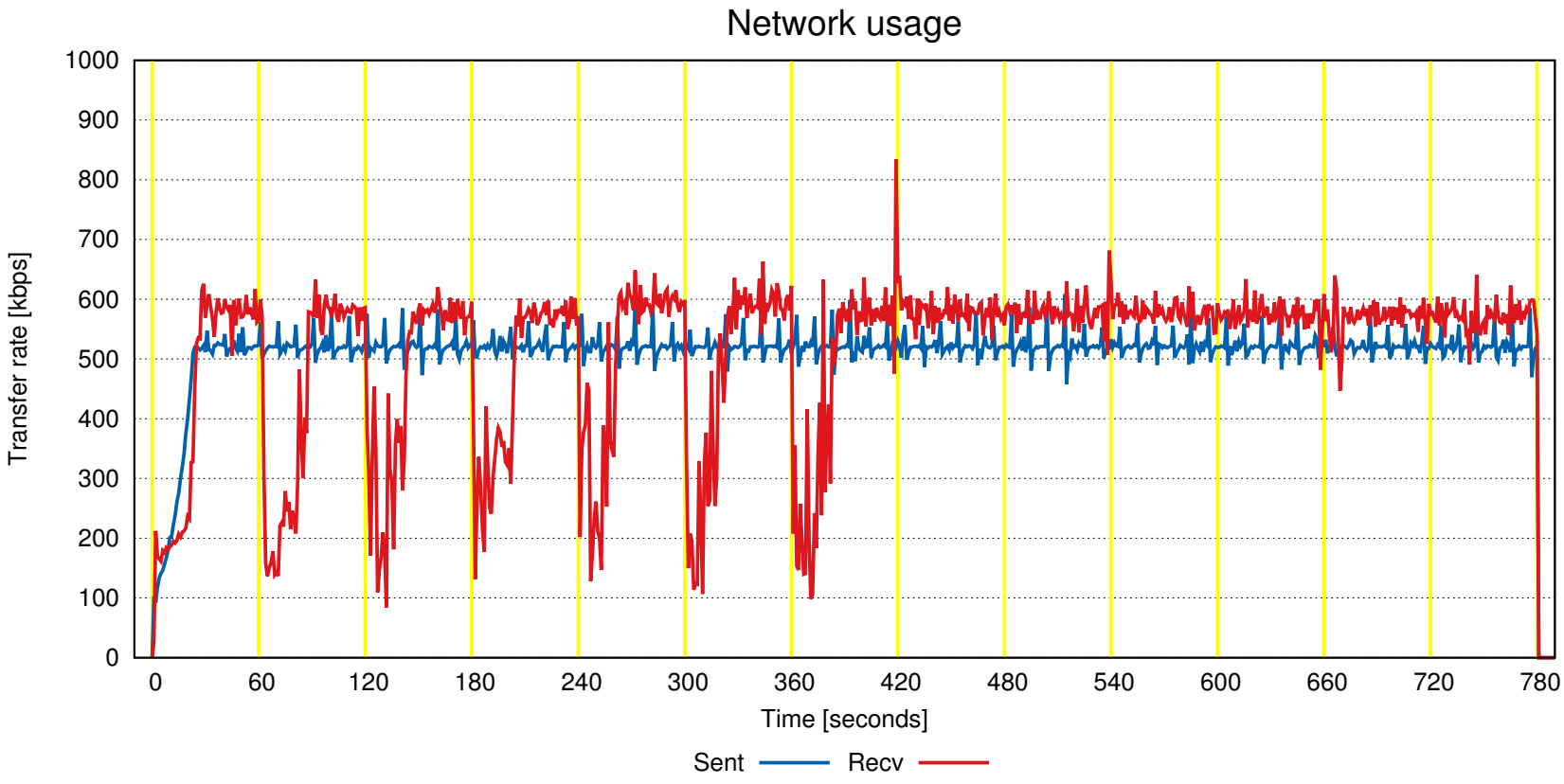
PERFORMANCE TESTS AT CLIENT - NETWORK USAGE



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