Improving Thin Client Performance Using the Smart Proxy Architecture

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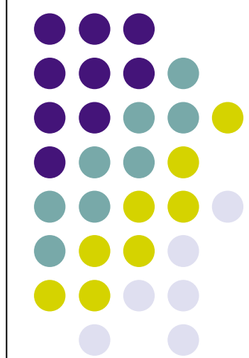


- Introduction
  - Sample Device
  - Sample Application
  - Definitions
- The Smart Proxy Architecture
- Improving VNC
- Results & Conclusion

Devices

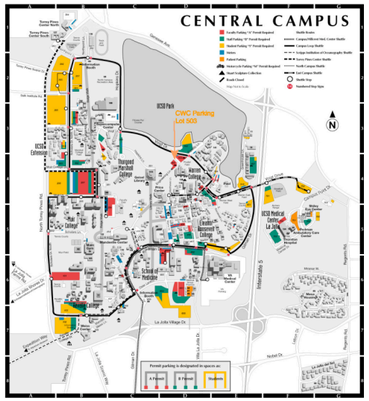
Zypad Wearable Computer

128 MB Ram
GPS, Accelerometer

Video Glasses

Application

Virtual Worlds



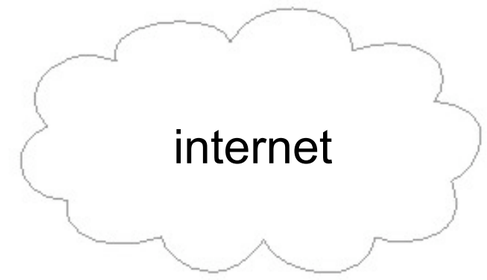
Maps

Historic Information

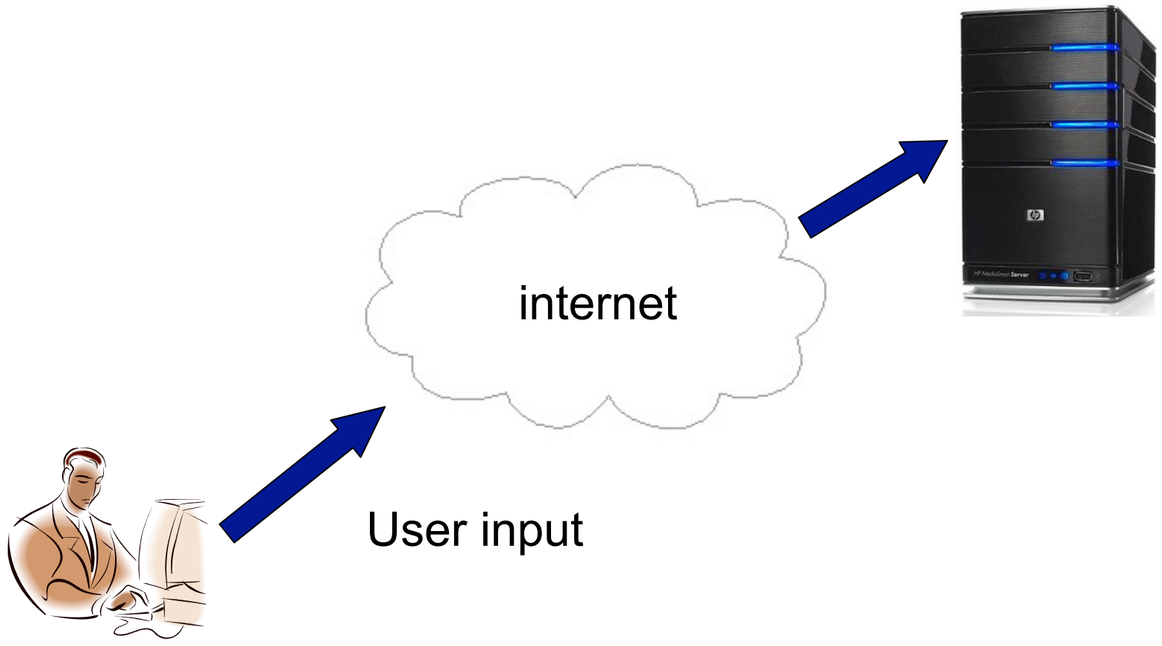
- Displaying contextual information about the user’s location

