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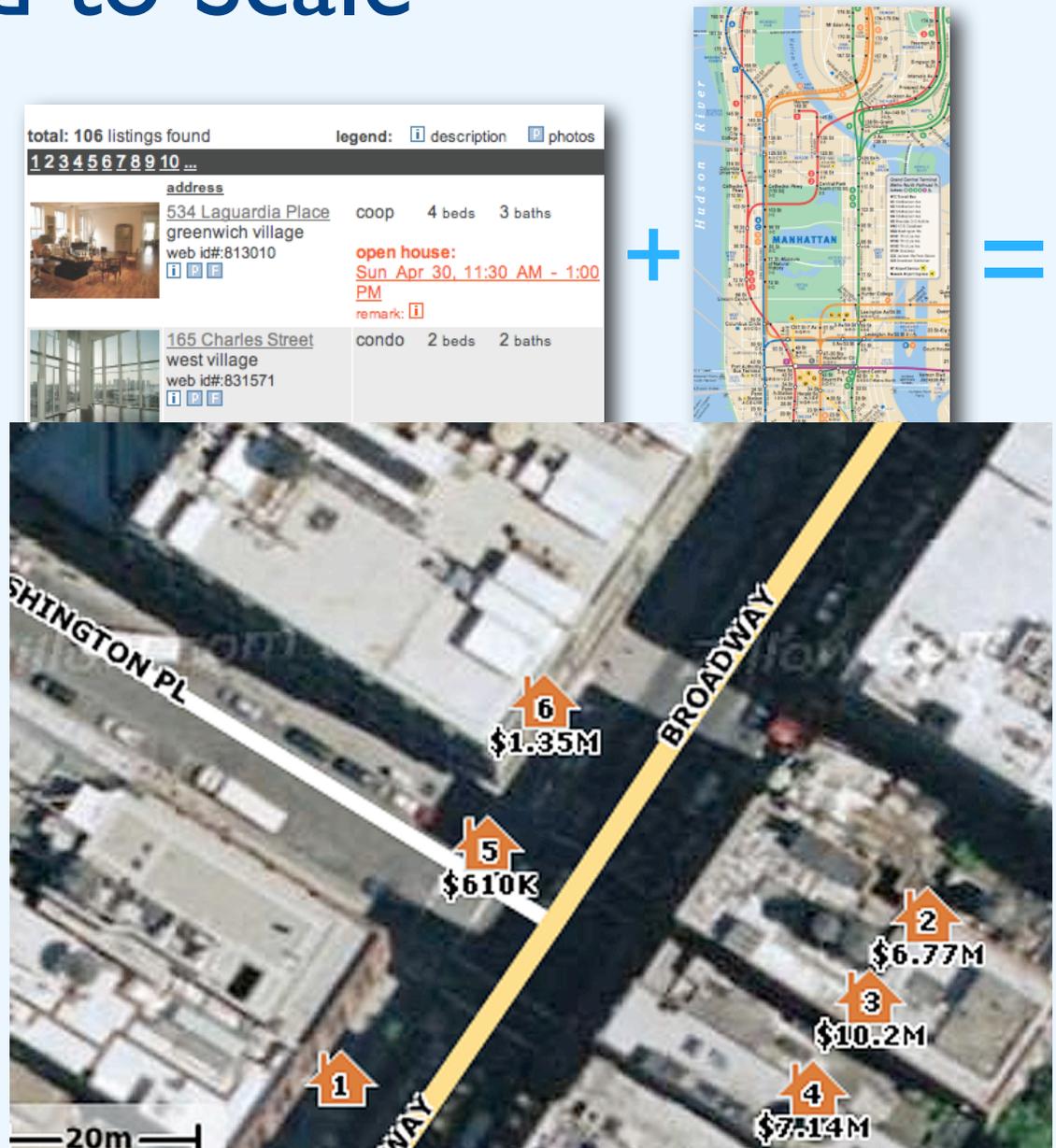
# *Na Kika*: Secure Service Execution and Composition in an Open Edge-Side Computing Network