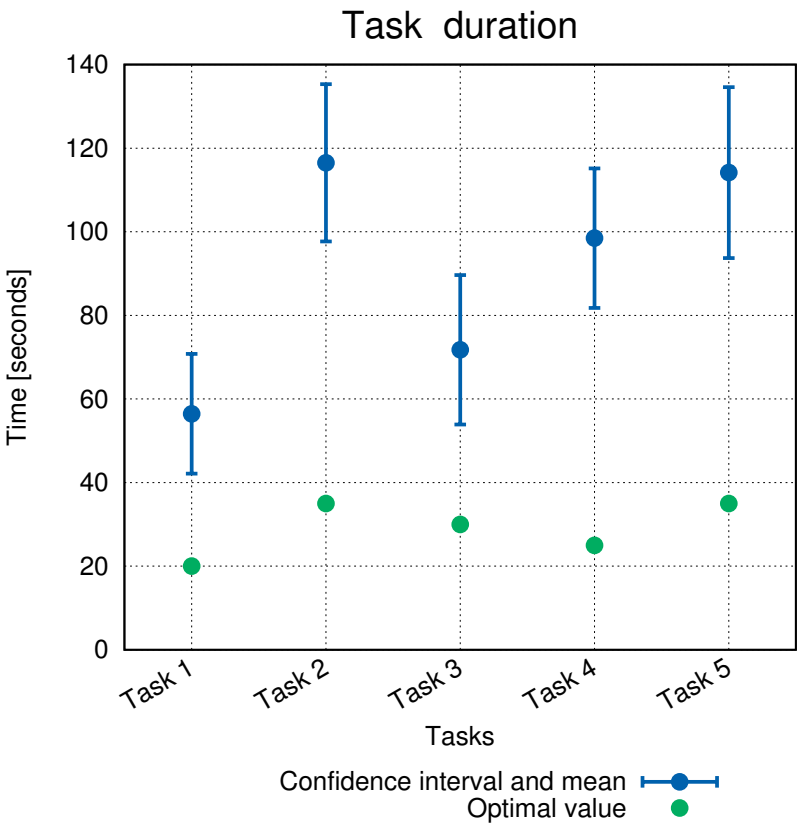
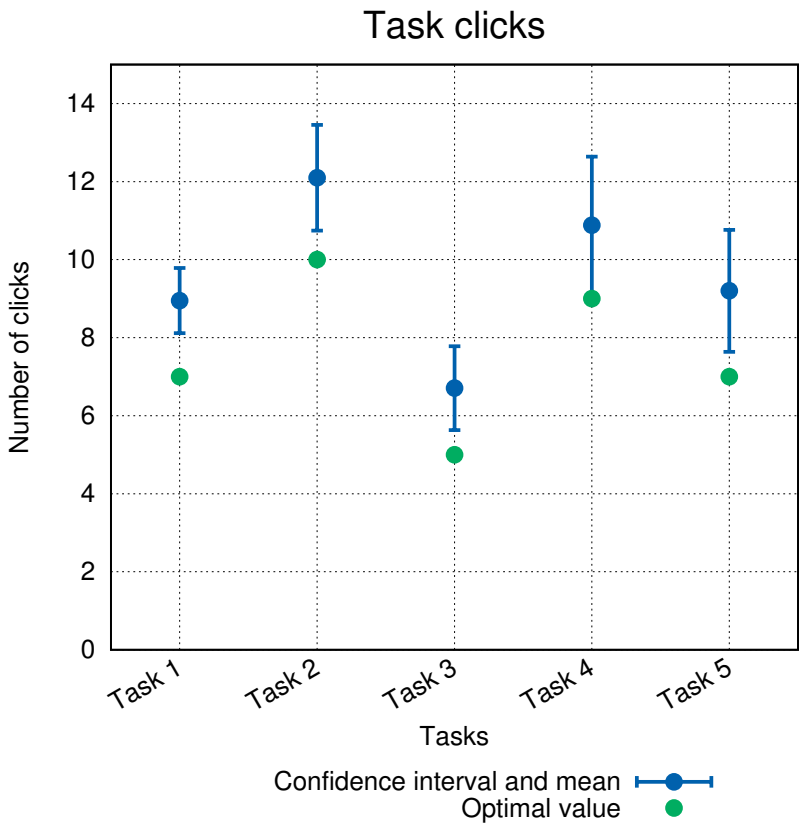
FIVE TASKS





