# Resource management strategies for Mobile Web-based services

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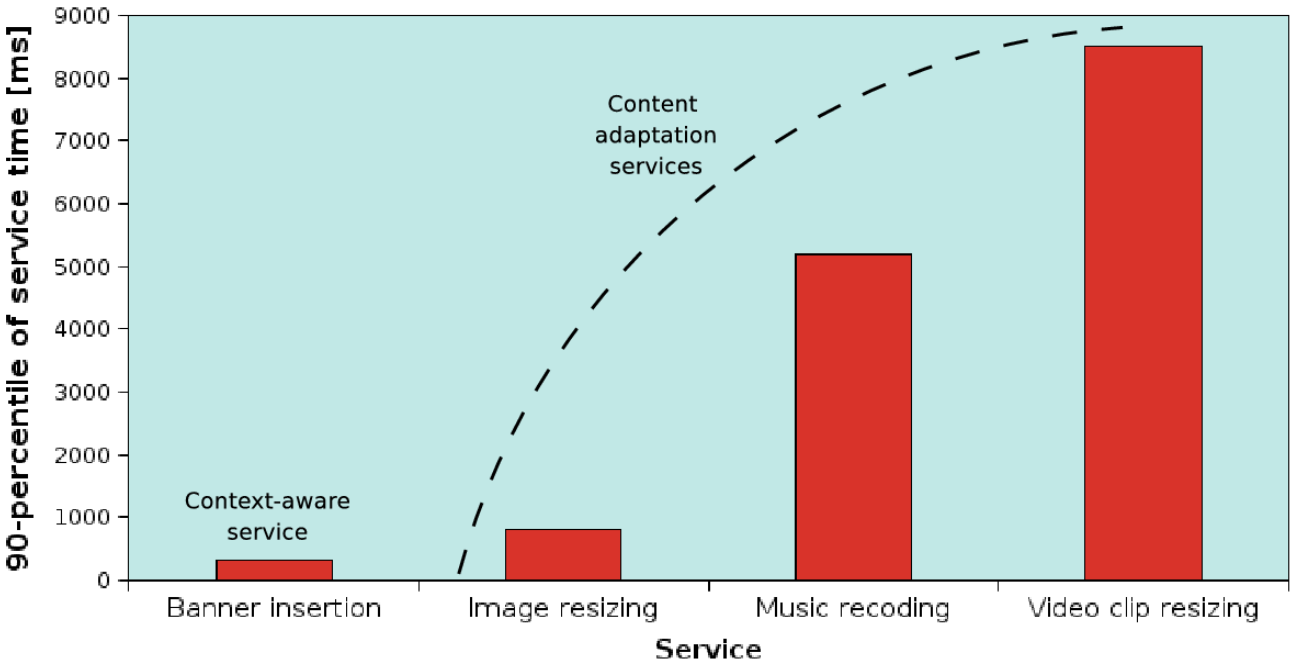
# *The mobile Web*

- **Web access form mobile devices**
  - Access to services tailored to device
    - On-the-fly adaptation
    - Small display
    - No keyboards
  - Services based on user preferences
  - Mobile Web increases the complexity of Web-based services
- **Growth of mobile Web**
  - Mobile users expected to grow by 900% within 2013
- **Will current architectures support future demands of mobile Web?**

# *Mobile Web-based services*

- **Focus on two significant categories of site**
  - 80% of top 100 most popular sites
- **Online news sites**
  - Information portals (sports, economy)
  - Newspaper and news broadcasting sites (e.g., cnn.com)
- **Social-multimedia sites**
  - Web 2.0 sites
  - Social networking (e.g., Facebook, blogsphere)
  - Resource sharing networks (e.g., YouTube, Flickr)

