An HTTP-Based Versioning Mechanism for Linked Data

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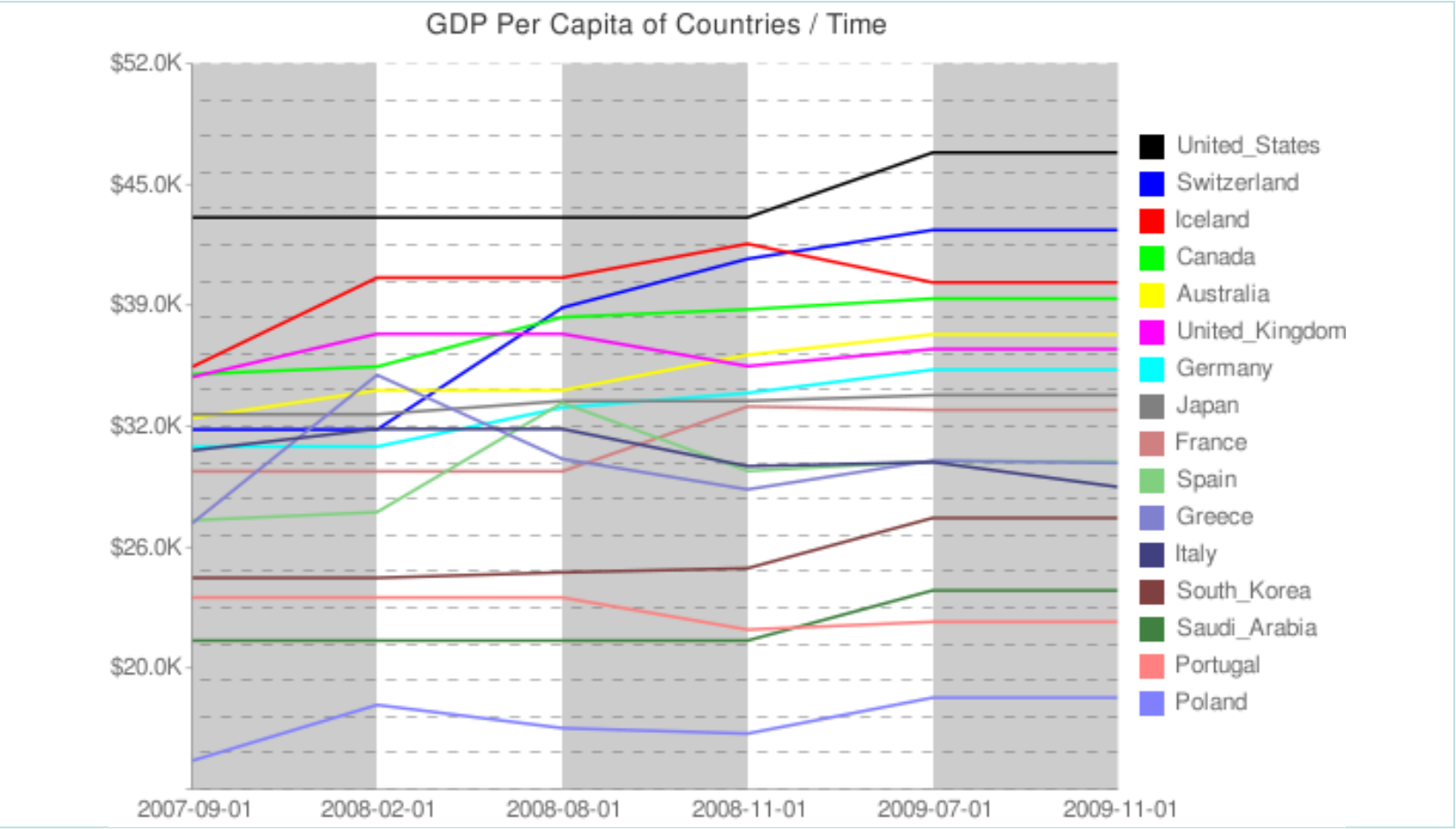
Harihar Shankar
Scott Ainsworth

Memento is partially funded by the Library of Congress

Presentation at http://bit.ly/ac9GhH

Time-Series Analysis across DBpedia Versions



Data collected through HTTP Navigation

Outline

- Memento - Time Travel for the Web
- Resource Versioning suggested by Memento
- Resource Versioning for Linked Data
- DBpedia Demonstrator