- Difficulty per task.
- Errors per task.

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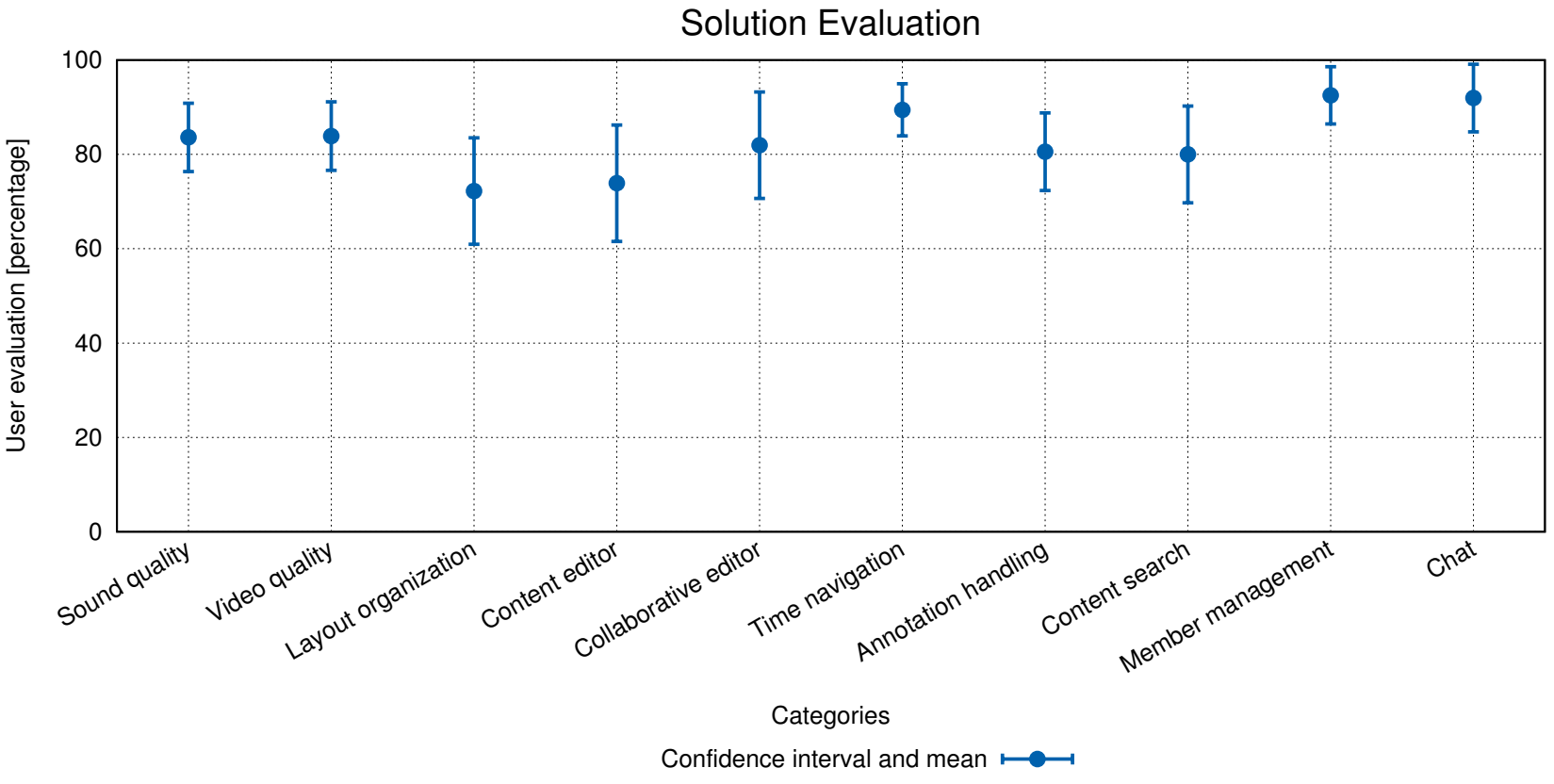
OVERALL EVALUATION