# *Workload evolution trends*

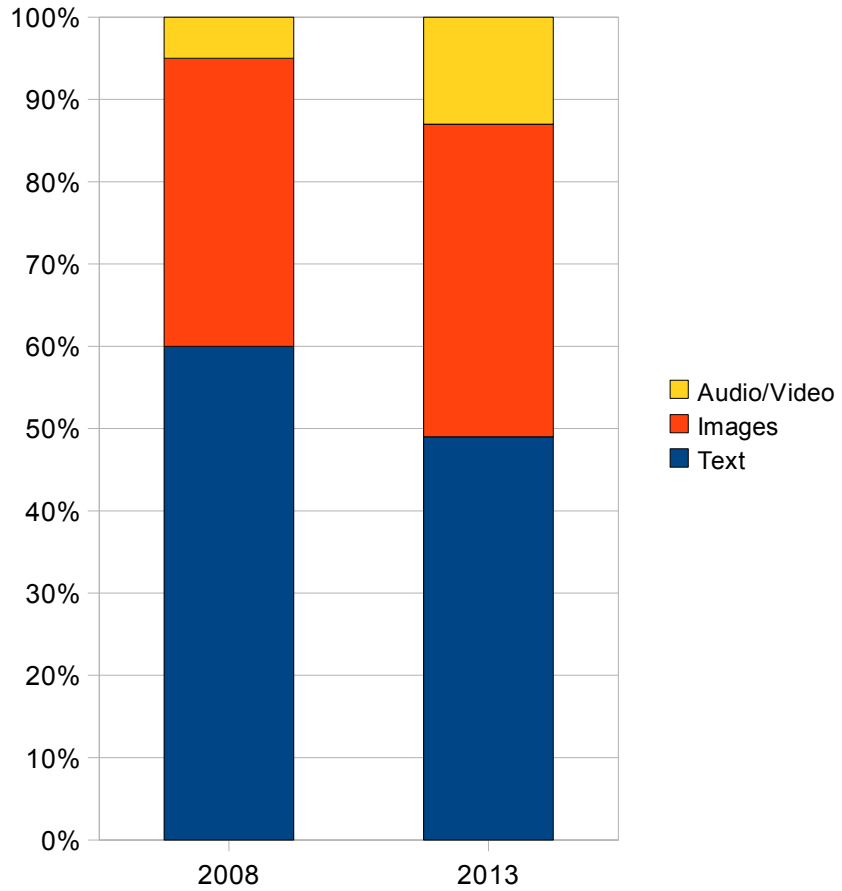



- **Workload composition**
- **Size of workload resources**
- **Workload intensity**