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# Dynamic Content: Easy to Build Hard to Scale

- Dynamic content is increasingly popular, easy to create and publish
- Example: mashups
  - chicagocrimes.org = Crime reports over Google Maps
  - zillow.com = Real Estate stats over Microsoft Virtual Earth
- Easy to realize on a home server
  - PHP, Python, ASP, JSP, ...
- Collaborate, plug together
- Does not scale

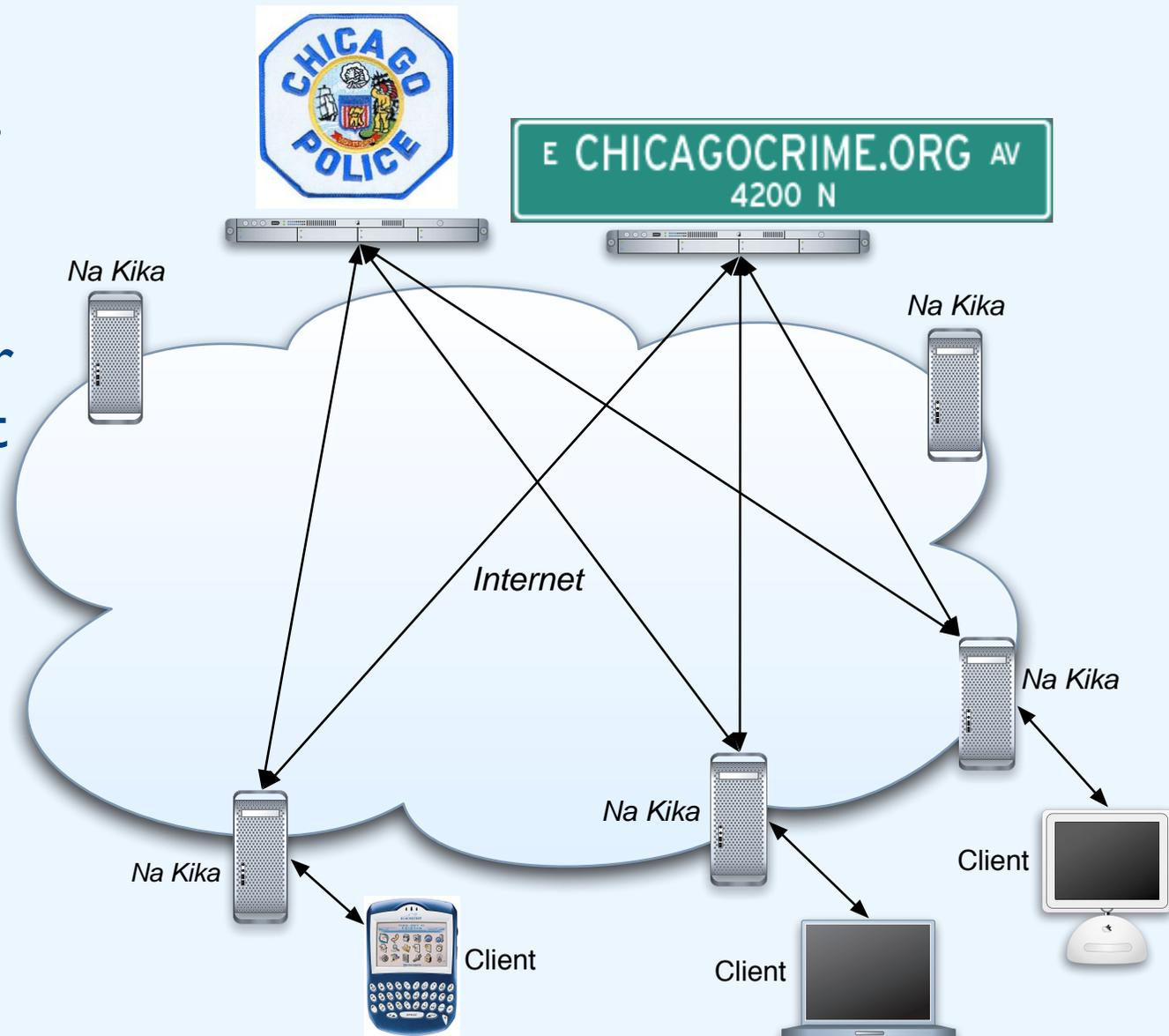


# We Need a New Delivery Platform

- Need a platform that is scalable, extensible and secure
  - Near the client, supports mixing/mashing, controls hosted code
- Clusters amplify resources, not necessarily near the client
  - [TACC, Veritas, Linux-HA]
- Edge-side hosting targeted at big trusted sites
  - [Akamai, ACDN, CoITrES, Tuxedo, vMatrix, WebSphere]
- P2P collaborative architectures limited to static content
  - [Coral, CoDeeN, CobWeb]
- Some efforts provide containment but not composition
  - [Active Cache, SDT]
- Na Kika reconciles extensibility with security