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CONCLUSIONS

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- New usage scenarios for communication and collaboration applications.
- Enrich communications using hypermedia concepts. Record, playback and collaboration features.
- Prototype implementation and testing.

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FUTURE WORK

FUTURE WORK

- Implement fast-forward playback.
- Improve solution’s security.
- Scale our solution to multiple servers.

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Questions?

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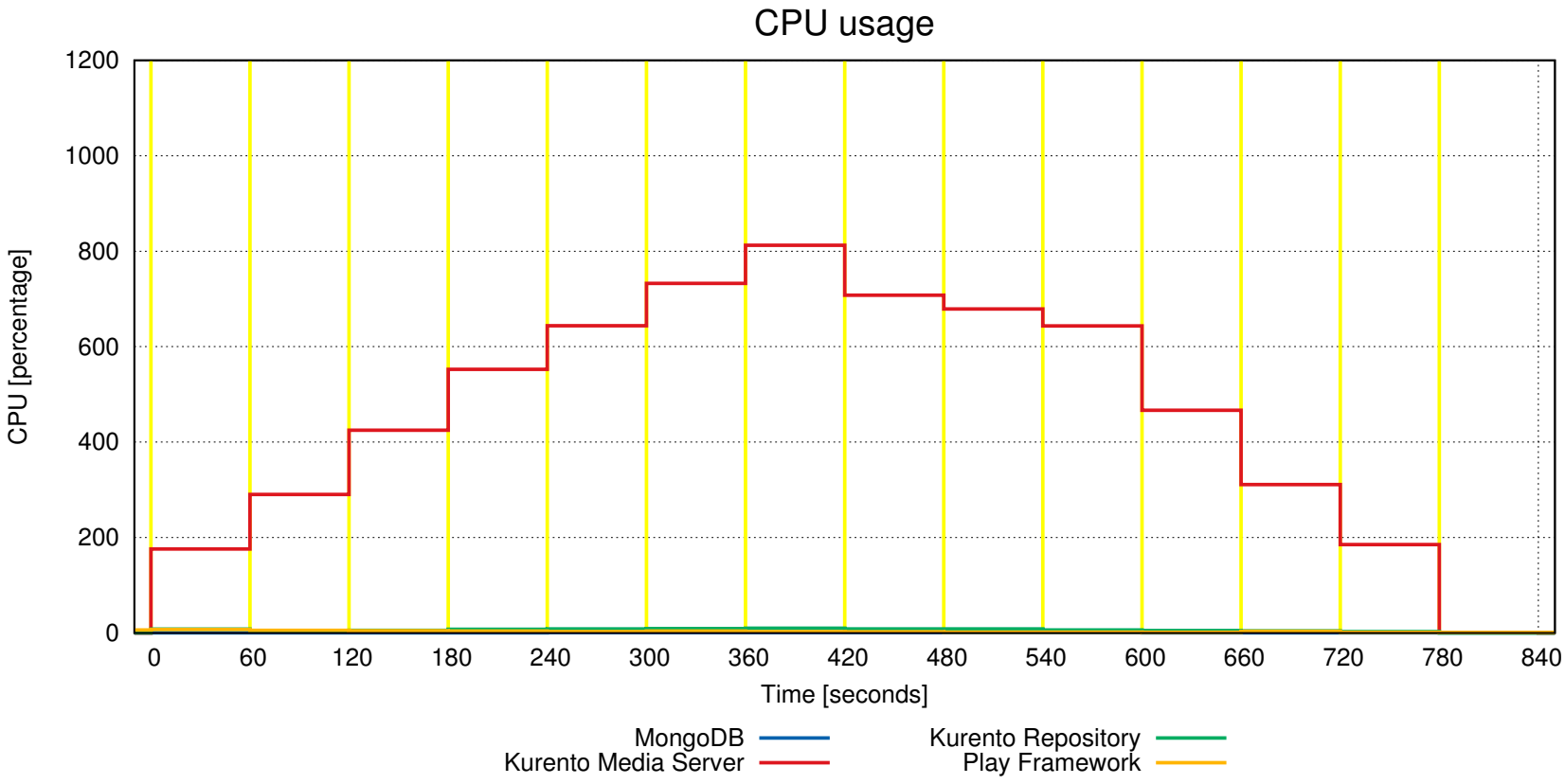
PERFORMANCE TESTS - CPU (AVERAGE)