- Introduction
- Definitions
  - What is Thin Client Computing?
  - Why Thin Clients?
  - Latency and Performance
- The Smart Proxy Architecture
- Improving VNC
- Results & Conclusion

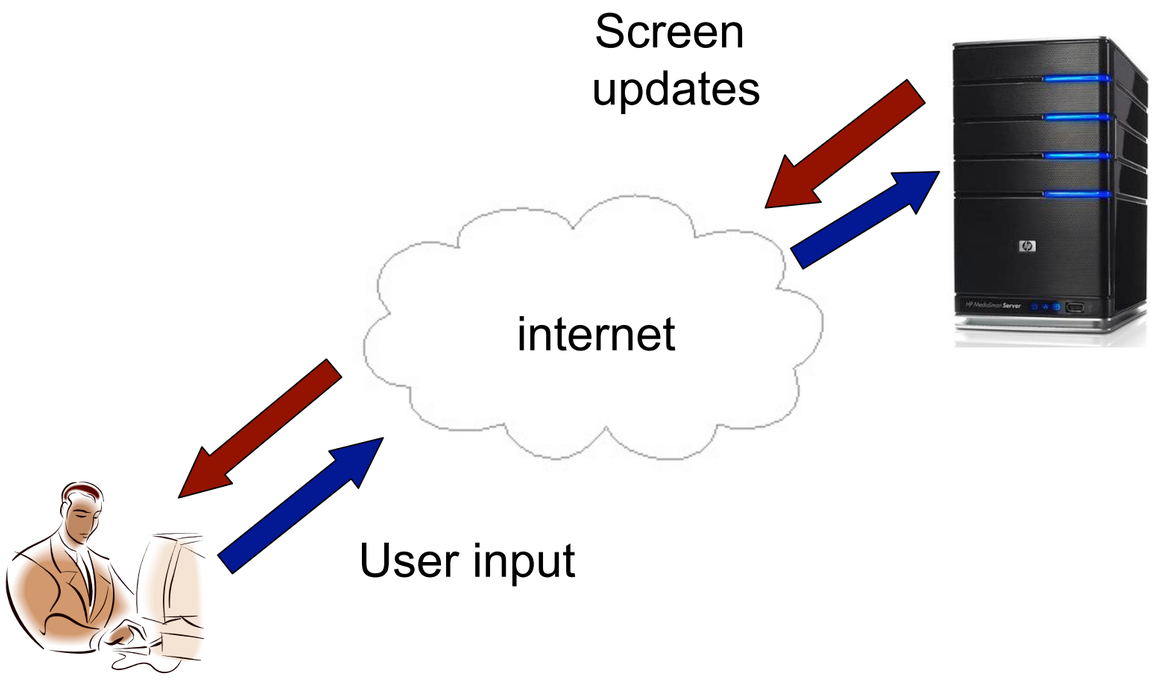
What is Thin Client Computing?



What is Thin Client Computing?



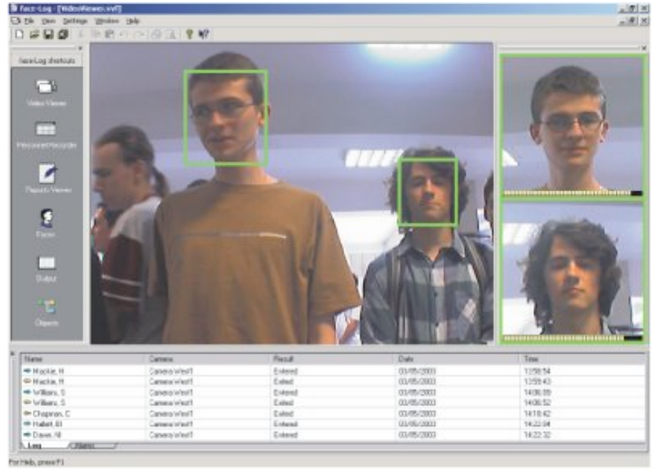
What is Thin Client Computing?