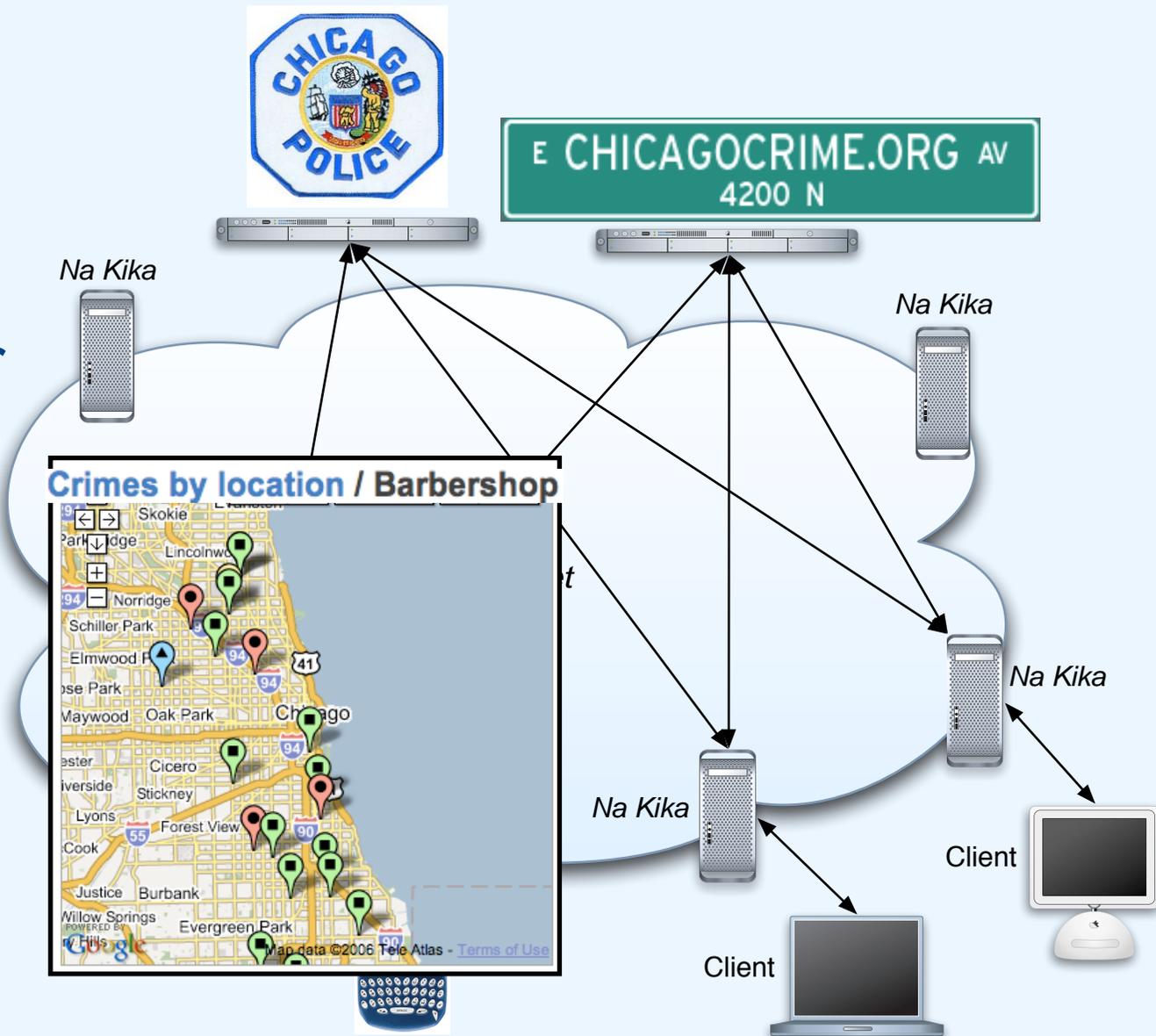
# Na Kika Architecture

- DNS redirects clients to nearby proxies
- Proxies organized in structured overlay for caching static content
- Sites publish scripts that are treated like static content
- Scripts are executed and composed at the edge for scaling dynamic content



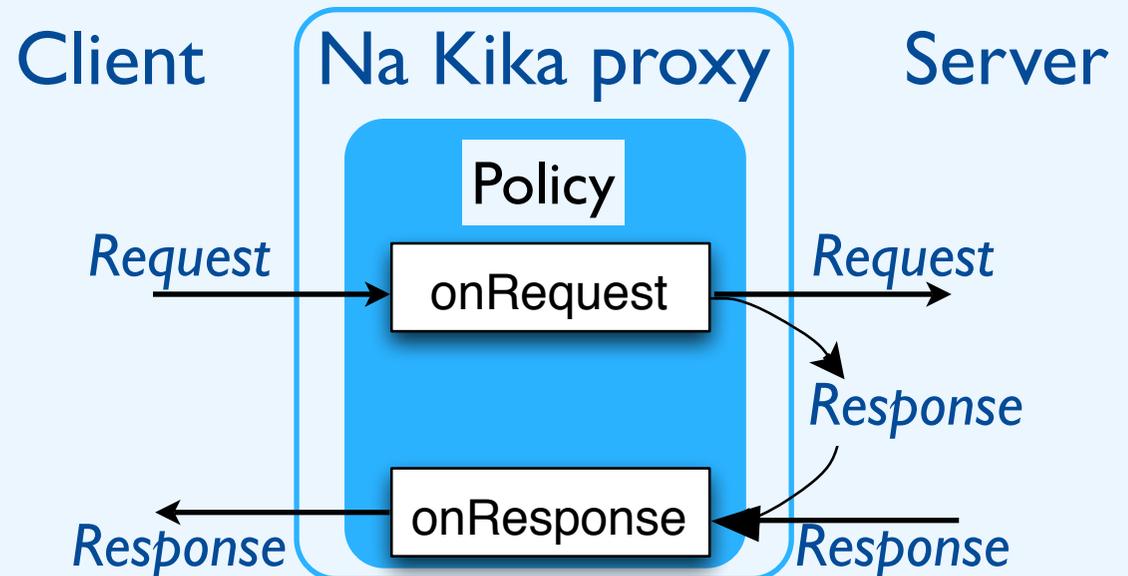
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# Programming Model

- Write scripted code:
  - Easy, already familiar
  - Javascript
- Structure functionality inside event handlers
  - *onRequest* handler
  - *onResponse* handler
- Specify handlers as a *Policy* object



```
p = new Policy();  
p.onRequest = function(){ ... }  
p.onResponse = function(){ ... }  
p.register();
```