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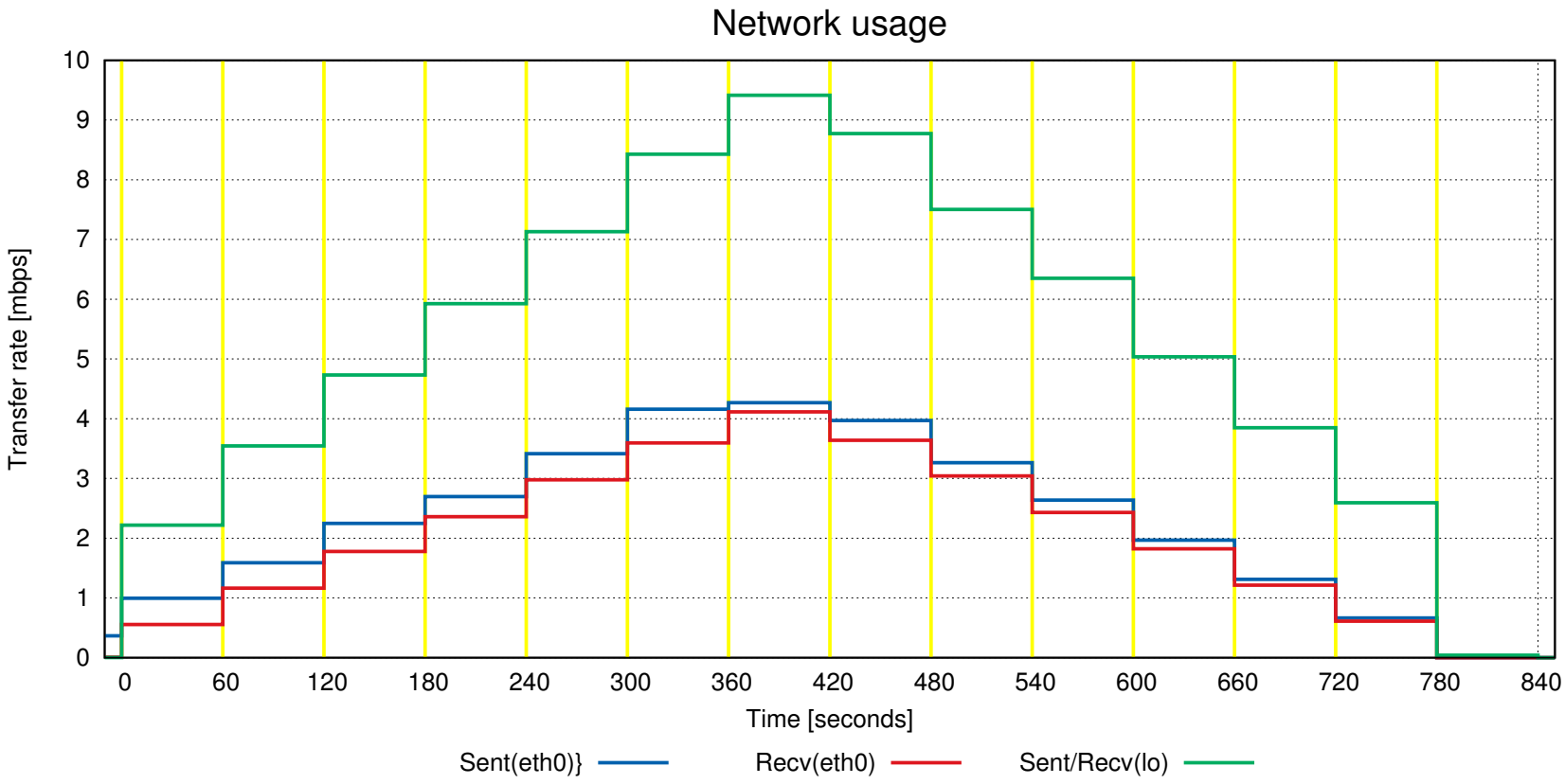
PERFORMANCE TESTS - NETWORK USAGE (AVERAGE)