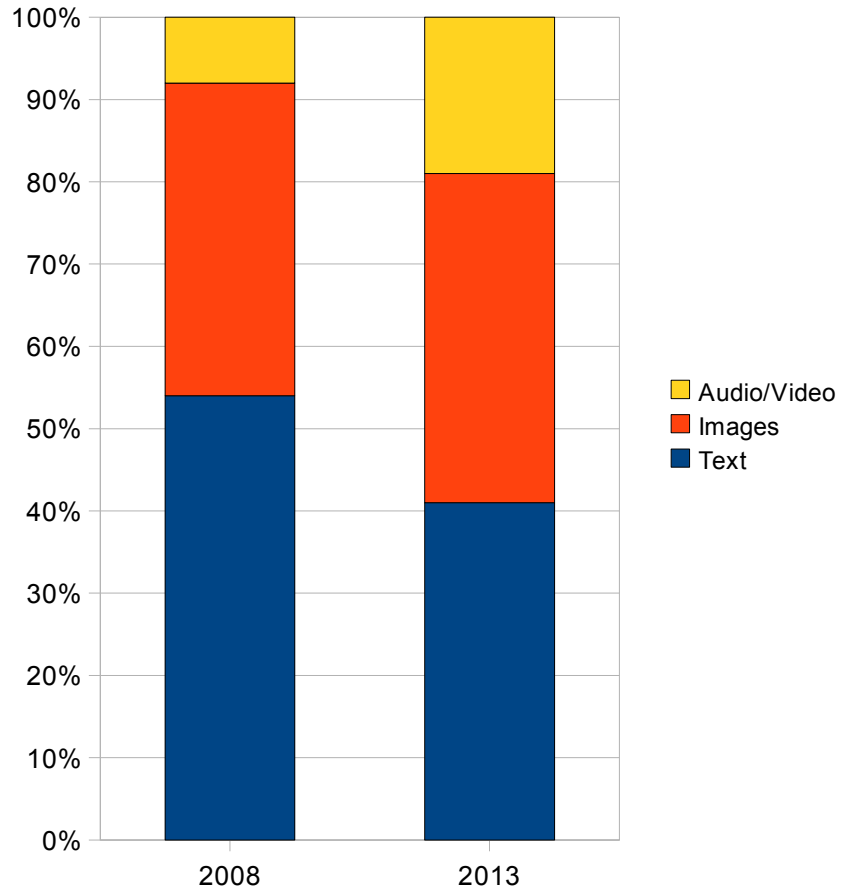
- **→ Growth of computational demands**

# *Workload composition*

## Online news




## Social multimedia




## Growing amount of multimedia resources

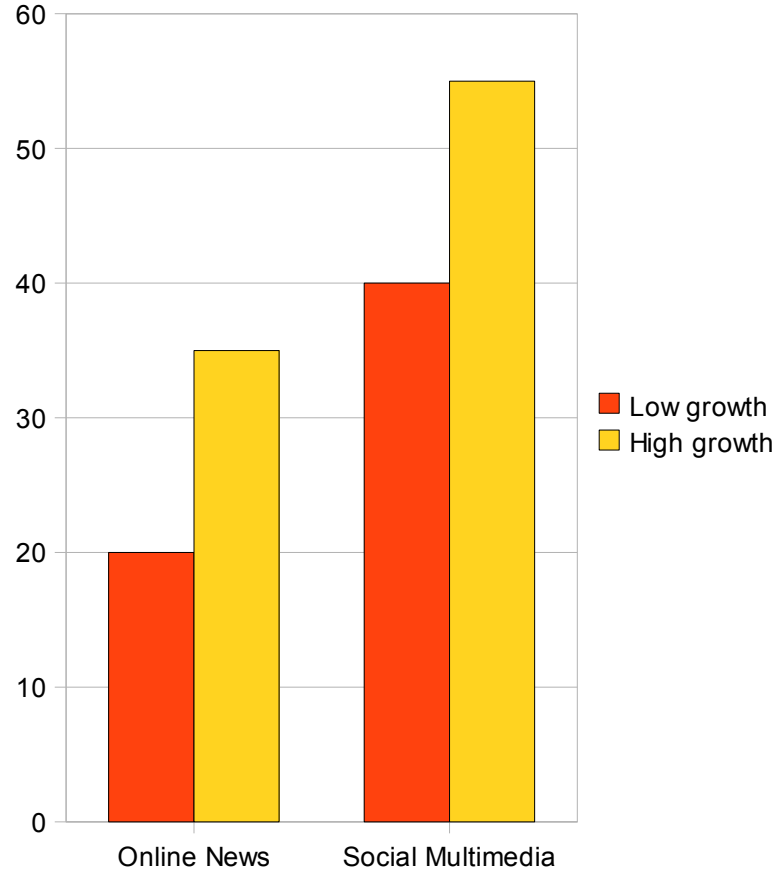
# *Size of workload resources*

- **Resources are getting larger**
  - Picture size
  - Video resolution and length

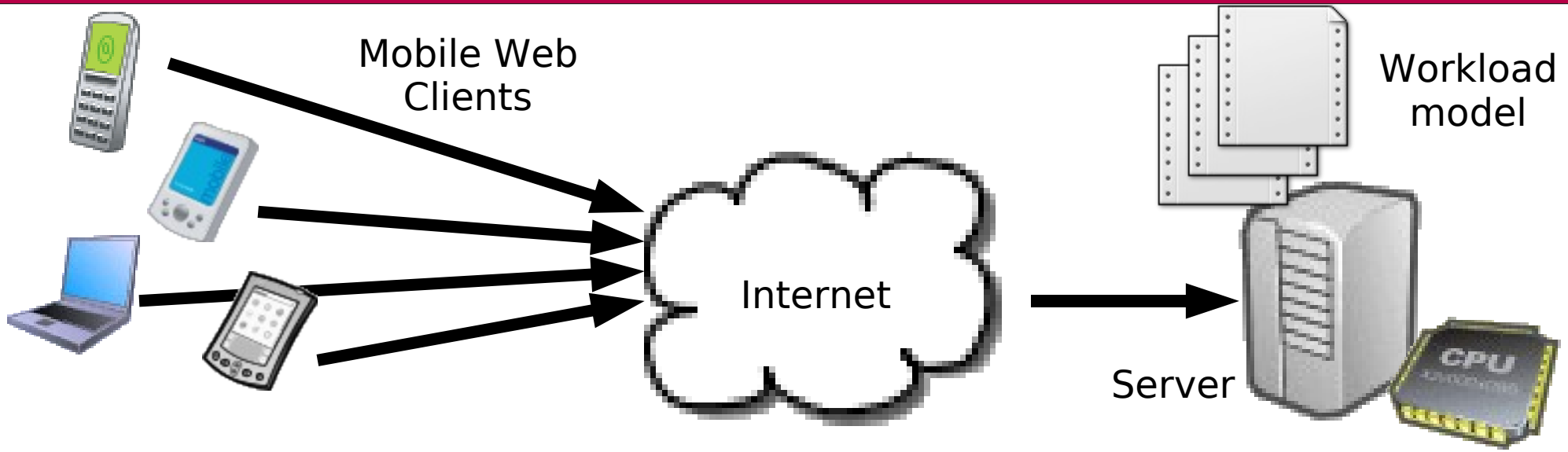
- **Growth of median resource size**
  - 12% per year for images
  - 16% per year for audio and video

# *Workload intensity*

- **Growth of workload intensity**
  - Low growth scenario
    - 20%-40% per year
  - High growth scenario
    - 35%-55% per year
- **Moore's law:**
  - Computational power doubles every 18 months
  - **Is it enough?**



# *Experimental testbed*




- **Simulation based on Omnet++ with Inet package**
- **Server model:**
  - Working set description (type and size of resources)
  - Dynamic services (depends on resource size and CPU)
  - Internal server resources (time shared CPU)
  - HTTP 1.1 interactions (chucked downloads and uploads)
- **Mobile Web clients** (workload intensity based on clients)
  - Use of HTTP streaming for multimedia resources