# Service Modularity

- Leverage descriptive nature of HTTP messages
  - URL
  - Client IP address
  - Method
  - Headers
- Select handlers based on HTTP message properties
- Execute the most specific match

*Request*

```
p1 = new Policy();
p1.url = ["*.zillow.com/*"];


p1.client = ["0.0.0.0/0"];

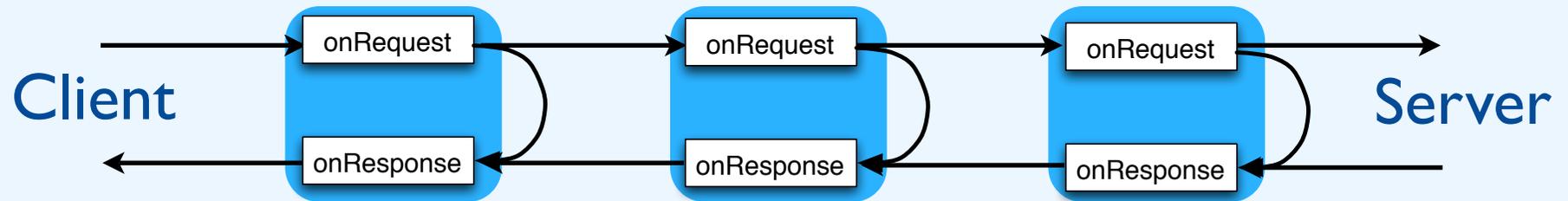
p1.method = ["GET"];
p1.onRequest = function(){ ... }
p1.onResponse = function(){ ... }
p1.register();
```

```
p2 = new Policy();
p2.url = ["*.zillow.com/*"];


p2.client = ["128.122.0.0/16"];

p2.method = ["GET"];
p2.onRequest = function(){ ... }
p2.onResponse = function(){ ... }
p2.register();
```

# Service Composition

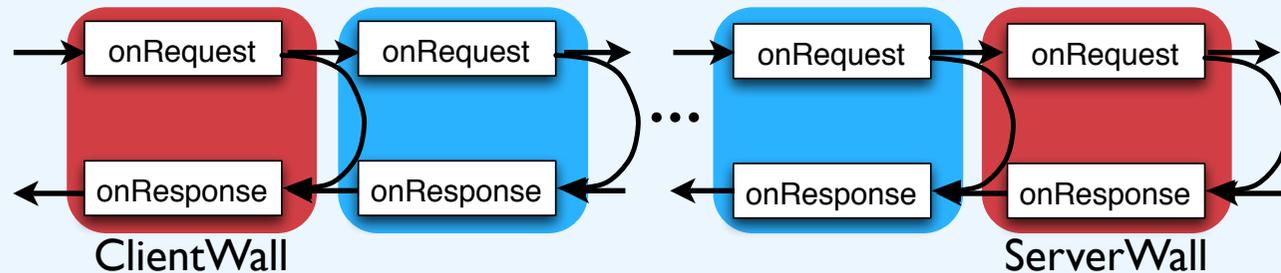


- Event handler pair mimics proxy structure
- A series of event handlers is called a *pipeline*
- Compose handlers via the *nextStages* property.

```
p = new Policy();  
p.nextStages = ["chicagocrime.org/map.js",  
               "cityofchicago.org/police/crime.js"];  
p.onRequest = function(){ ... }  
p.onResponse = function(){ ... }  
p.register();
```

# Admission & Emission Control

- Reuse same mechanisms
  - Handler selection
  - Composition
- Make security policies extensible
- Insert two extra pipeline stages
  - ClientWall near client
  - ServerWall near server



```
p = new Policy();
p.url = ["www.gac.lt/en/chaseonline.chase.com/*"];
p.method = ["GET", "POST"];
p.onRequest = function(){
    Request.terminate(ACCESS_DENIED);
}
p.register();
```