Why Thin Clients?
Lightweight Devices

Why Thin Clients?
Intensive Applications

- Machine Learning/Vision
  - Object recognition
  - Speech recognition
- Graphics
  - Rendering
- Data Storage
  - Video

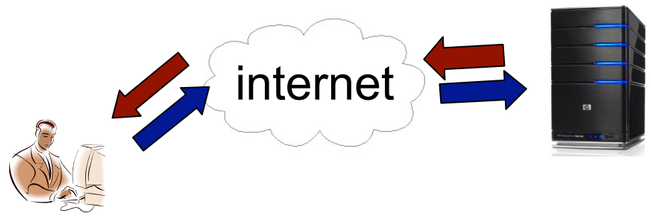


Why Thin Clients?
Security & Data Loss

- A lost laptop doesn't mean lost data
- Helps companies stay compliant with privacy laws such as HIPAA

Latency and Performance

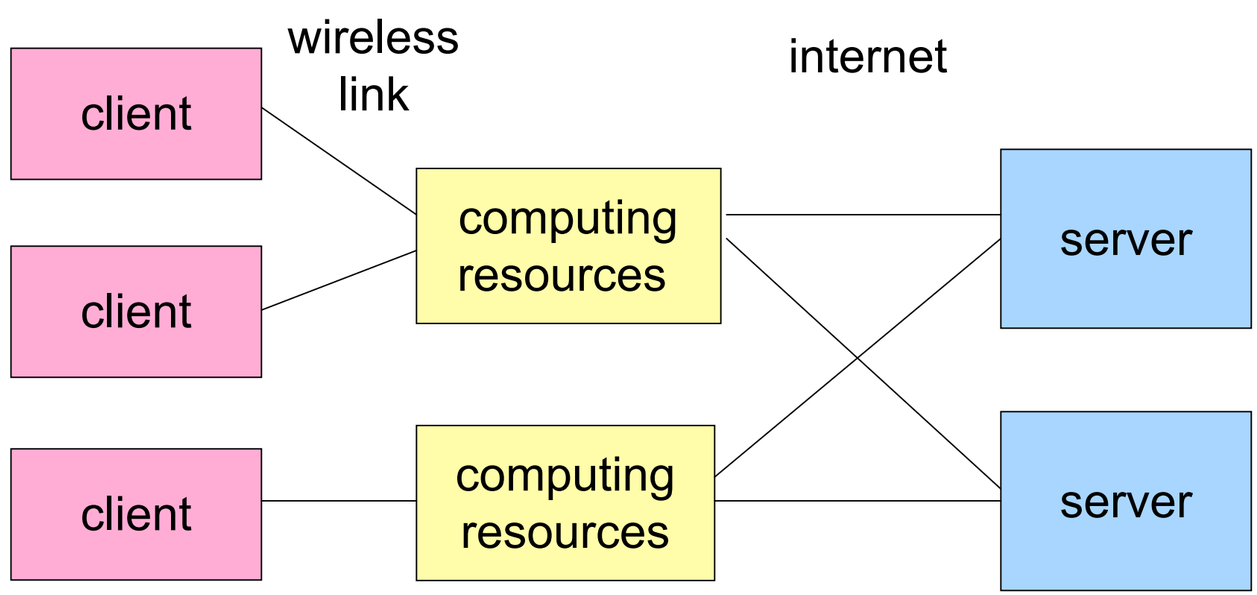
Desktop



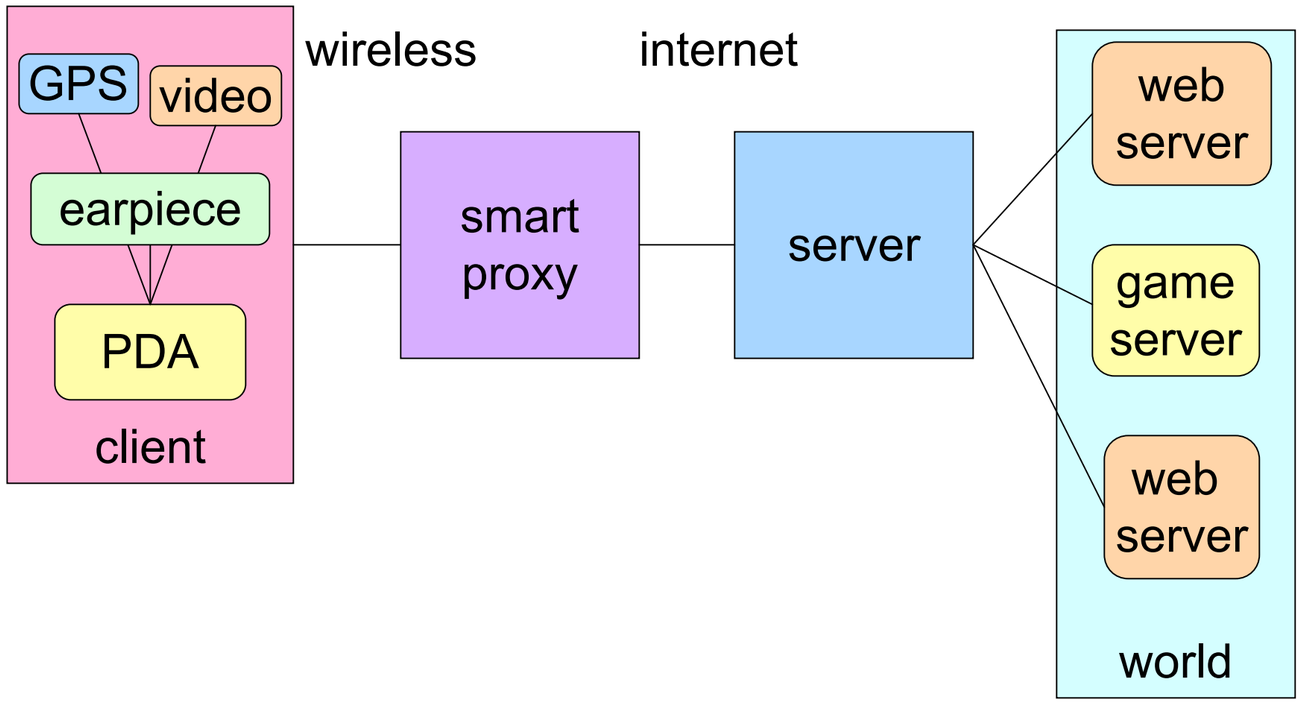
Thin Client

- Introduction
- Definitions
- The Smart Proxy Architecture
  - Resource Assumptions
  - The Smart Proxy Architecture
  - Uses of the Smart Proxy
- Improving VNC