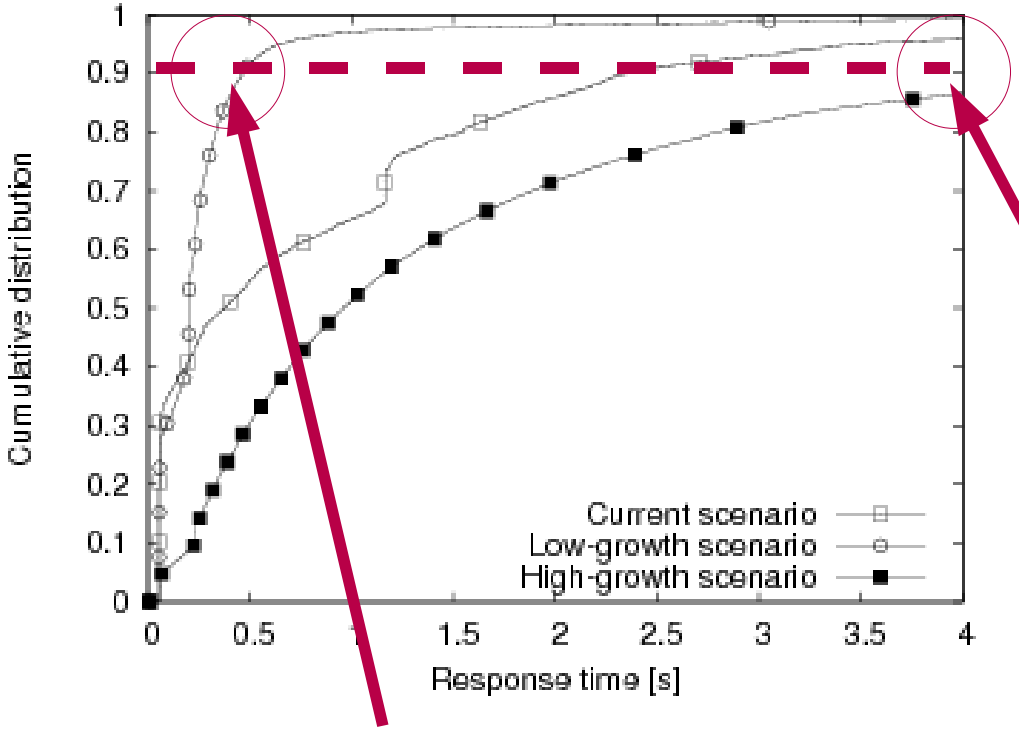
# *Experimental scenarios*

- **Current scenario**
  - Nowadays workload models
  - Current CPUs
- **Low-growth scenario**
  - Conservative assumptions on workload evolution
  - Future CPUs
- **High-growth scenario**
  - Worst-case for supporting architectures