# Containing Hosted Code

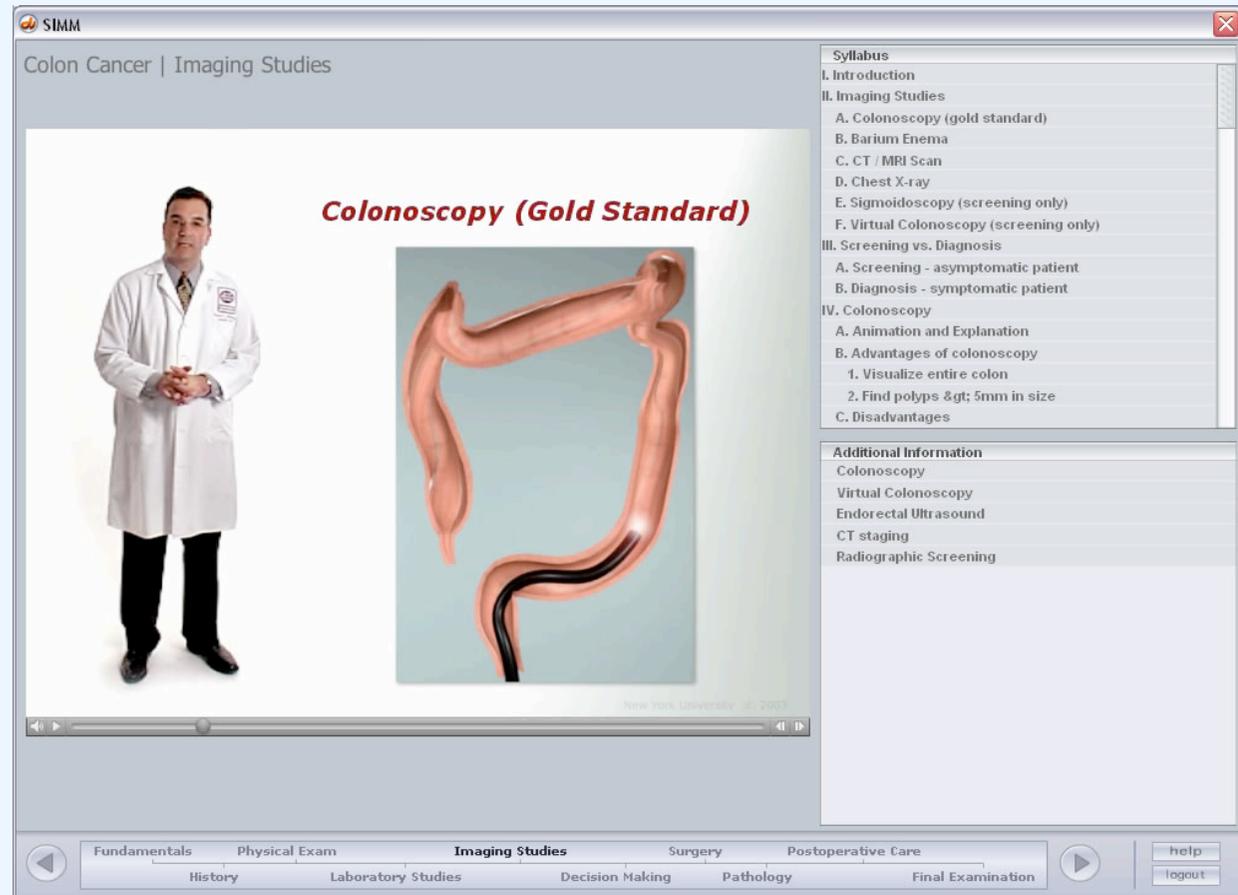
- Scripts are sandboxed
  - Select native libraries, no direct access to system
- No hard quota
  - Hard to set appropriate limits on a shared resource
- Control consumption *only* under congestion
  - Congestion control enforces collaboration
  - If no congestion, do nothing (no hard limits)
  - Otherwise, throttle requests
  - Terminate largest consumers as a last resort.