- Results & Conclusion

Resource Assumptions: Active Wireless Spaces



Smart Proxy Architecture

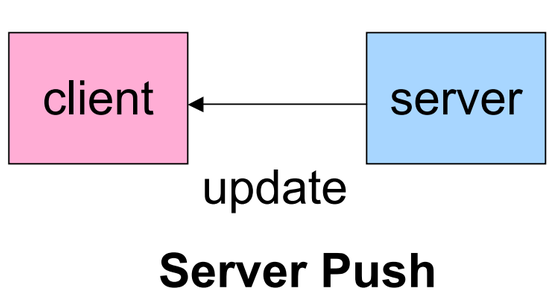


Uses of the Smart Proxy

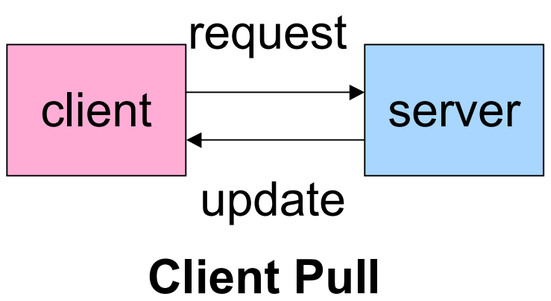
- Buffering updates
- Compress or Decompress Updates
  - Scalable Video Coding
  - Video Processing
- Encryption

- Introduction
- Definitions
- The Smart Proxy Architecture
- Improving VNC
  - What is VNC?
  - Defining Performance
  - The Proxy and VNC
  - Example
  - Implementation Details
- Results & Conclusion

What Is VNC



Server Push

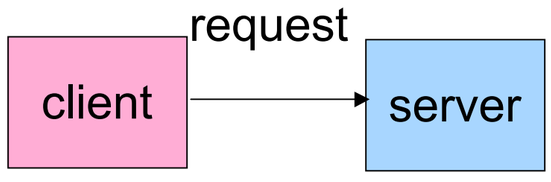


Client Pull

• VNC is a widely-used thin client system with several available open-source implementations.