# Performance impact

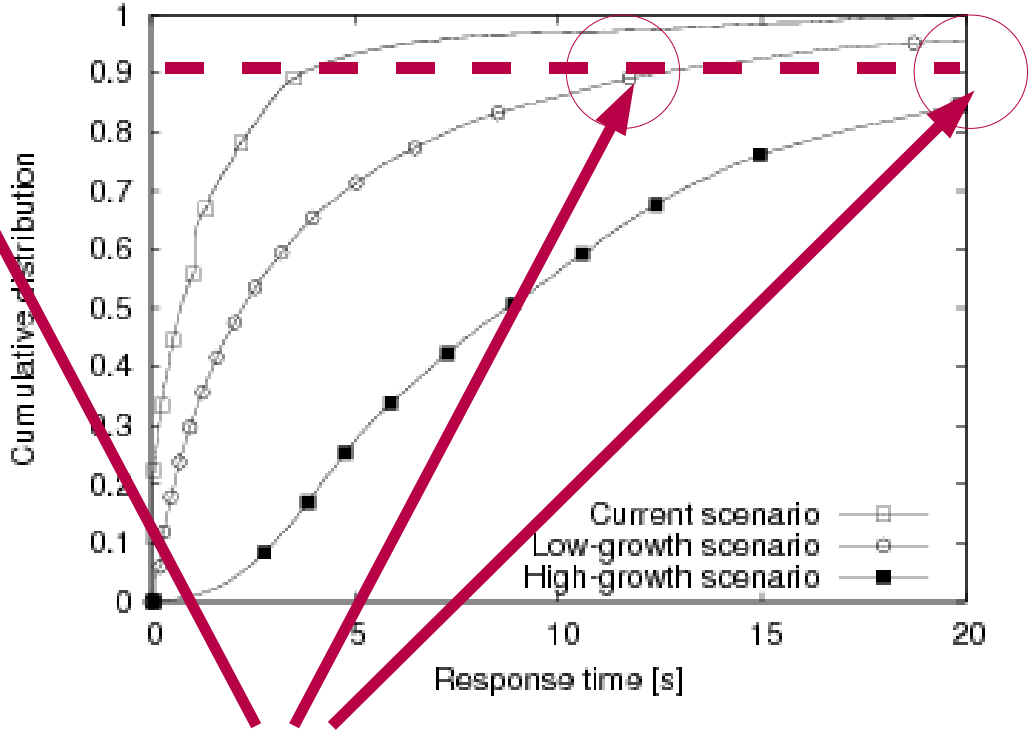
## Response time

### Online news



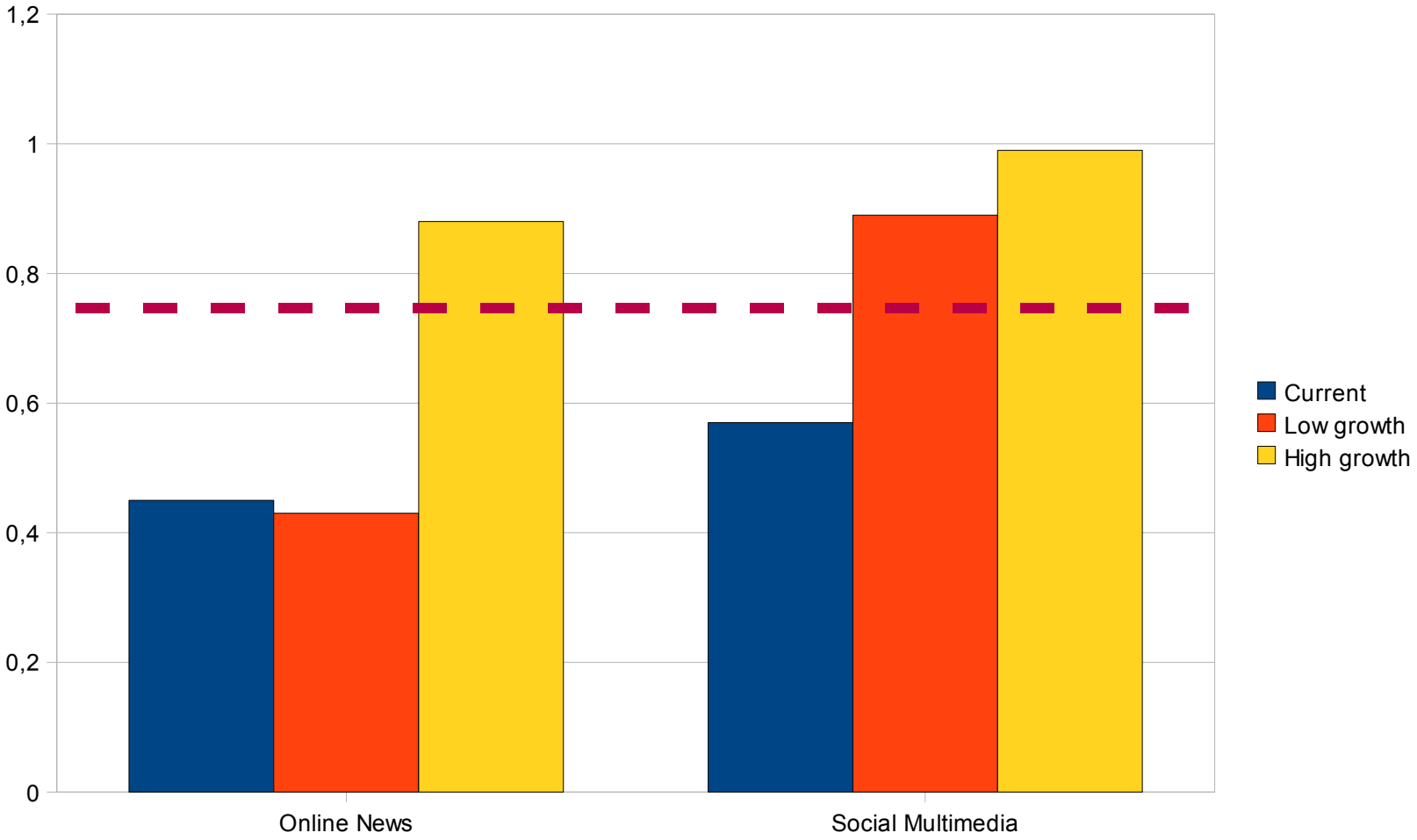

CPU power growing **more** than workload

### Social multimedia




CPU power growing **less** than workload

# CPU Utilization




**CPU overload occurring in 3 out of 4 scenarios**

# *Resource management strategies*

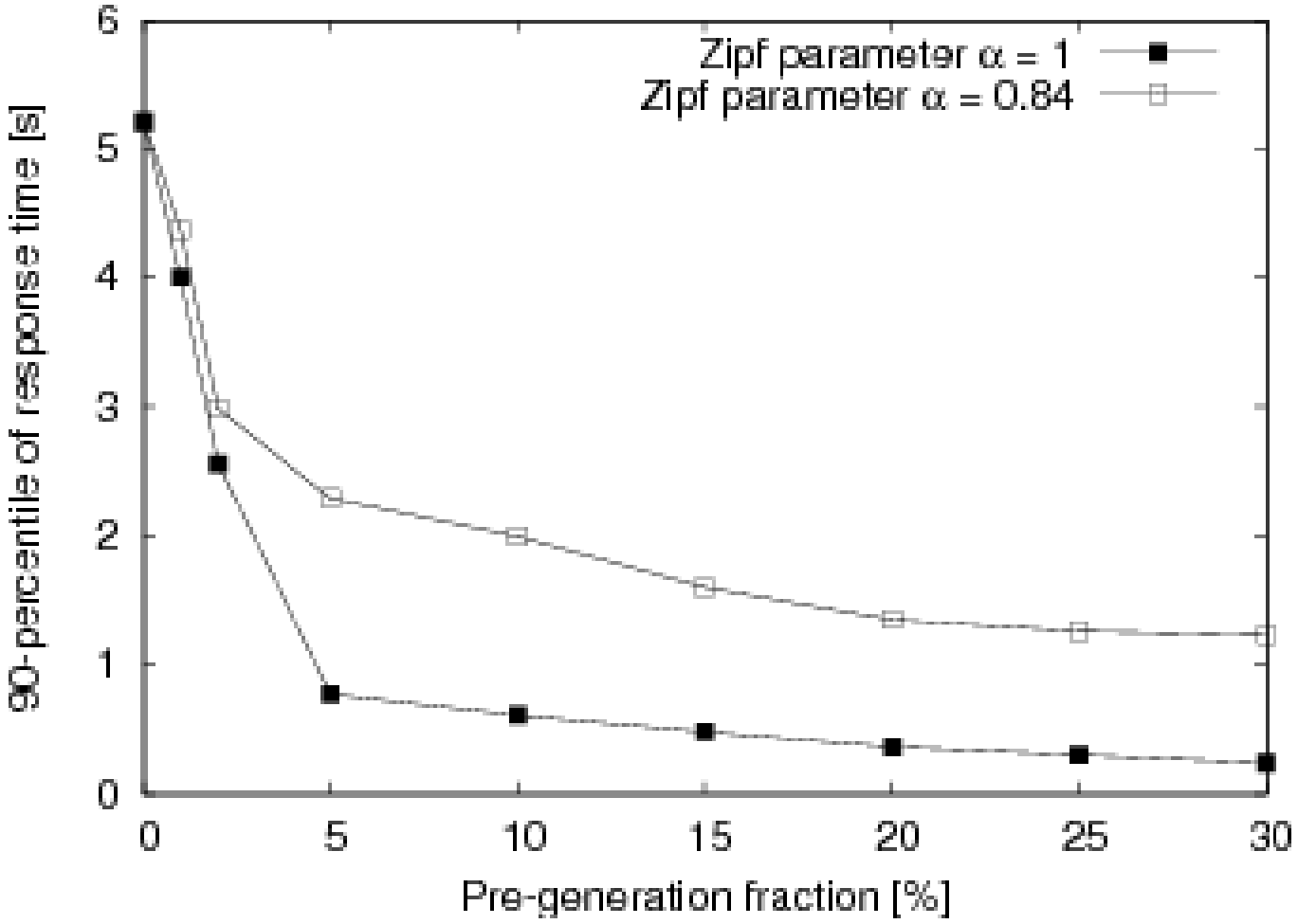
- **Need to reduce computational demand**
- **Avoid adaptation of multimedia resources on-the-fly**
- **→ Pre-generation of multimedia content**
- **Pre-generating every content**
  - Not every resource can be pre-generated
  - Highly volatile workload
  - High computational and storage demands
  - → Unfeasible

# *Resource management strategies*

- **Pre-generating a fraction of the contents**
  - Focus only on the most popular resources
  - Exploit Zipf-like popularity distribution
  - How much pre-generation is required?

