



Bandwidth Optimization for Mobile Thin Client Computing

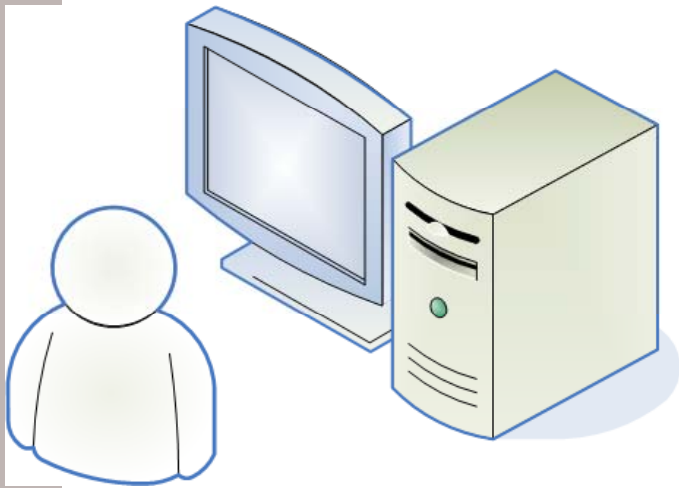
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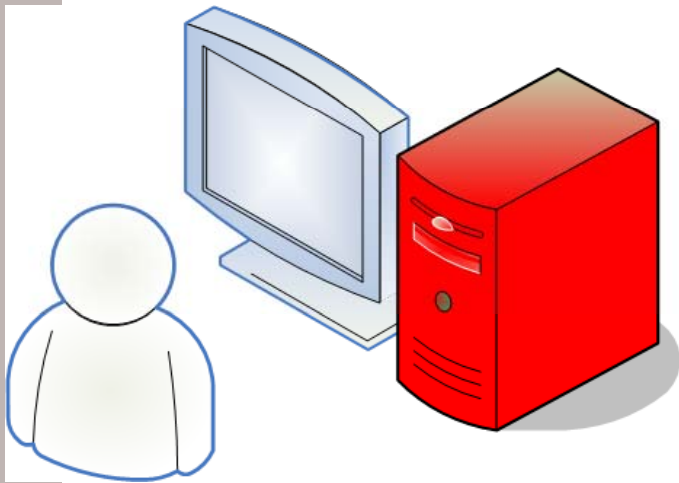
■ Thin Client Computing Concept

- Shift computations to a distant server
 - user input and screen updates are sent over the network



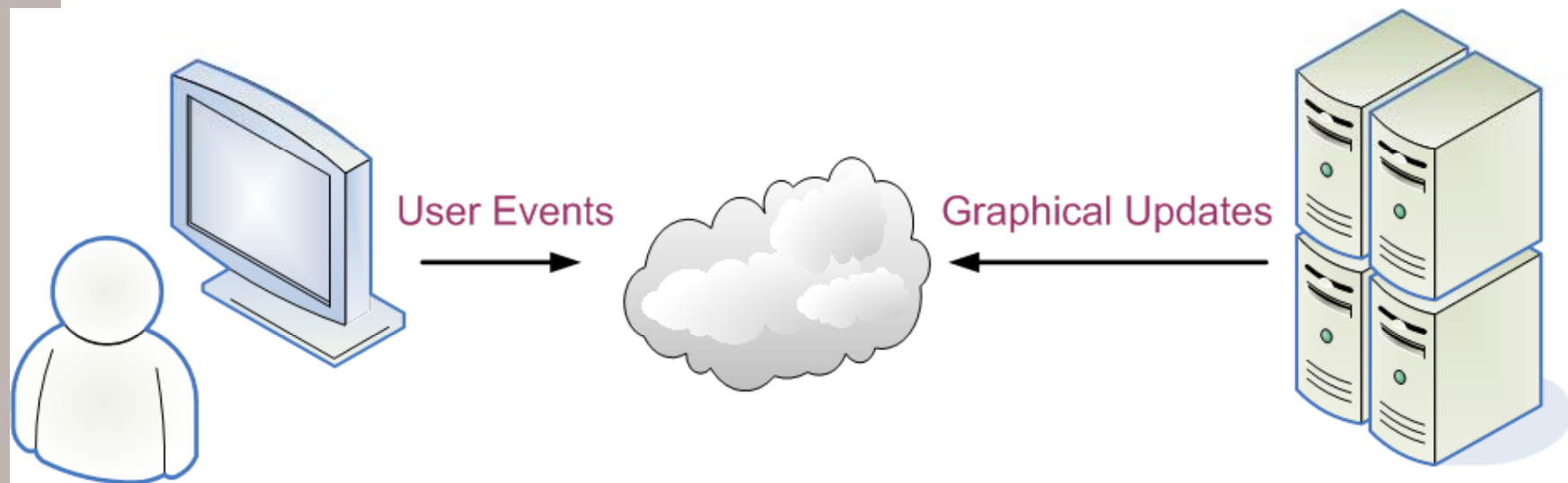
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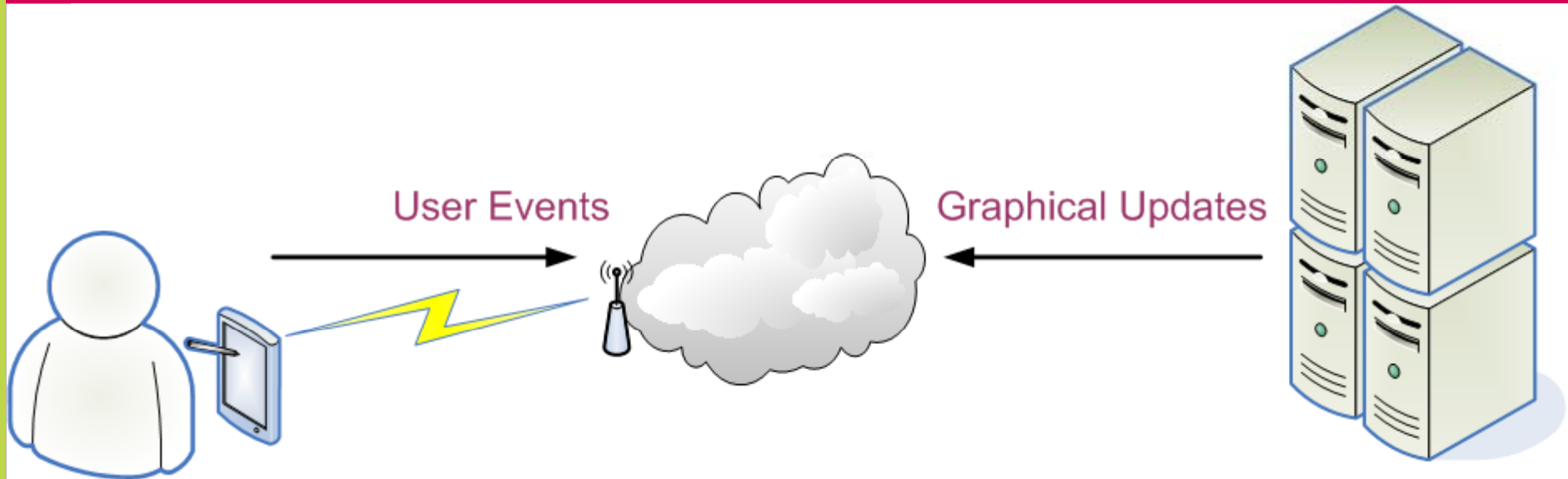