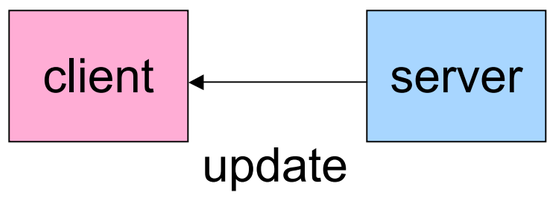
Defining Performance

1. Client requests new update



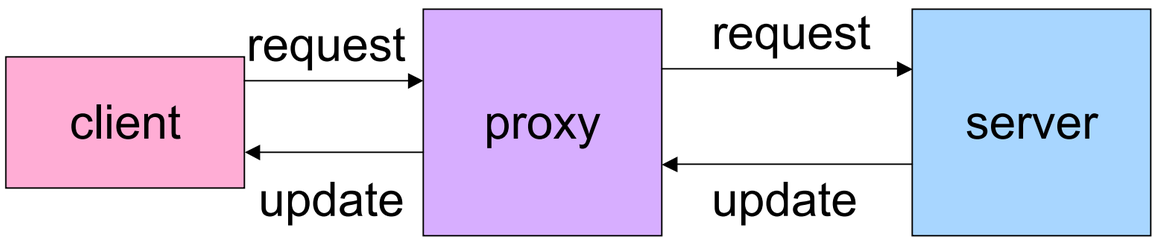
2. Client waits

3. Server sends update



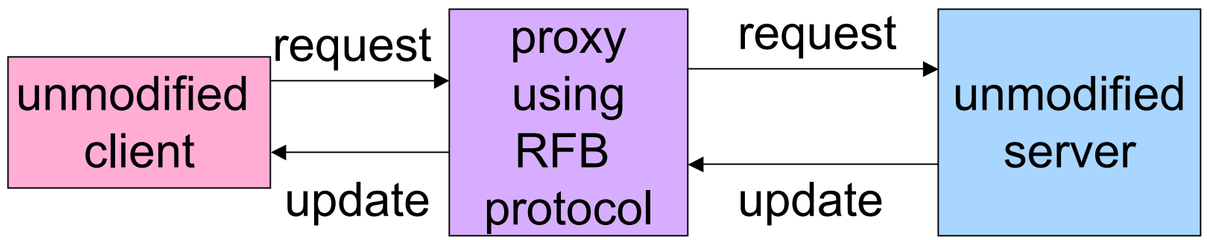
4. Client processes update

The Proxy and VNC



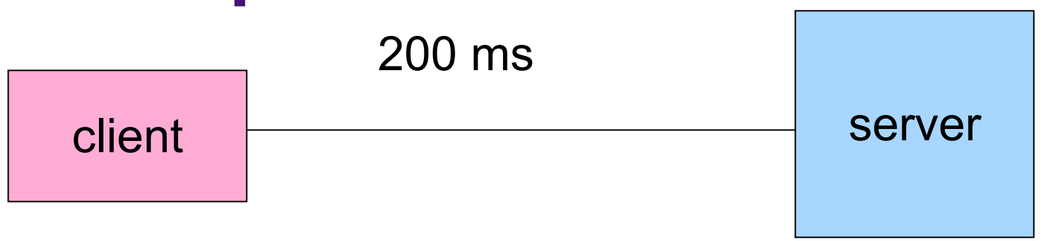
- The Smart Proxy sends requests to the server at the rate the client is processing them, without waiting for an update from the server
- This lets the Smart Proxy adjust for time delays between the client and server

The Proxy and VNC



- The client sees the proxy as the server, and the server sees the proxy as the client.
- As long as the proxy sends and receives messages in the RFB protocol, the VNC client and server applications require no modifications.

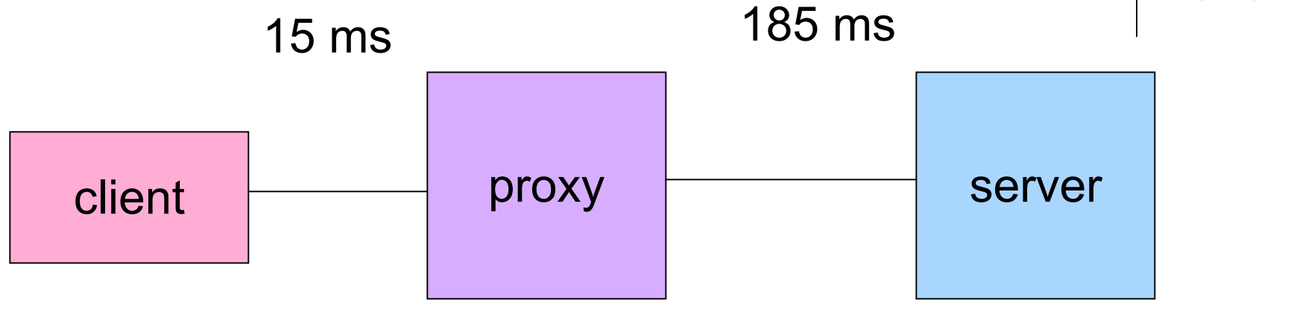
Example



- Client sends request - 200 ms
- Server processes - 5 ms
- Server sends update - 200 ms
- Client processes - 5 ms