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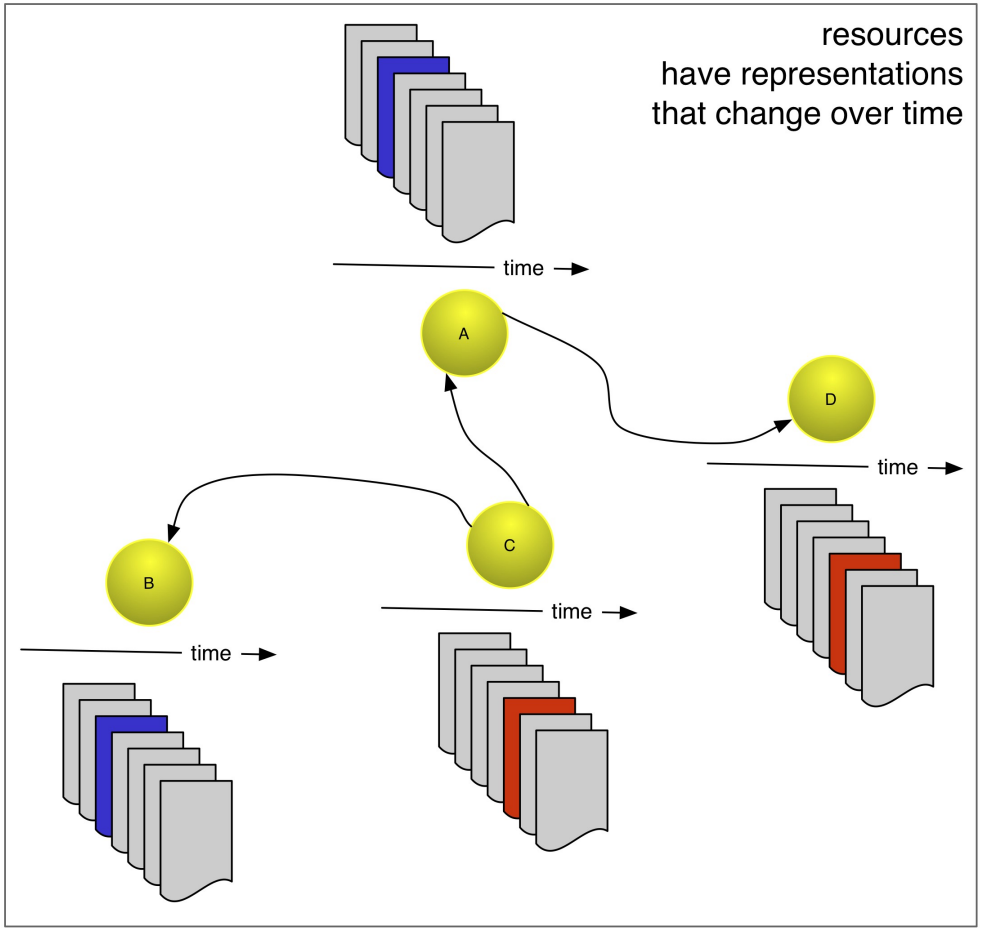