- **Workload characteristics:**
  - No clear model for popularity distribution
  - Zipf $\alpha$ parameter
    - From 0.8 (typical Web workload)
    - To 1.0 (highly skewed workload)

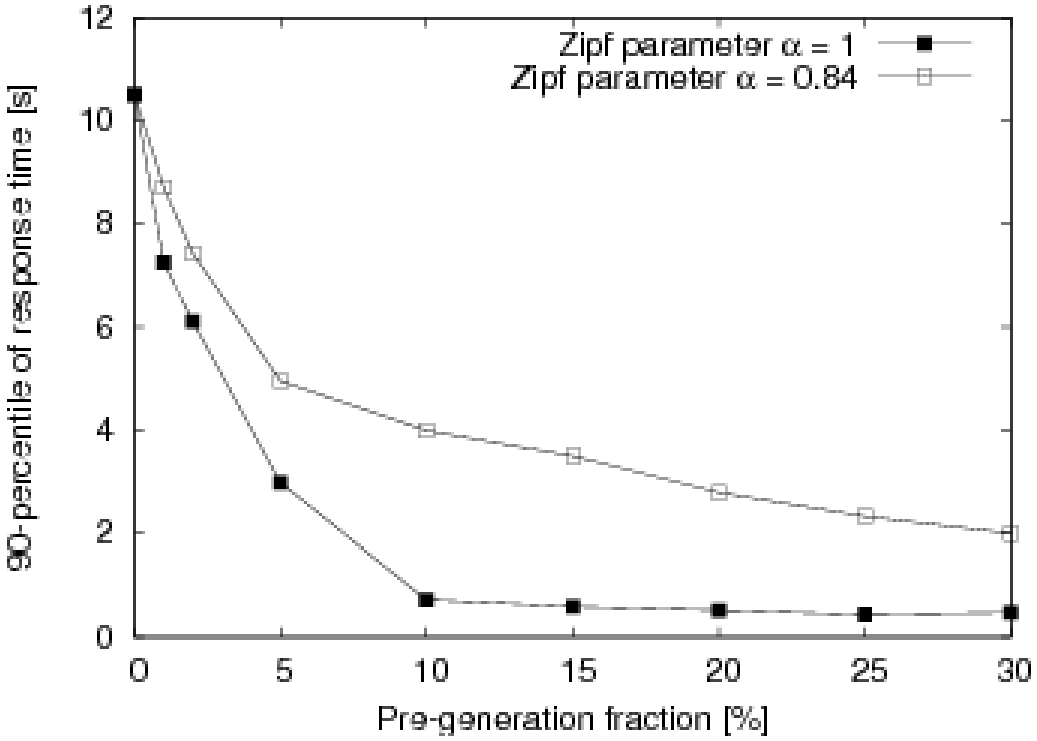
## Online news: High growth



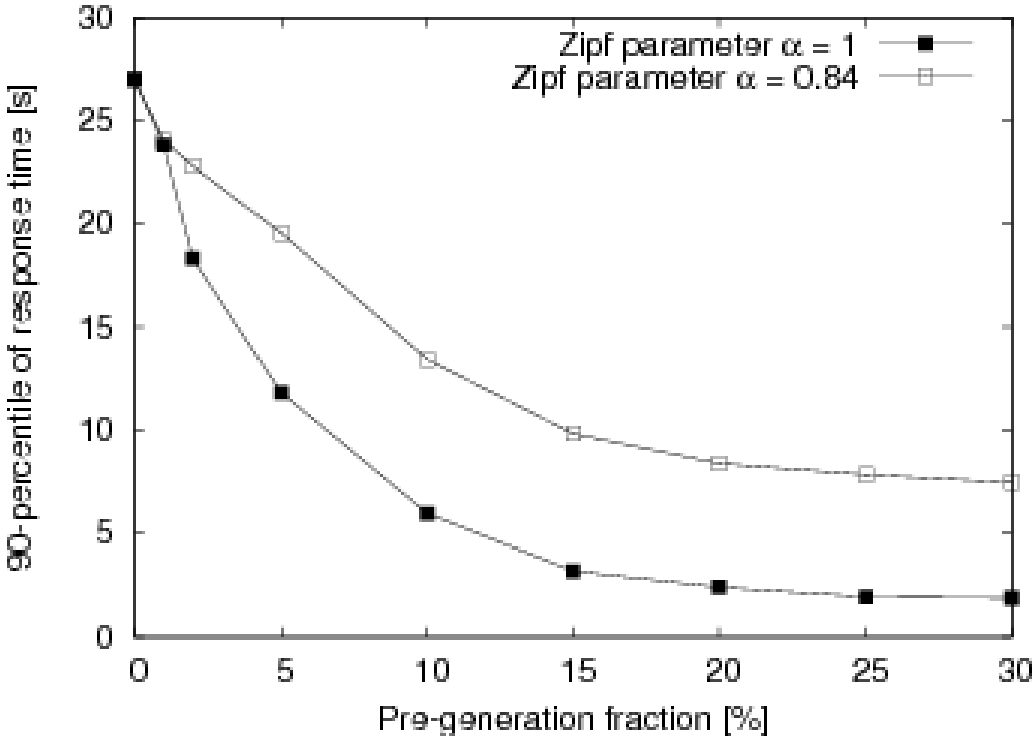
# Performance impact

## Social multimedia

### Low growth



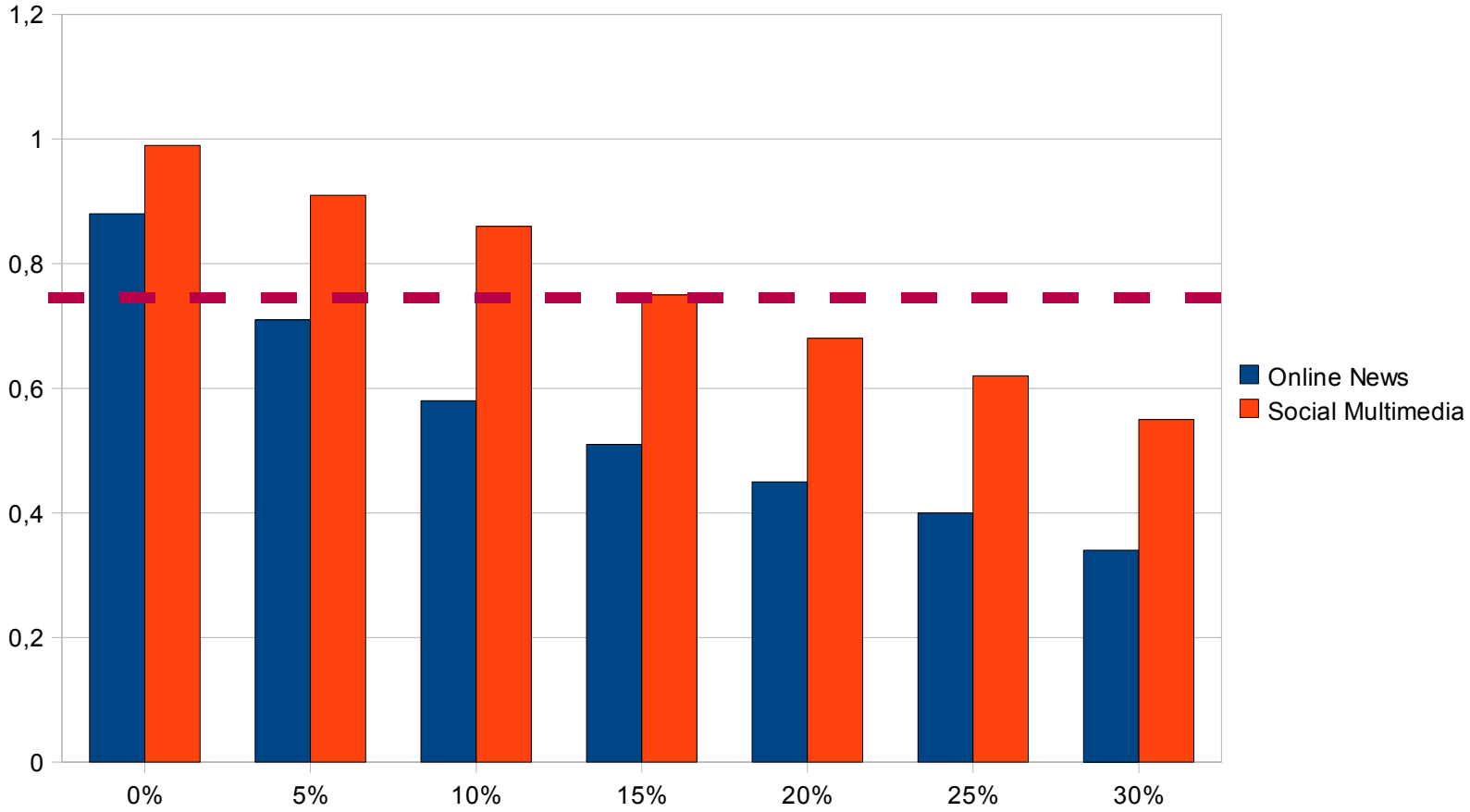

### High growth




Pre-generating up to 15% is good for most scenarios

# CPU Utilization

## High growth scenario



# *Conclusion and open problems*

- **Focus on Mobile Web**
- **Workload evolution 2008 → 2013**
  - Social networking + Multimedia will be the killer application of future mobile Web
  - Computational demand will grow faster than CPU power in most considered scenarios
- **Possible solution: pre-generating the most popular resources**
  - 5%-15% of the working set may be sufficient
- **Open problem: identifying the popular resources**
  - Highly volatile workload (the *read-write* Internet)
  - Short resource life span (~ 24-48 hours)
  - Need for early detection of popular resources

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