Total time = 410 ms

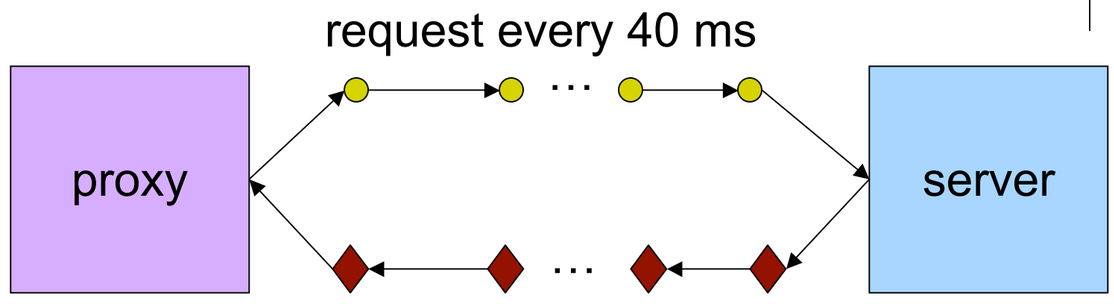
Example



- Proxy processes - 5 ms
- Proxy sends update to Client - 15 ms
- Client processes - 5 ms
- Client sends request - 15 ms

Total time = 40 ms

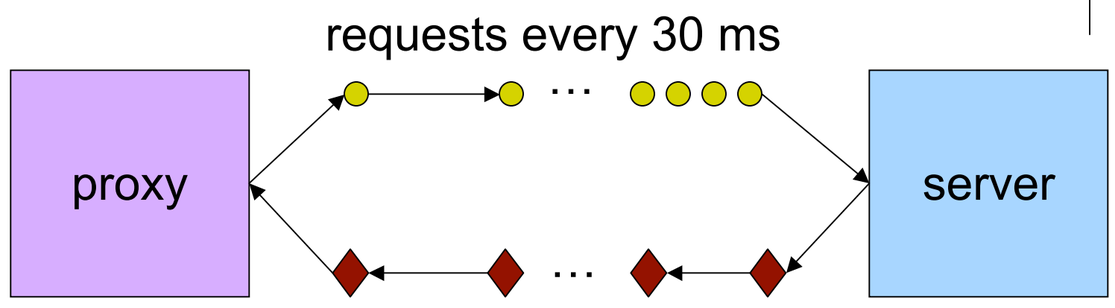
Example



update every 40 ms

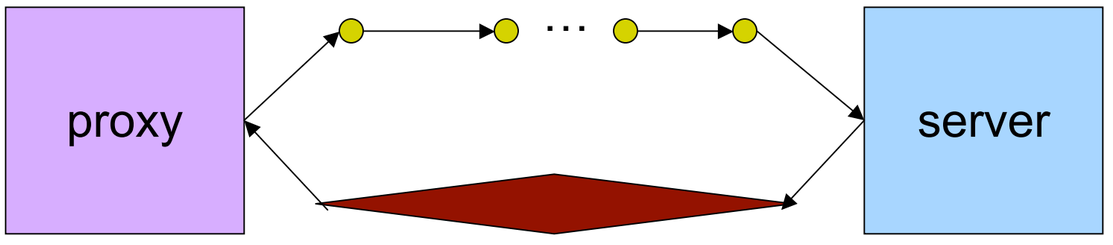
- The proxy sends requests to the server at the same rate the client is processing them, without waiting for a response from the server