■ Thin Client Computing Concept

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■ Thin Client Computing Concept



- Use this technology for mobile devices, moving users
 - problems:
 - varying delay / bandwidth
 - battery drain on the client device because of wireless network interface



■ **MobiThin Project Scope**

- European Project: 7th Framework Programme
- **Bringing demanding applications to mobile devices**
 - Work on both **infrastructural** level as **protocol** level
 - Wireless optimization
 - Intelligent service distribution
 - Protocol adaptive to environment conditions

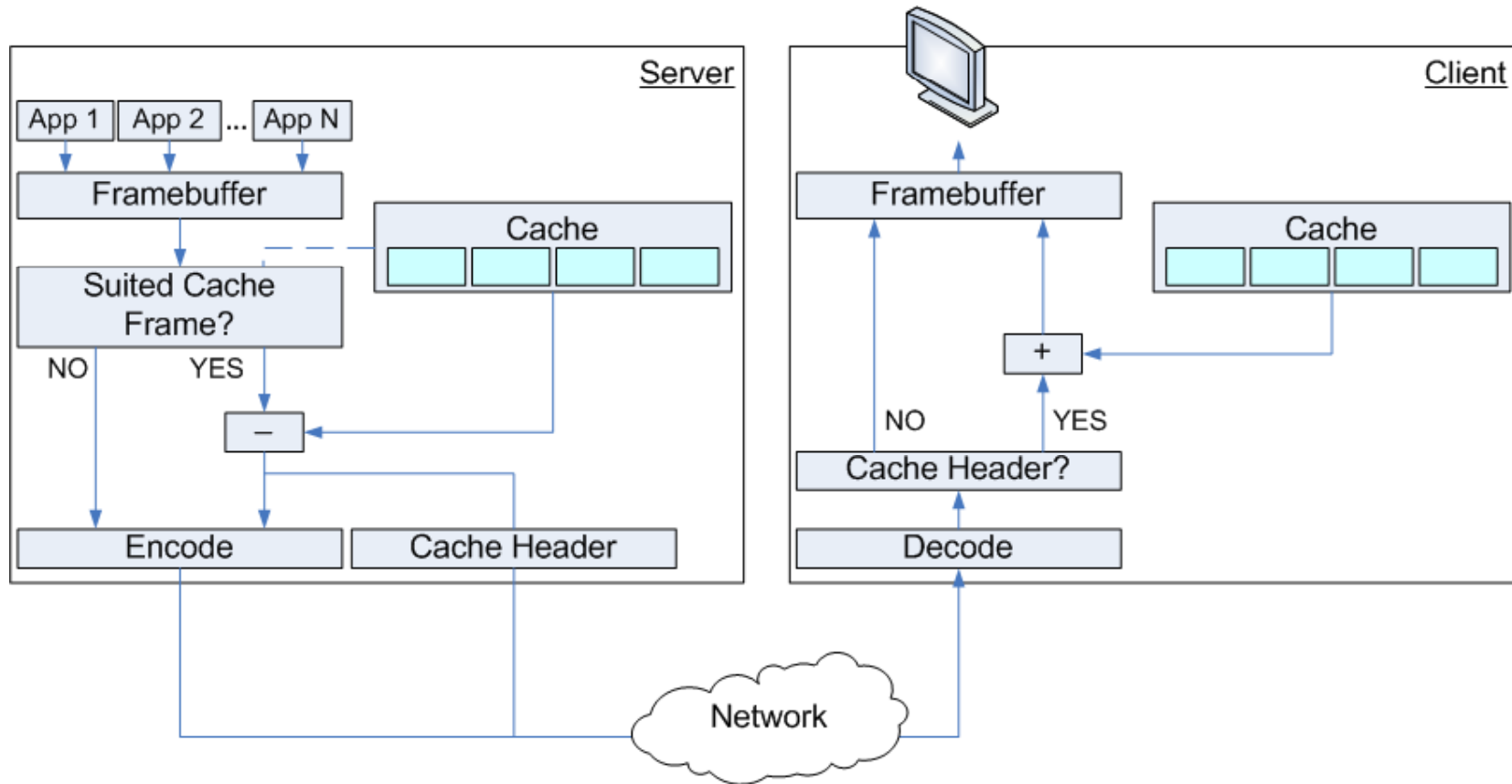
www.mobithin.eu

Overall PC Usage Observations /Assumptions



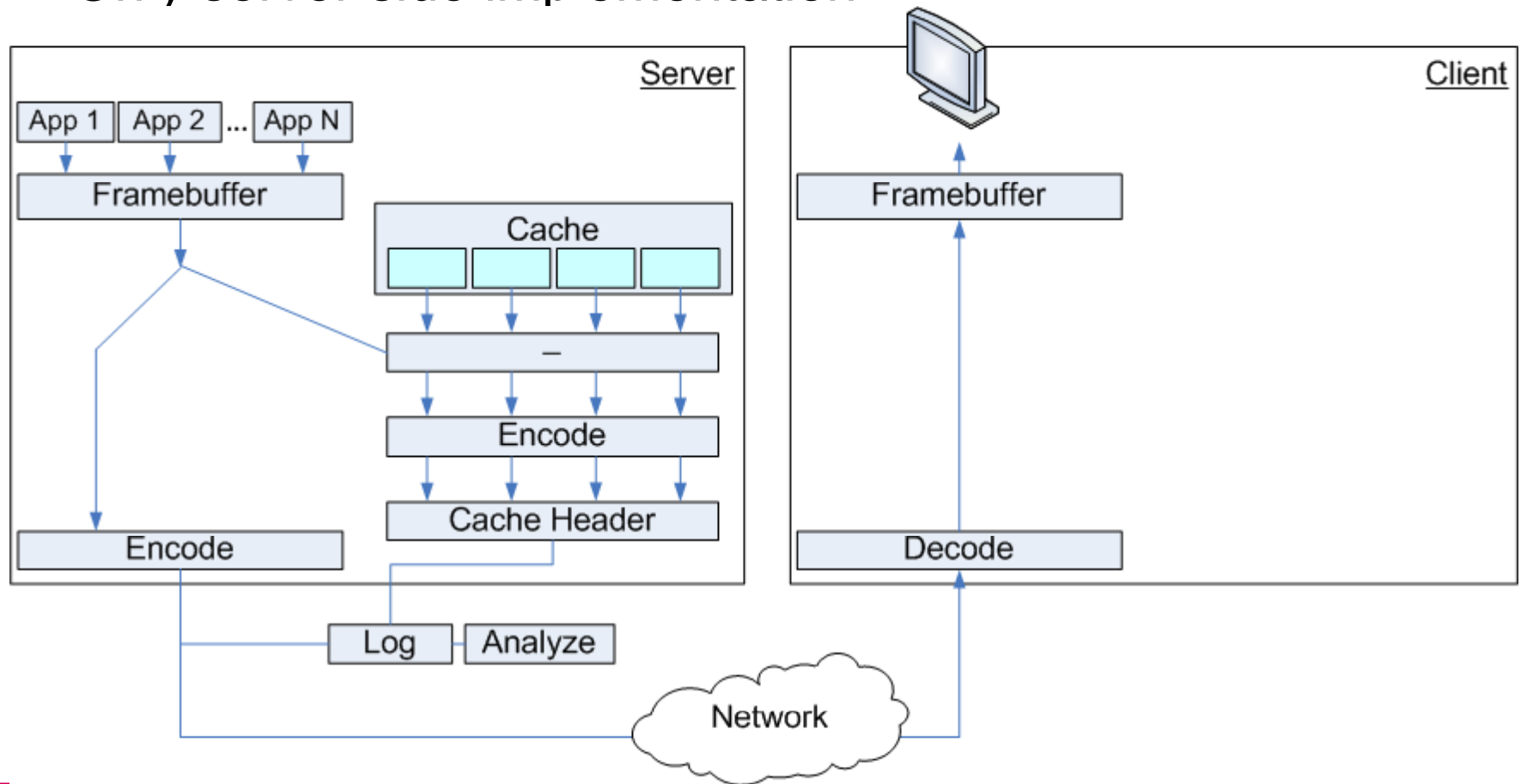
- Frequent background screens
 - Desktop with shortcuts
 - Home page of browser
 - White screen and menus of text editor
- Most screen updates are small in size