# Evaluation

- How does Na Kika compare to a single server?
  - Wise-MD web-based learning application
- How easy is it to extend functionality/security?
  - Examples of Na Kika extensions
- Is throttling/termination effective?
  - Both under overload and malicious scripts [see paper]

# Wise-MD

- Wise-MD is a web-based education tool developed at NYU medical
  - (formerly known as SIMMs)
- Global participation
  - U.S. + Australia
- Multimedia intensive
  - 1 GB total content
- Dynamic
  - HTML generated from XML and XSL stylesheet

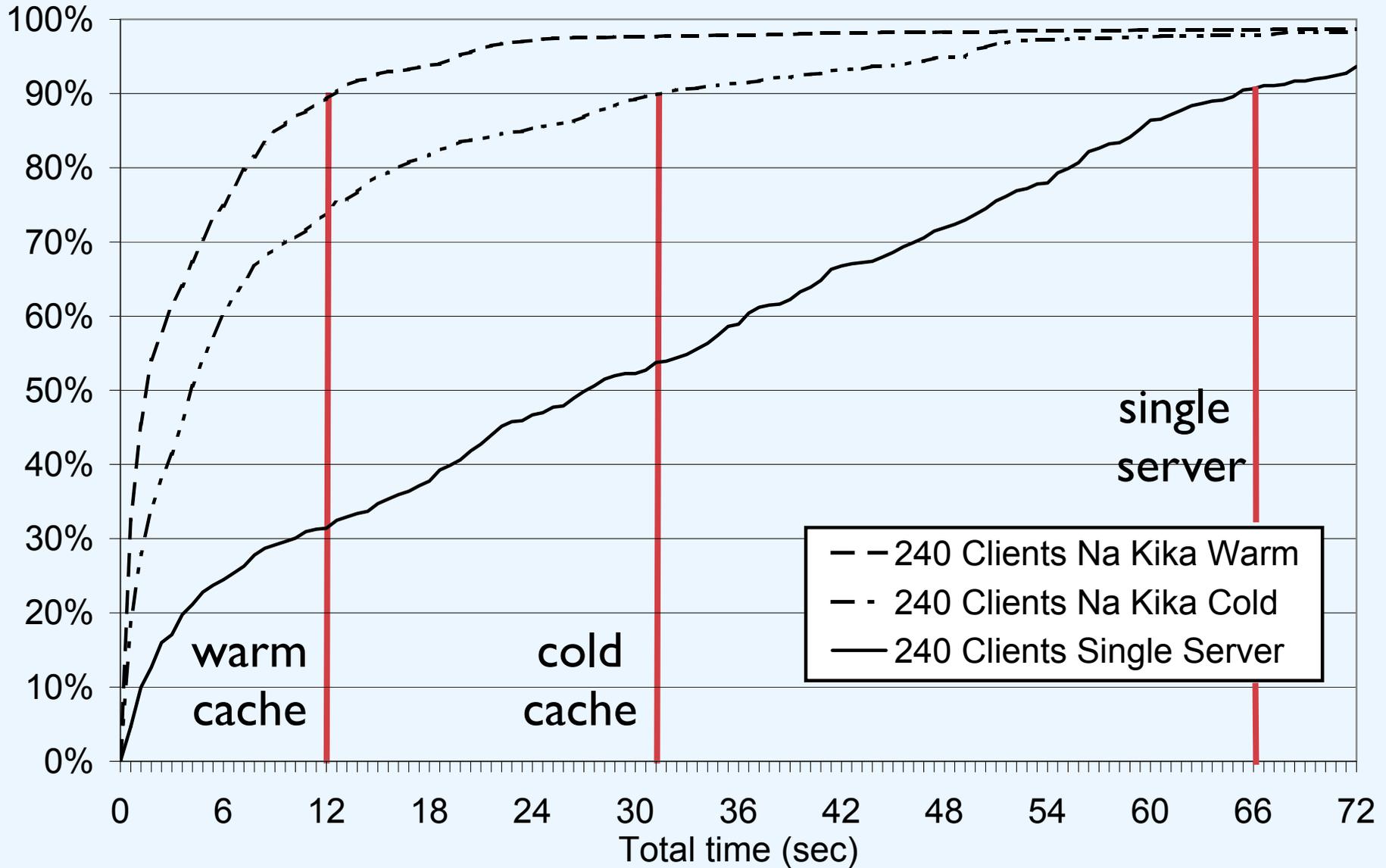


# Wise-MD on Na Kika

- 1 developer, 100 + 130 lines of code, 2 days to port
- Comparison between single server and Na Kika
  - Clients and proxies run on 12 PlanetLab nodes each
  - For multimedia content accessed by 240 clients

	Clients seeing more than 140Kbps bandwidth	Failures seen by clients
Single Server	0%	60%
Na Kika Cold Cache	11.5%	5.6%
Na Kika Warm Cache	80.3%	1.9%

# Wise-MD on Na Kika (html)



# Extensibility in Action

- Na Kika Pages (NKP)
  - Programming model similar to PHP, JSP, ASP
- Image transcoding
  - Transforms images to JPG, scales them down
- Annotated Wise-MD
  - Layer electronic post-it notes over Wise-MD
- Content blocking
  - First additional stage creates policy based on blacklist
  - Second new stage executes policy, rejecting illegal URLs

# Annotated Wise-MD In Action

NYU School of Medicine SIMM

http://www.cs.nyu.edu.nakika.net:8091/~nikos/stickysimm/index.html

Getting Started Latest Headlines www.weather.com - ... |H isoHunt - IRC and B... Cardmember Servic... Bank of America | H...

**Sticky Notes** Add Note Hide/Show Notes

[edit](#) [delete](#) [hide/show](#)

Remember to redo the last SIMM tomorrow

Aliqu... conse... temp... biber...  