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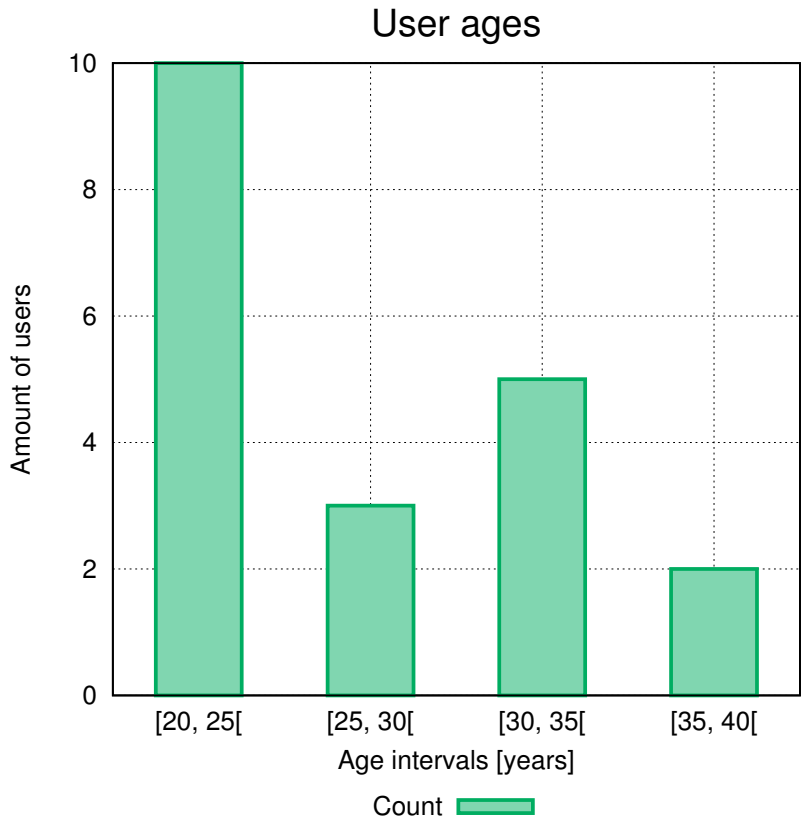
USER INTERFACE TESTS