Caching Mechanism: Concept



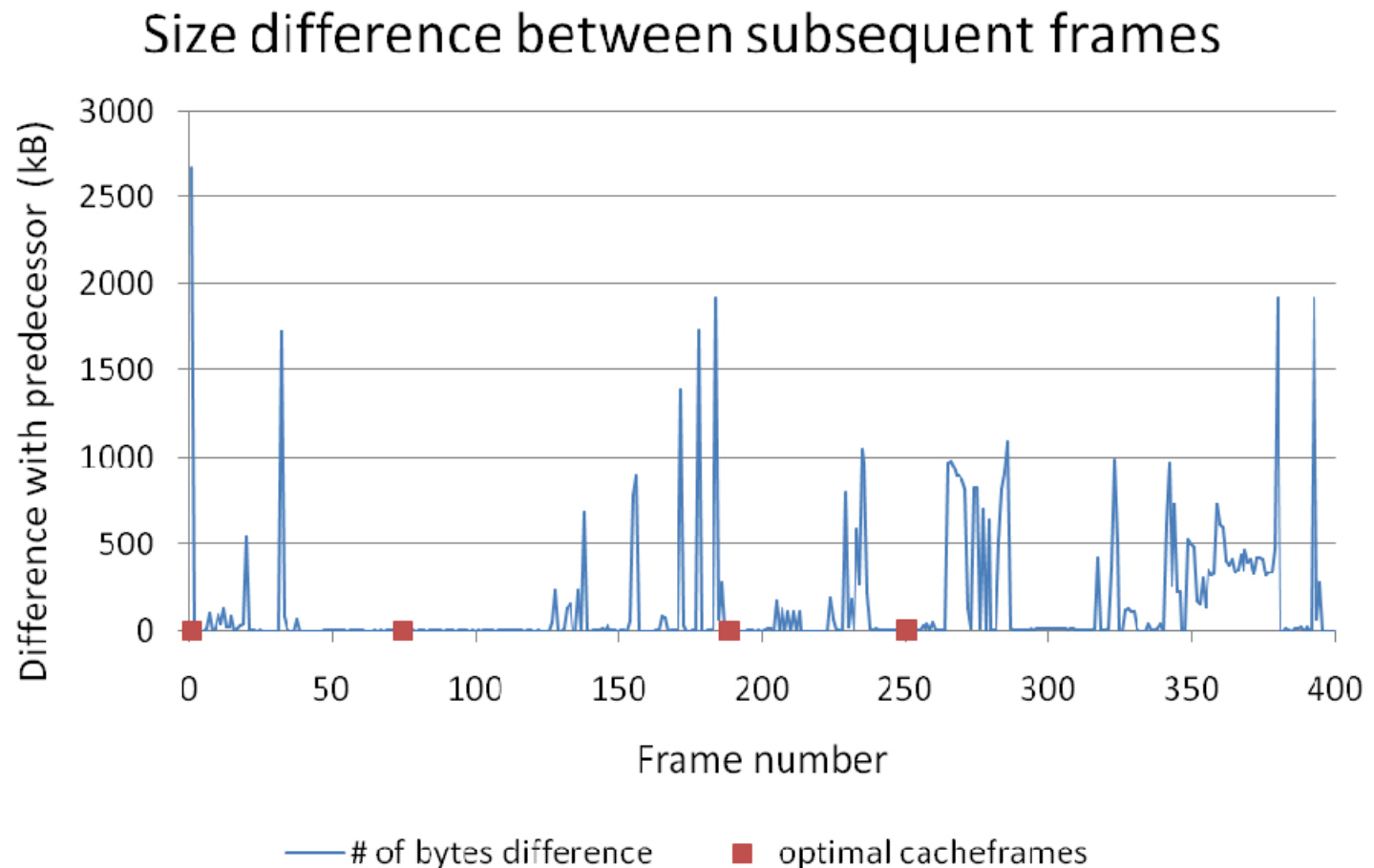
Caching Mechanism: Prototype Implementation