... et massa. Fusce nec ligula eu elit luctus feugiat. Mauris pretium justo et tortor. Nunc ligula. Cras a justo vel nulla  
... et risus. Duis tincidunt sapien. Aliquam non erat eu metus tempor bibendum. Sed in tortor. Proin facilisis, sem vel  
... r mauris, sit amet pulvinar enim elit id pede. Vivamus lacinia neque id neque. Vivamus quis magna vitae eros  
... atea dictumst.

Module Selection:

 **Adrenal Adenoma:**  
In this module, you will learn how to work up an adrenal adenoma and gain comprehension of the complex physiology of the adrenal gland.

 **Carotid Stenosis:**  
In this module, you will learn about cerebral vascular occlusive disease and its relation to symptoms.

 **Cholecystitis:**  
In this module you will be introduced to the pathophysiology of Acute Cholecystitis and other diseases related to Cholelithiasis.

Transferring data from xander.cs.nyu.edu...

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# Easy to build, Easy to Scale

- Less than 100 lines of code for each application
  - Annotations relied on 180 lines of external code
- Less than 8 hours to write and debug
- Deployment at the edge scales

# Limitations & On-going Work

- Source code must be made public
- Sites gain capacity, but lose control over performance
- Unsuitable for applications with large databases
  - Hard state replication in place, SPECweb99 [see paper]
  - Better replication strategies
- Proxies assumed trusted
  - Protection against misbehaving/malicious proxies
- Resource management as congestion control

# Conclusions

- Na Kika scales dynamic content
  - Focus on collaborative efforts
- Contributions
  - Same mechanism for defining functionality and policies
  - Congestion-based resource management

[www.nakika.org](http://www.nakika.org)