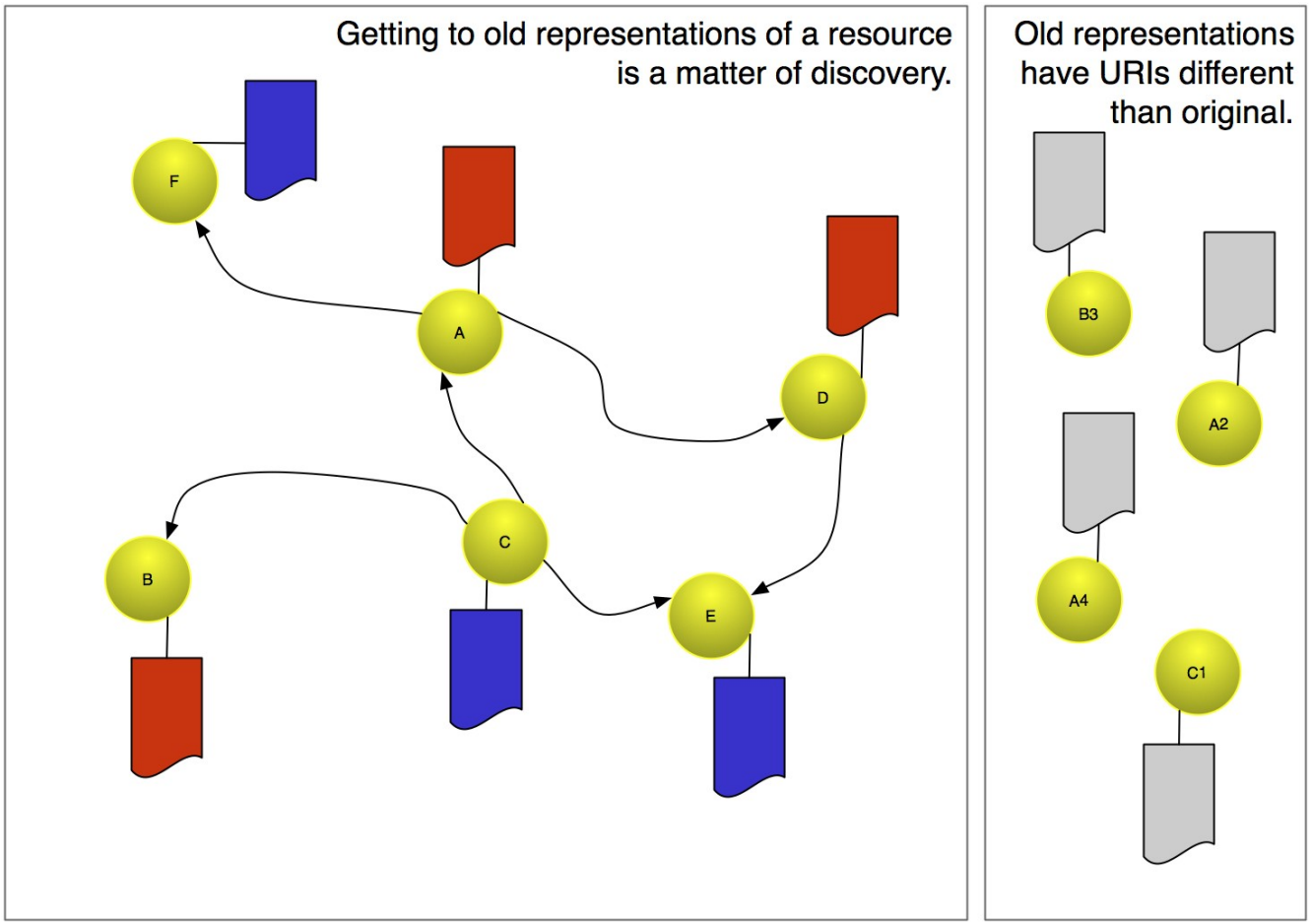
Resources have Representations that Change over Time