- Only server side implementation

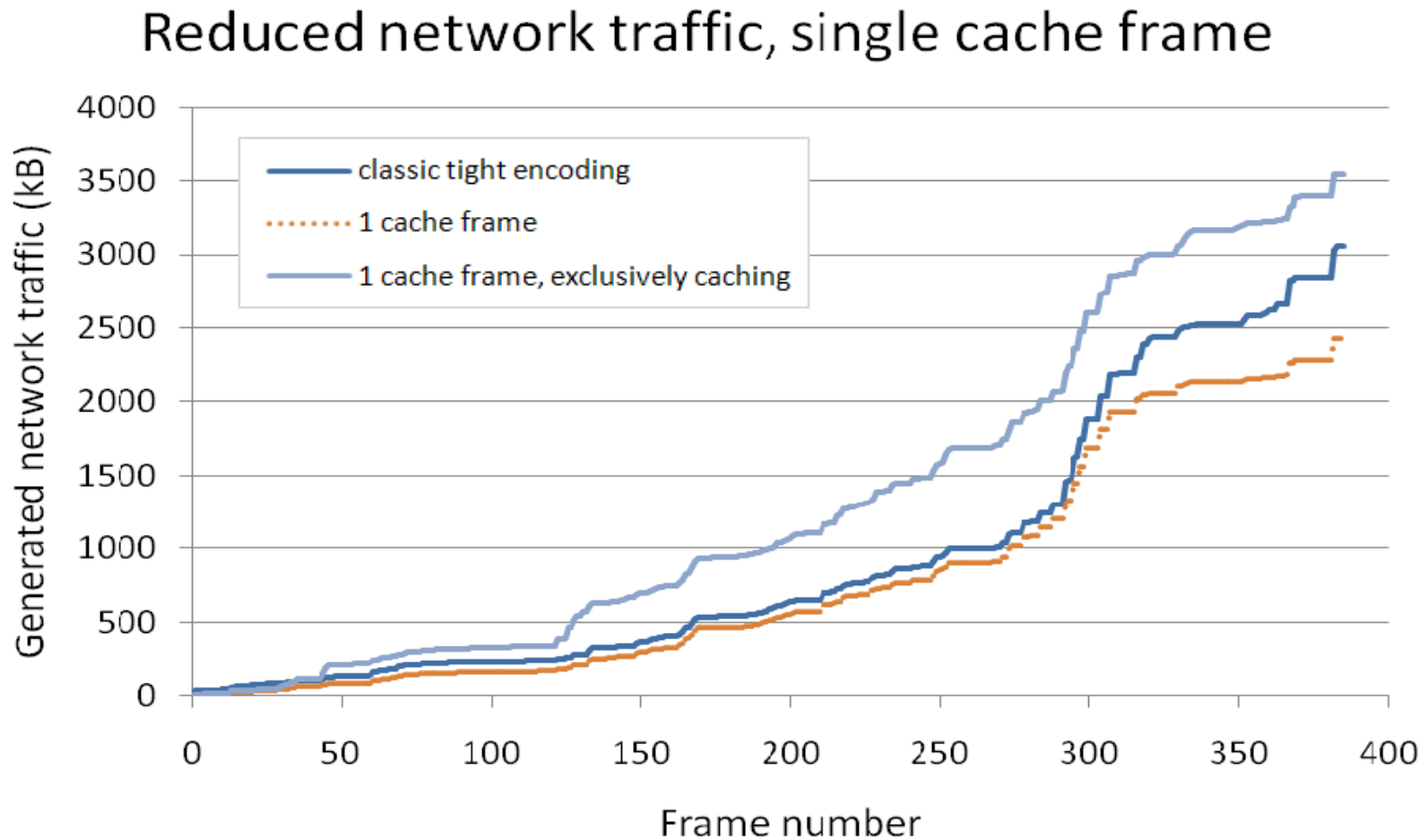


Caching Mechanism: Static Cache

- Statically defined cache frames based on 'training' session

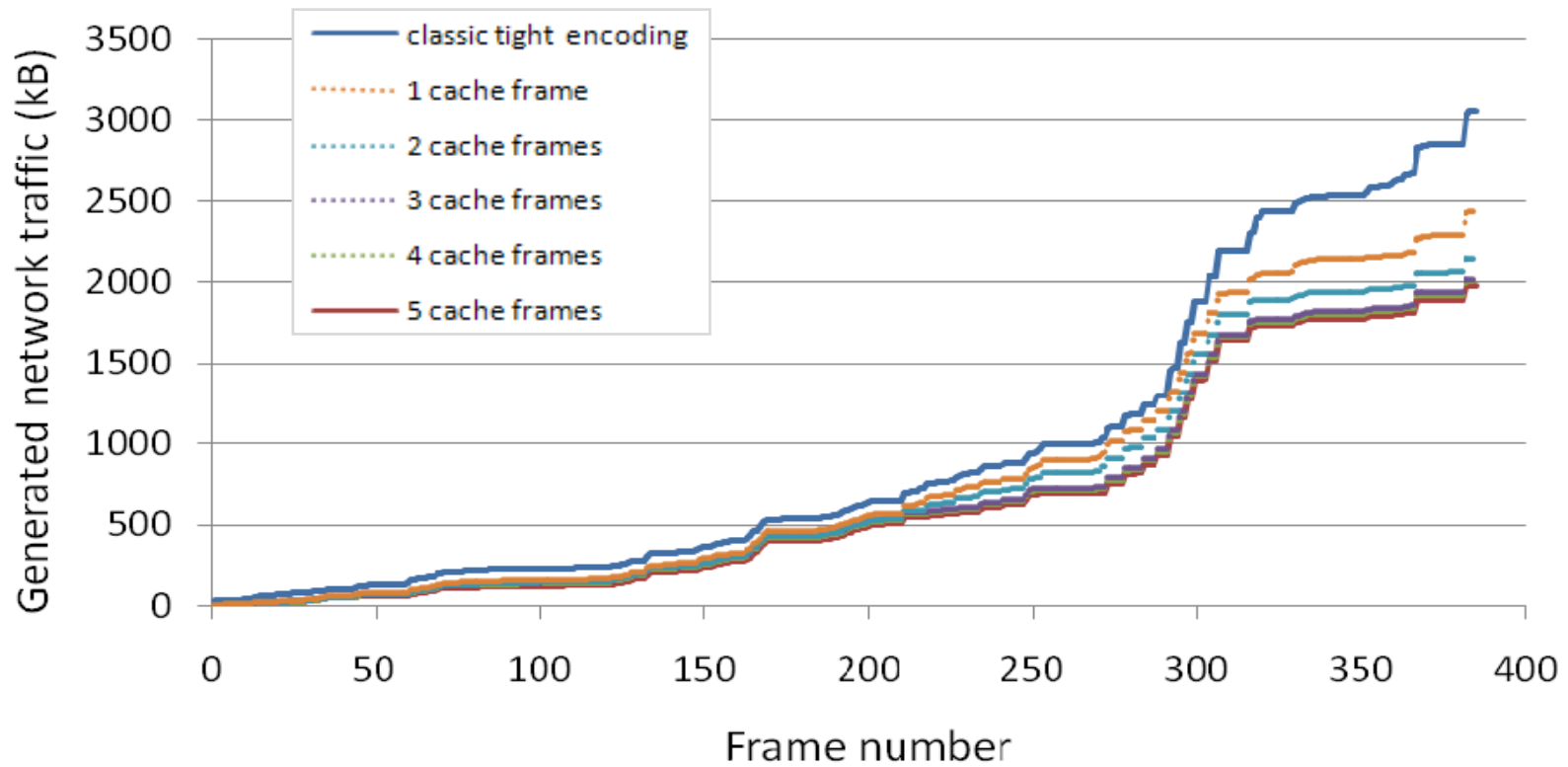


