GlobeTraff
A traffic workload generator for the performance evaluation of ICN architectures

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(presented by K. Pentikousis on behalf of the authors)

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Outline

• Traffic characteristics
• Models Implemented
  – Web, P2P, Video, Other
• The GlobeTraff tool
• Conclusions

Available at: http://goo.gl/QkBxVf
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Traffic characteristics

- Traffic patterns play a vital role
  - Past research has led to many traffic models
    - Web, P2P, Video
  - Application specific traces are not enough
  - We need to consider global traffic effects

- GlobeTraff is a synthetic traffic workload generator
  - Based on current Internet traffic models
  - Allows the creation of various traffic mixes
    - What applications? How much do they contribute?
  - Allows changing the characteristics of each model
    - Of course we cannot predict future applications
Traffic characteristics

• Popularity characteristics
  – Popularity distribution
    • Number/fraction of requests for object
  – Temporal locality
    • How are requests distributed in time?
  – Spatial locality (not modeled)
    • Distribution of requests across the network

• Object sizes
  – Distribution of sizes for items
    • Direct effect on transport
    • Indirect effect on caching
Models Implemented

- GlobeTraff supports several traffic types
  - Web, P2P, Video, Other
  - Models from recent literature
  - Fully parameterized via GlobeTraff’s GUI

- Traffic mixture
  - Based on measurements (with DPI techniques) [1][2]

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Percent of Total Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web</td>
<td>31.2-39%</td>
</tr>
<tr>
<td>P2P</td>
<td>17-19%</td>
</tr>
<tr>
<td>Video</td>
<td>13- 20.8%</td>
</tr>
<tr>
<td>Other</td>
<td>29-31%</td>
</tr>
</tbody>
</table>

Models Implemented: Web

• Popularity distribution: Zipf-like
  – \( p(i) = \frac{K}{i^a} \)
    • \( i \): popularity rank, \( N \): total items
    • \( K = \frac{1}{\text{Sum}(1/i^a)} \)
    • \( a \): slope of distribution, values 0.64-0.84

• Temporal Locality
  – Ordering via LRU stack model
  – Exact timing via exponential distribution

• Object Sizes
  – Concatenation of Lognormal (body) and Pareto (tail)
Models Implemented: P2P

• Popularity distribution: Mandelbrot-Zipf
  - \( p(i) = \frac{K}{((i+q)^a)} \)
    - \( q \): plateau factor, 5 to 100
    - Flatter head than in Zipf-like distribution (where \( q=0 \))

• Temporal Locality: based on BitTorrent
  - Average arrival rate of 0.9454 torrents per hour
  - Peers in a swarm arrive as \( \lambda(t) = \lambda_0 e^{-t/\tau} \)
    - \( \lambda_0 \): initial arrival rate (87.74 average)
    - \( \tau \): object popularity (1.16 average)
Models Implemented: P2P

- **Temporal Locality: based on BitTorrent**
  - Random ordering of swarm births (first request)
  - For each swarm we calculate a different $\tau$
    - Based on average $\tau$ and object popularity
  - Exponential decay rule for subsequent requests

- **Object Sizes**
  - Wide variation on torrent sizes
  - No analytical model exists
  - Either sampling of real BitTorrent traces
  - Or use of a fixed value
Models Implemented: Video

- Popularity distribution: based on YouTube
  - Weibull distribution \((k=0.513, \lambda=6010)\)
  - Gamma distribution \((k=0.372, \theta=23910)\)

- Temporal Locality
  - No analytical models available
  - Random distribution across total duration
    - Total duration is determined by the P2P trace

- Object Sizes: based on YouTube
  - Concatenated normal distribution for duration
  - Same for size since most videos are 330 Kbps
Models Implemented: Other

• Popularity distribution
  – Zipf-like distribution as it is the most common

• Temporal Locality
  – Same approach as for video traffic
  – Possibility of using the web traffic model
    • Exponential distribution of inter-arrival times

• Object Sizes
  – GlobeTraff allows the user to set the size
  – We expect huge amounts of *small* items
    • Internet of Things, machine-to-machine communication

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GlobeTraff: traffic workload generator
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The GlobeTraff tool

• Implementation
  – Based on the ProWGen tool
    • Used for the Web traffic model
    • Extended with the other models
  – Command line tool written in C++
  – Java GUI to drive the tool

• Usage
  – Composition of the generated traffic mix
  – Total size for the trace
  – Parameters for each model
    • Also distributions where multiple options exist
The GlobeTraff tool: Web traffic

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The GlobeTraff tool: P2P

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GlobeTraff: traffic workload generator
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The GlobeTraff tool: Video

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The GlobeTraff tool: Other traffic

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The GlobeTraff tool

• Output
  – In two files as in ProWGen
    • Per traffic type and for the entire mix
  – Table 1: Objects in the workload
    • Unique ID for the object
    • Popularity expressed as total number of requests
    • Size in bytes
    • Application type (1: Web, 2: P2P, 3: Video, 4: Other)
  – Table 2: Workload in time
    • Time the request is submitted
    • ID of the Object referred to
    • Size of the object (same as Table 1)

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Future ICN traffic

• How would traffic load look like in an ICN environment?
  – Models based on existing applications and network architecture

  o Efficient content delivery (e.g., caching) → P2P traffic could diminish (?)
  o New (ICN) applications?
    o E.g., Internet of Things (IoT) traffic
  o Increased signaling traffic
    o E.g., CCN Interest packets, IoT name resolution (?)
  o ...

• Adapting GlobeTraff
  – Models only content requests, not the actual delivery mechanism
  – Easily extensible
Conclusions

• Realistic traffic models are very important for ICN
  – Need to evaluate an entirely new concept
  – Cannot rely on individual traffic models
  – All traffic types end up in the same caches!

• GlobeTraff provides global traces
  – Many traffic models based on literature
  – Fully parameterized via GUI
  – Allows projections on mix and individual types
GlobeTraff

• **Available at:**  http://goo.gl/QkBxVf

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• **Also see:**