Archived Resources serve prior Representations



Sep 11 2001, 20:36:10 UTC

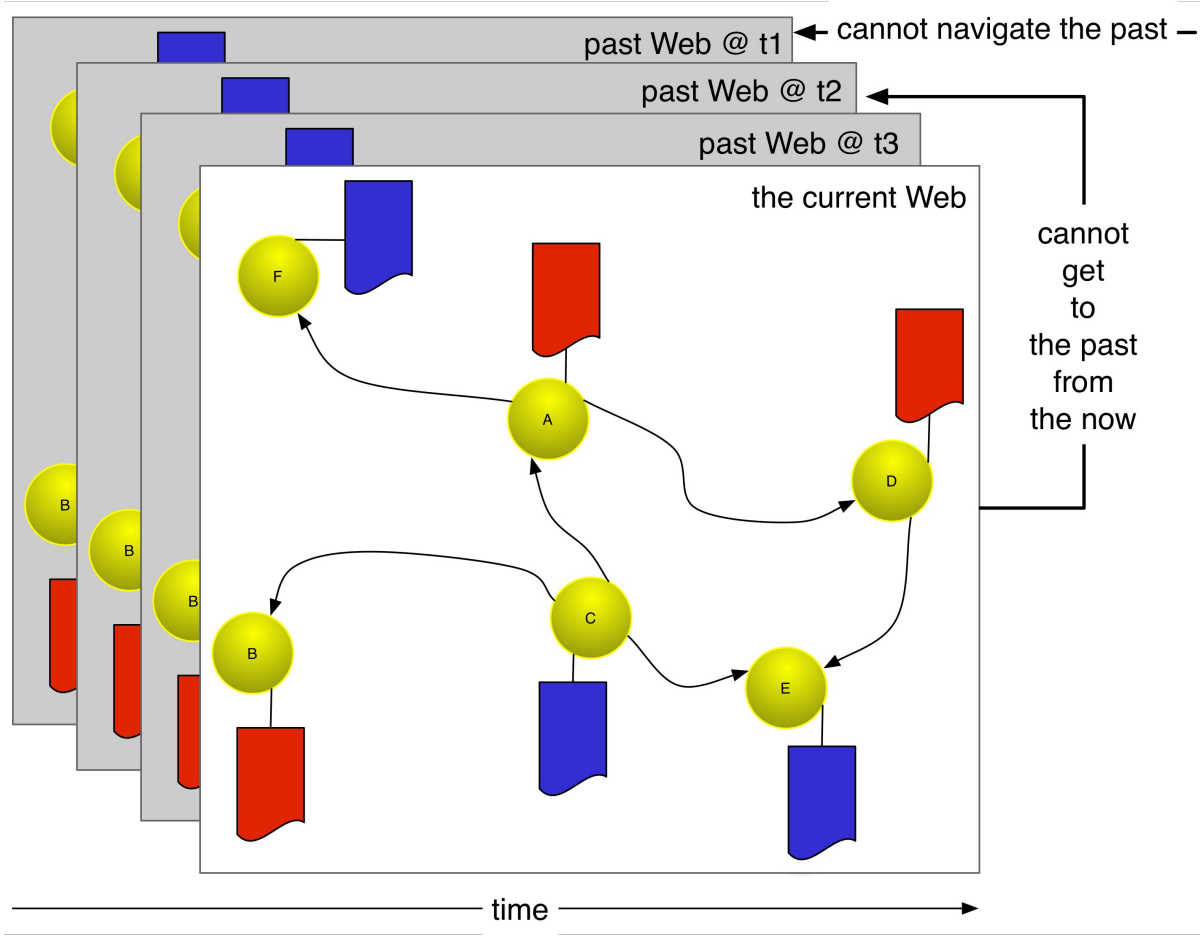
Dec 20 2001, 4:51:00 UTC

Archived Resources

http://web.archive.org/web/20010911203610/http://www.cnn.com/
archived resource for
http://cnn.com

http://en.wikipedia.org/w/index.php?title=September_11_attacks&oldid=282333
archived resource for
http://en.wikipedia.org/wiki/September_11_attacks

Current and Past Web are Not Integrated

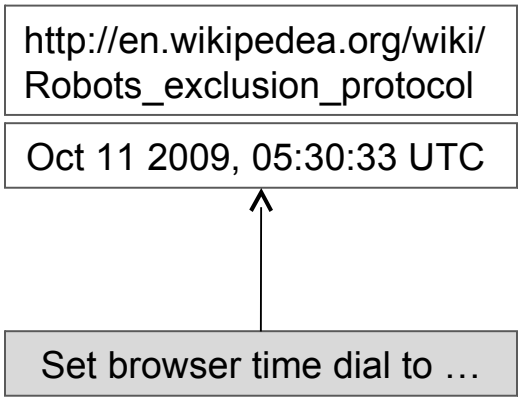


- Current and Past Web based on same technology.
- But, going from Current to Past Web is a matter of (manual) discovery.
- Memento wants to make going from Current to Past Web a (HTTP) protocol matter.
- Memento wants to integrate the Current And Past Web.