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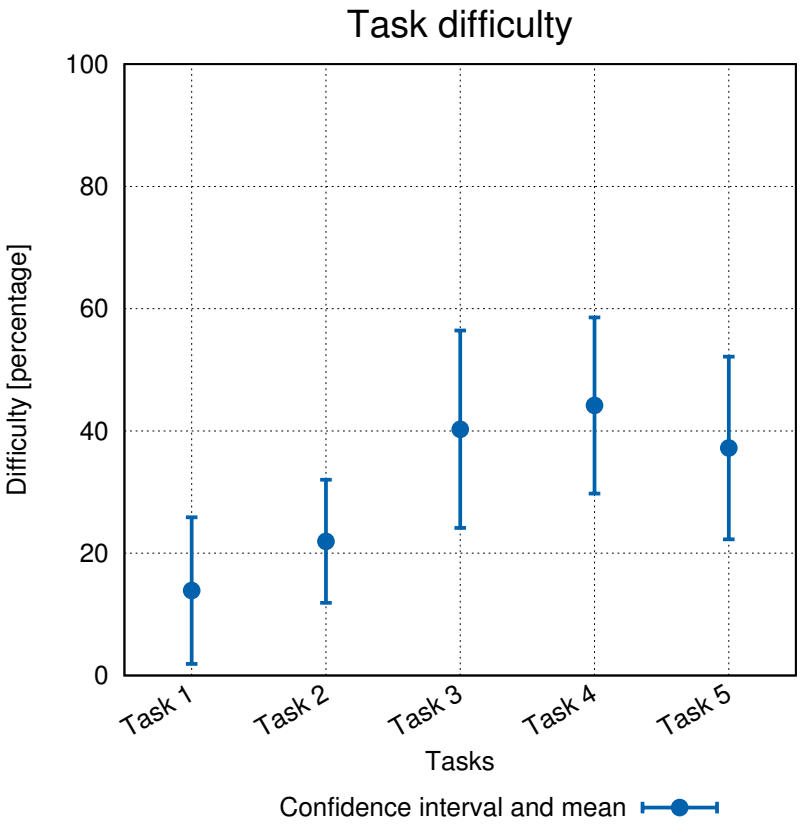
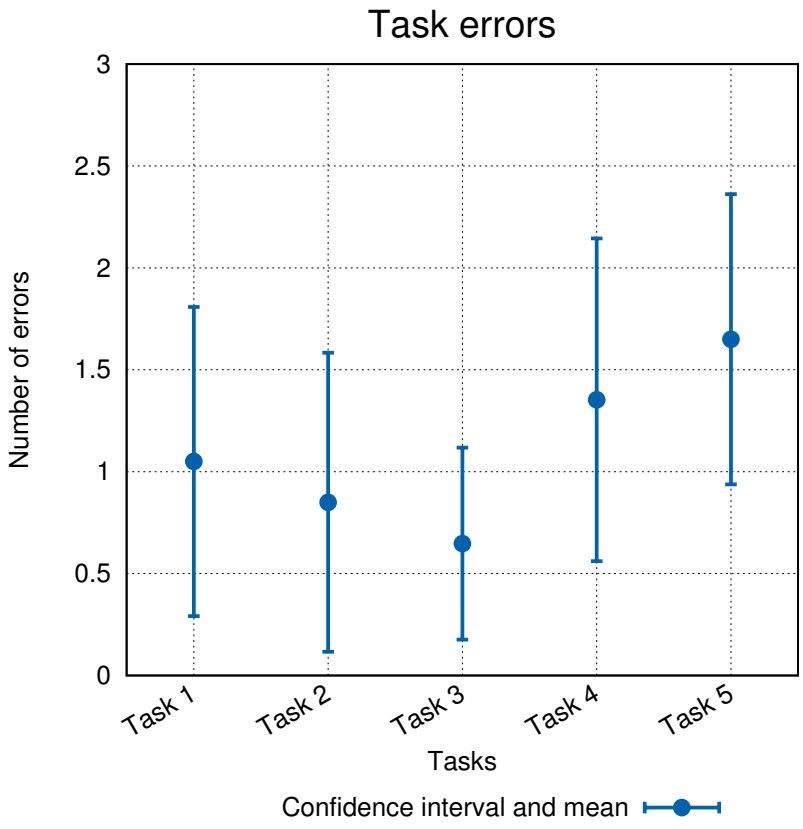
FIVE TASKS