Results: Total Bandwidth Reduction



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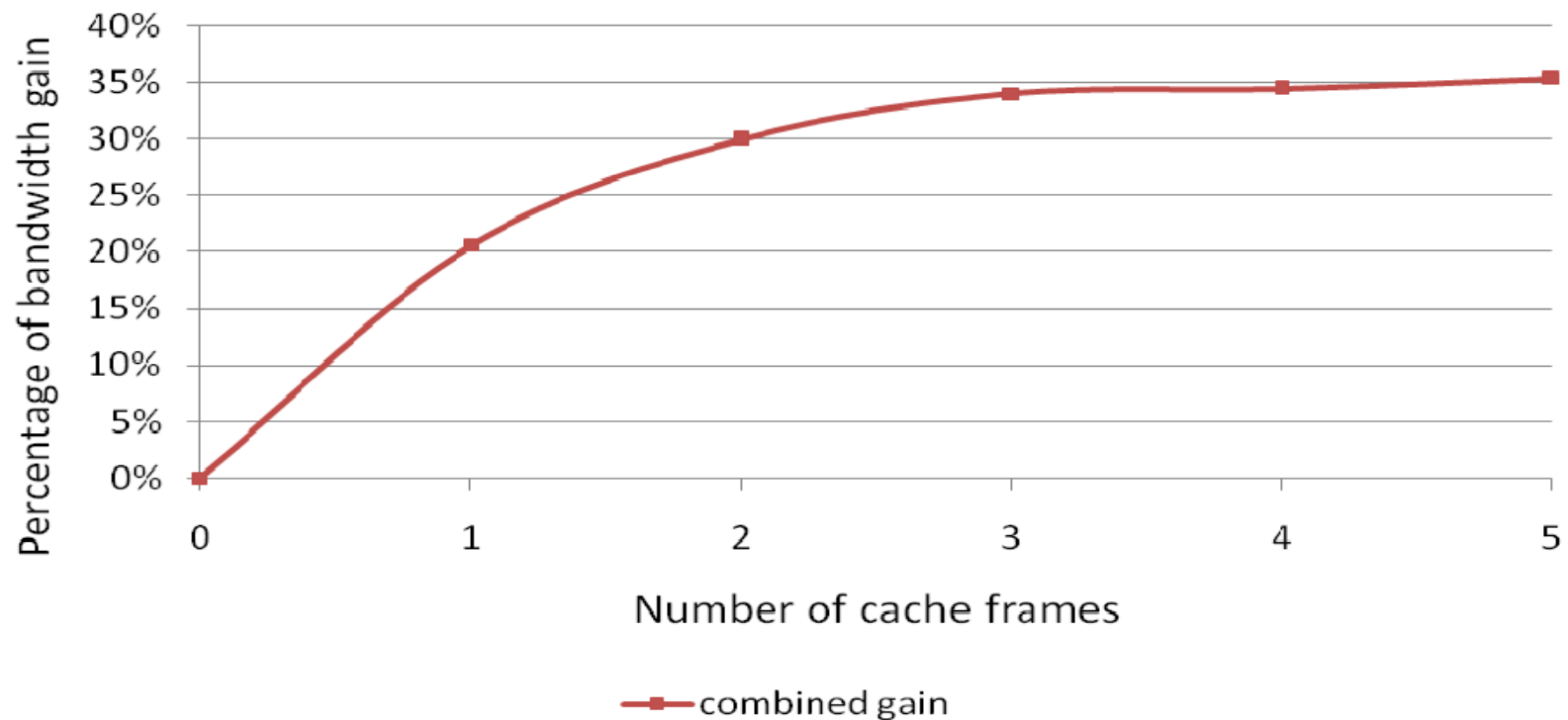
Reduced network traffic, multiple cache frames