Implementation Details



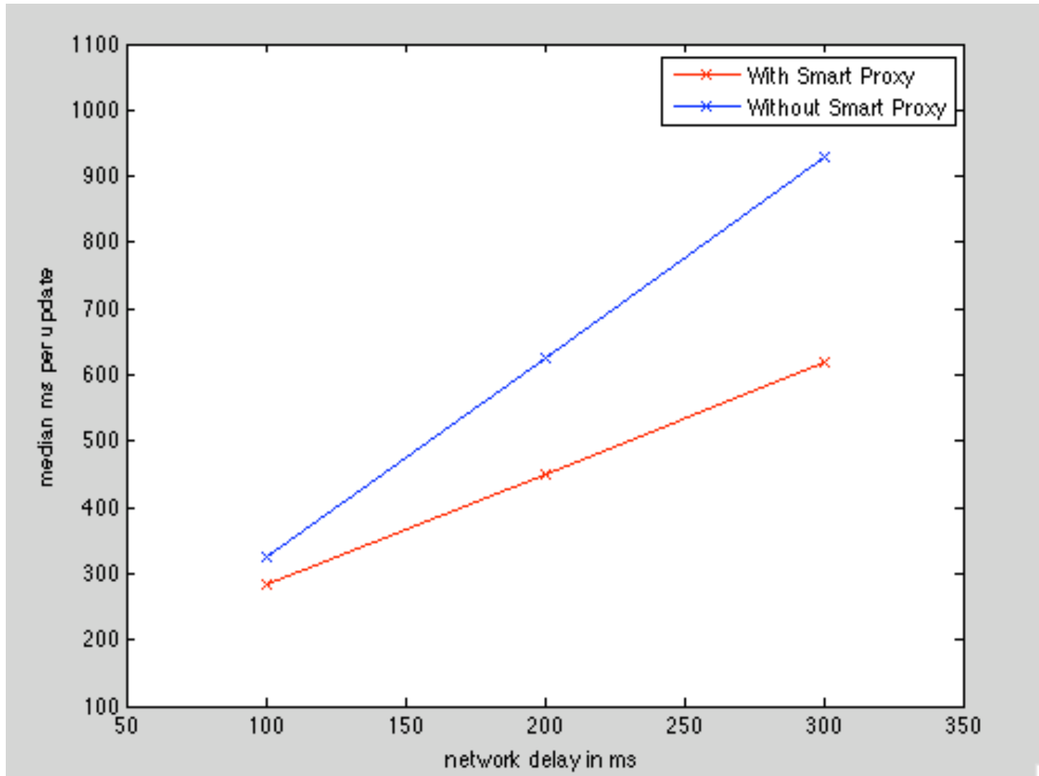
- If the proxy sends faster than the server can process updates, requests can accumulate at the server
- This causes more work for the server, resulting in a slower response

Implementation Details

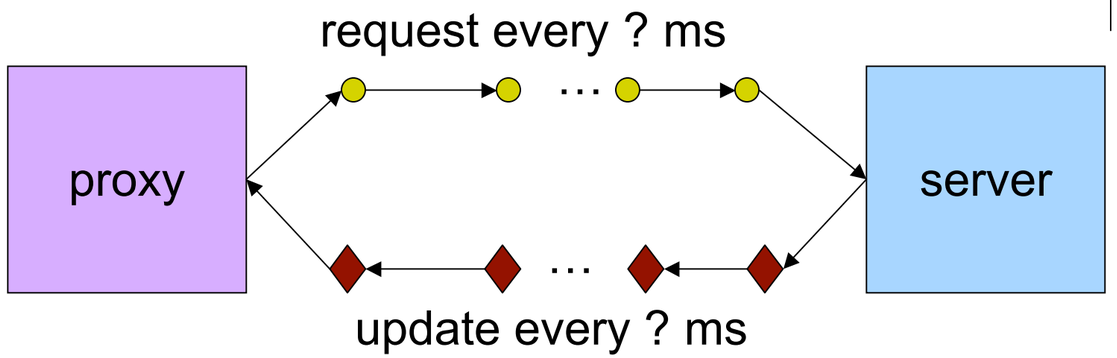


- Occasionally the server sends very large updates, which may be larger than the TCP window size.
- We are working at the application level, and the underlying protocols still require waiting for acknowledgements, which are affected by network delays

Results


With Smart Proxy
Without Smart Proxy
median ms per update
network delay in ms
1100
1000
900
800
700
600
500
400
300
200
100
50
100
150
200
250
300
350

Future Work



- Have the proxy automatically configure itself to send at the optimal rate.
- Is it possible to have to proxy perform as well as the client-server system with no delay?

Conclusion

- We can improve VNC performance by having a Smart Proxy mediate the update rate over network delays.
- Faster thin clients can help us integrate powerful computing into our mobile lives.