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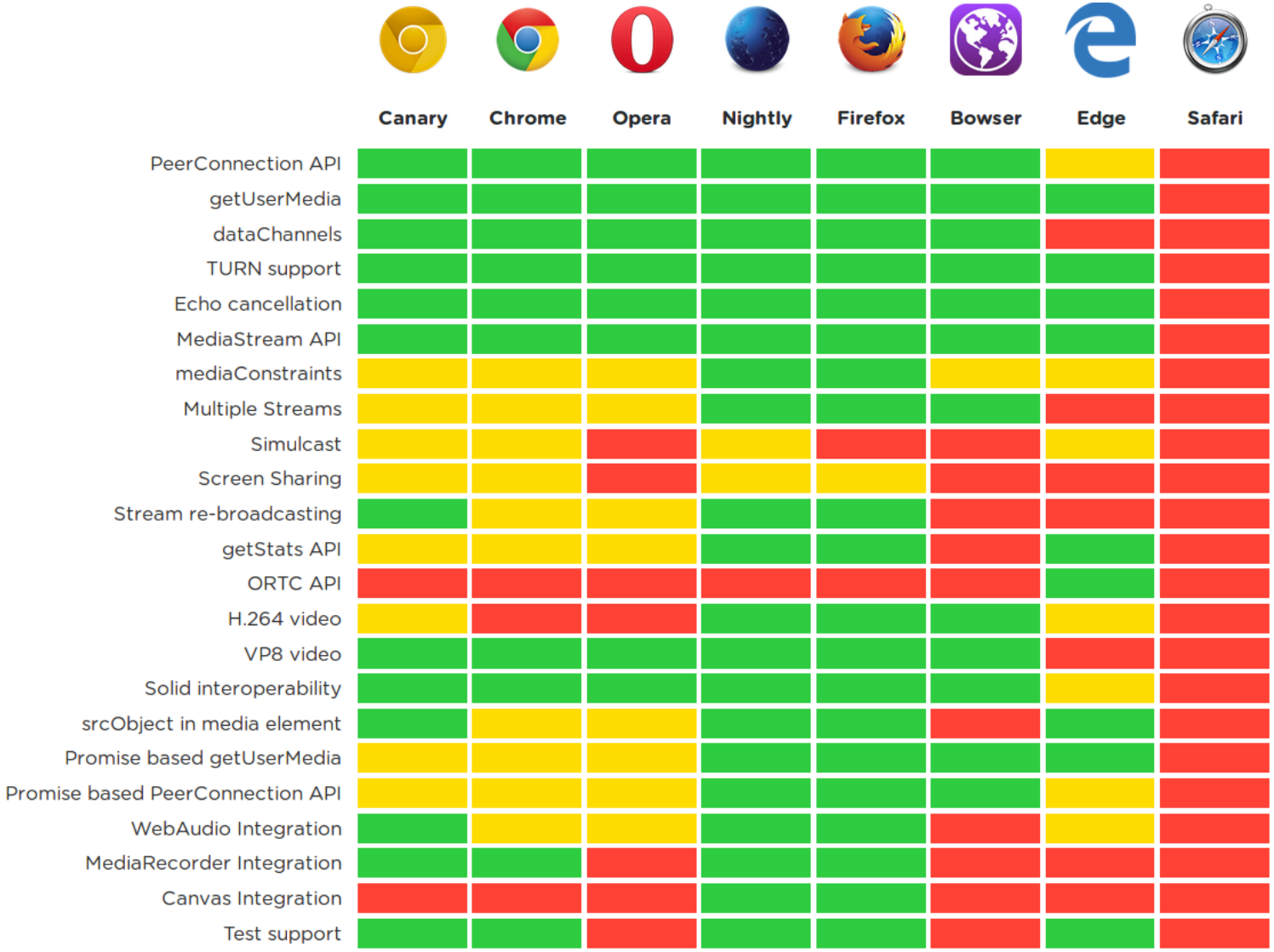
WEB BROWSER SUPPORT



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