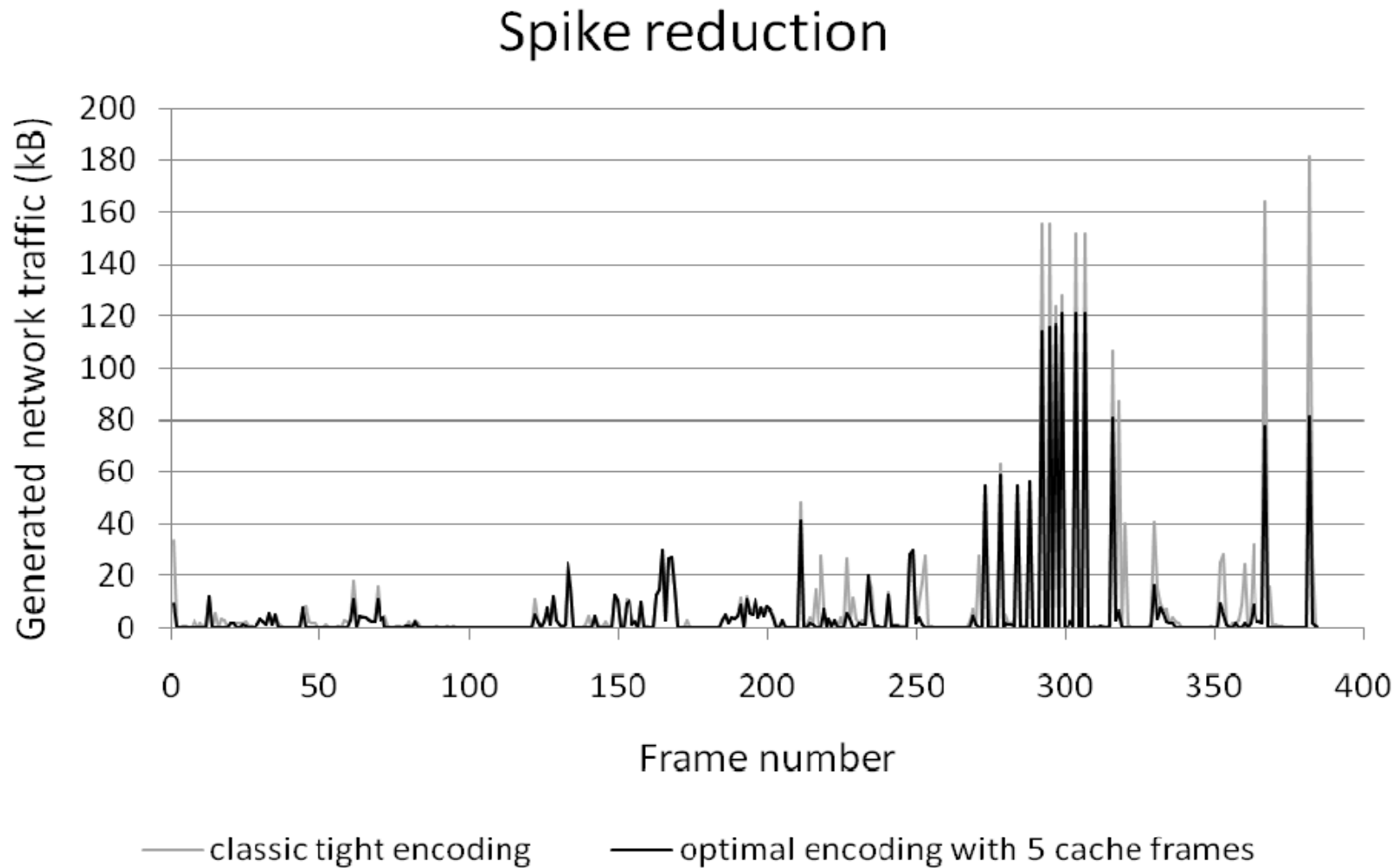
Results: Number of Cache Frames

- Never decreasing
- Amount depends on content of cache frame

Influence of number of cache frames on bandwidth gain



Results: Momentary Bandwidth Reduction



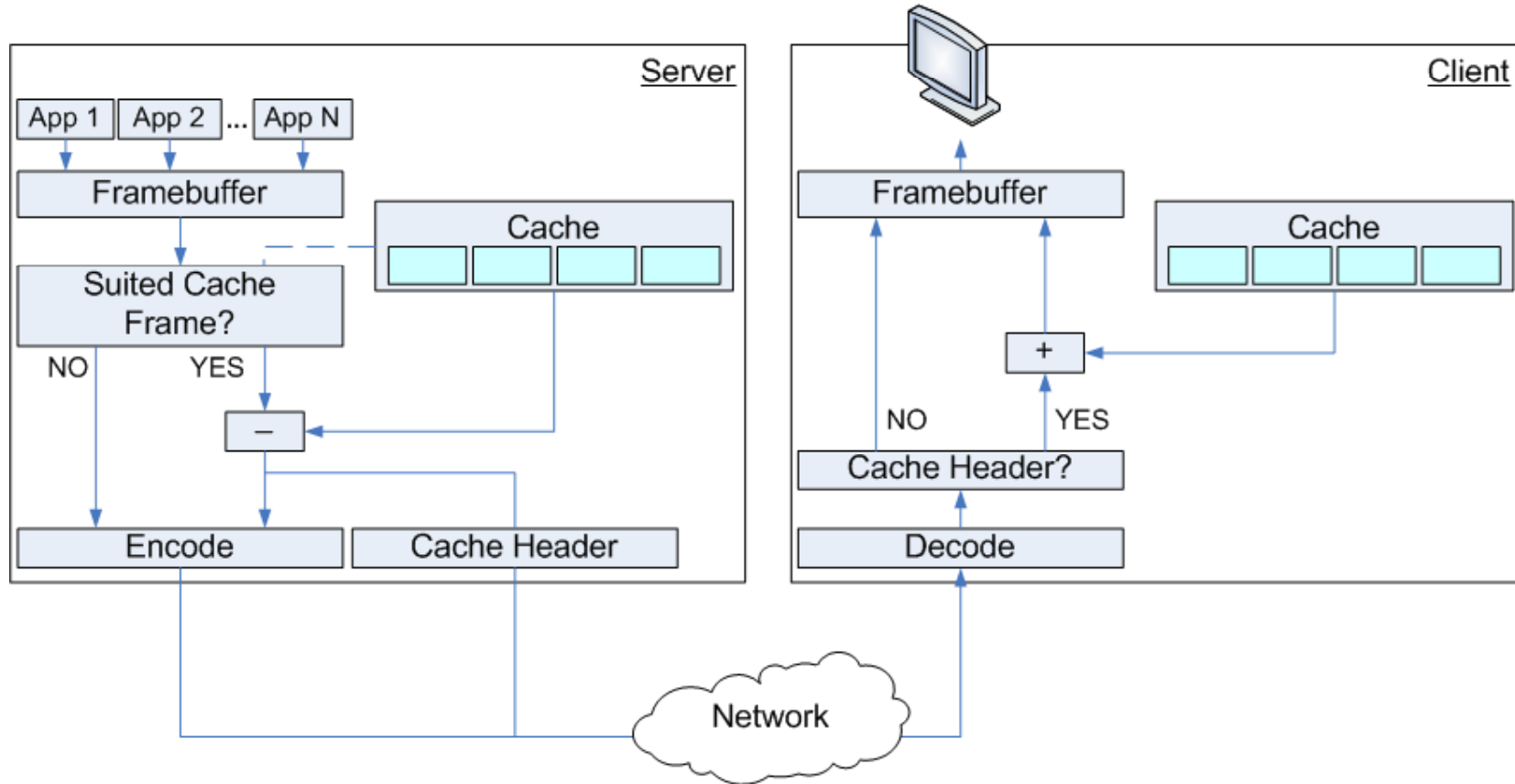
Conclusion

- Numbers
 - Overall gain
 - 1 cache frame: 20%
 - 5 cache frames: 34%
 - Spike reduction: 33%
- Highly dynamic content: cache will not be very efficient
 - Solution:
 - analyze the image content and switch to streaming

■ Future Work - Opportunities

- Better metric for difference between frames
 - Better evaluation of optimal cache (spread)
 - Automated selection of optimal cache frames based on 'training' session
 - Faster and better evaluation of the cache frame to use for current frame update (decrease delay)
- Dynamic cache
- Caching of windows: more semantics than just pixel based cache
- Resolution differences between client and server

Future Work - Opportunities



■ Thanks for the attention!