Vision: Navigate the Web of the Past

http://en.wikipedea.org/wiki/
Robots_exclusion_protocol

Vision: Navigate the Web of the Past



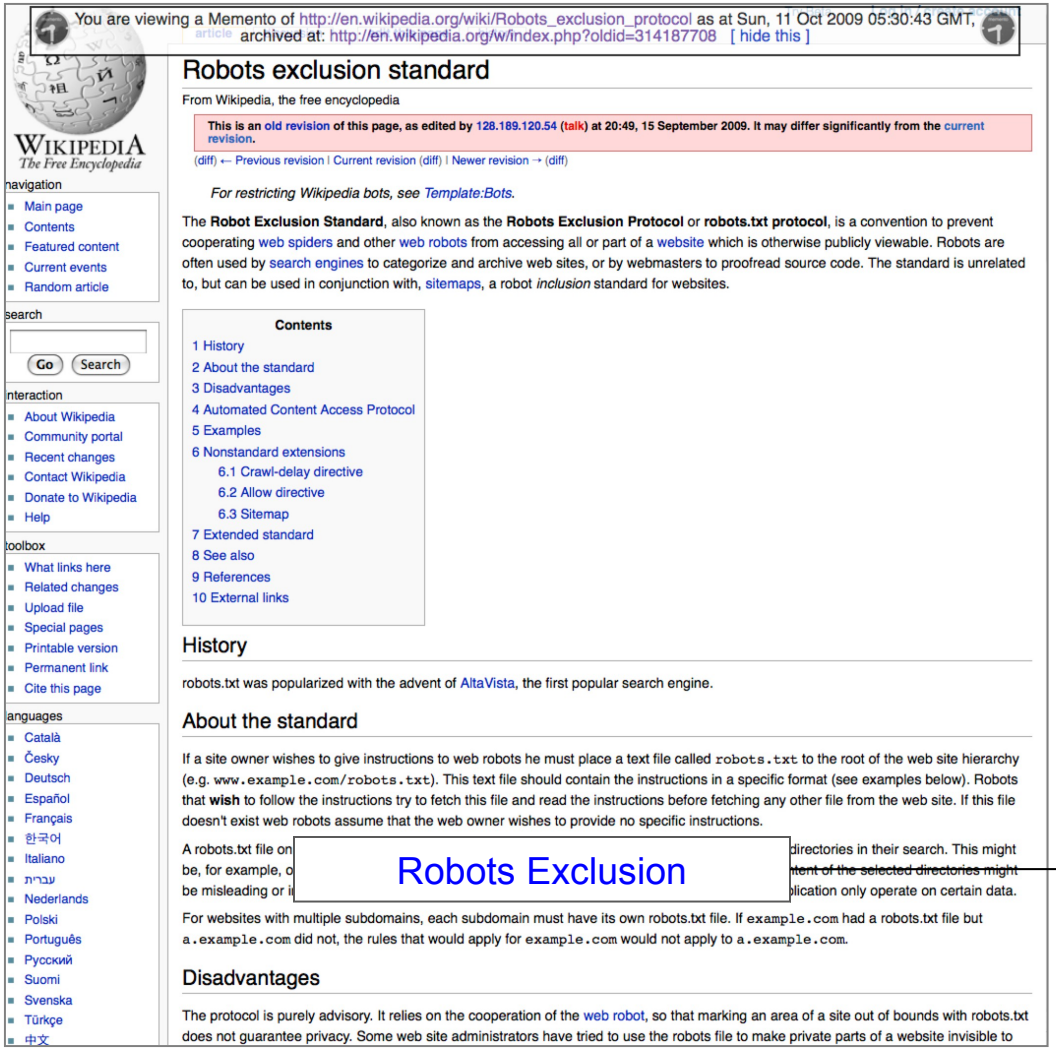
Vision: Navigate the Web of the Past

http://en.wikipedea.org/wiki/Robots_exclusion_protocol

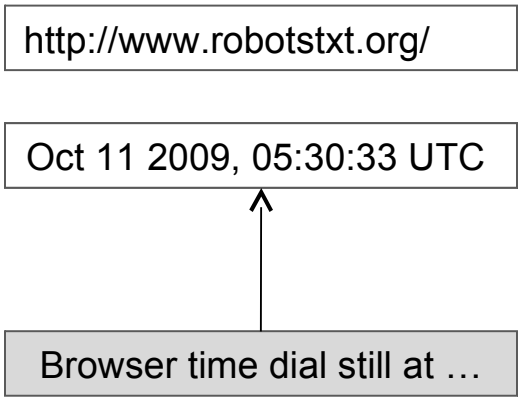
Oct 11 2009, 05:30:33 UTC

From Wikipedia History: Version Sep 15 2009, 20:49:00 UTC

Vision: Navigate the Web of the Past



Vision: Navigate the Web of the Past

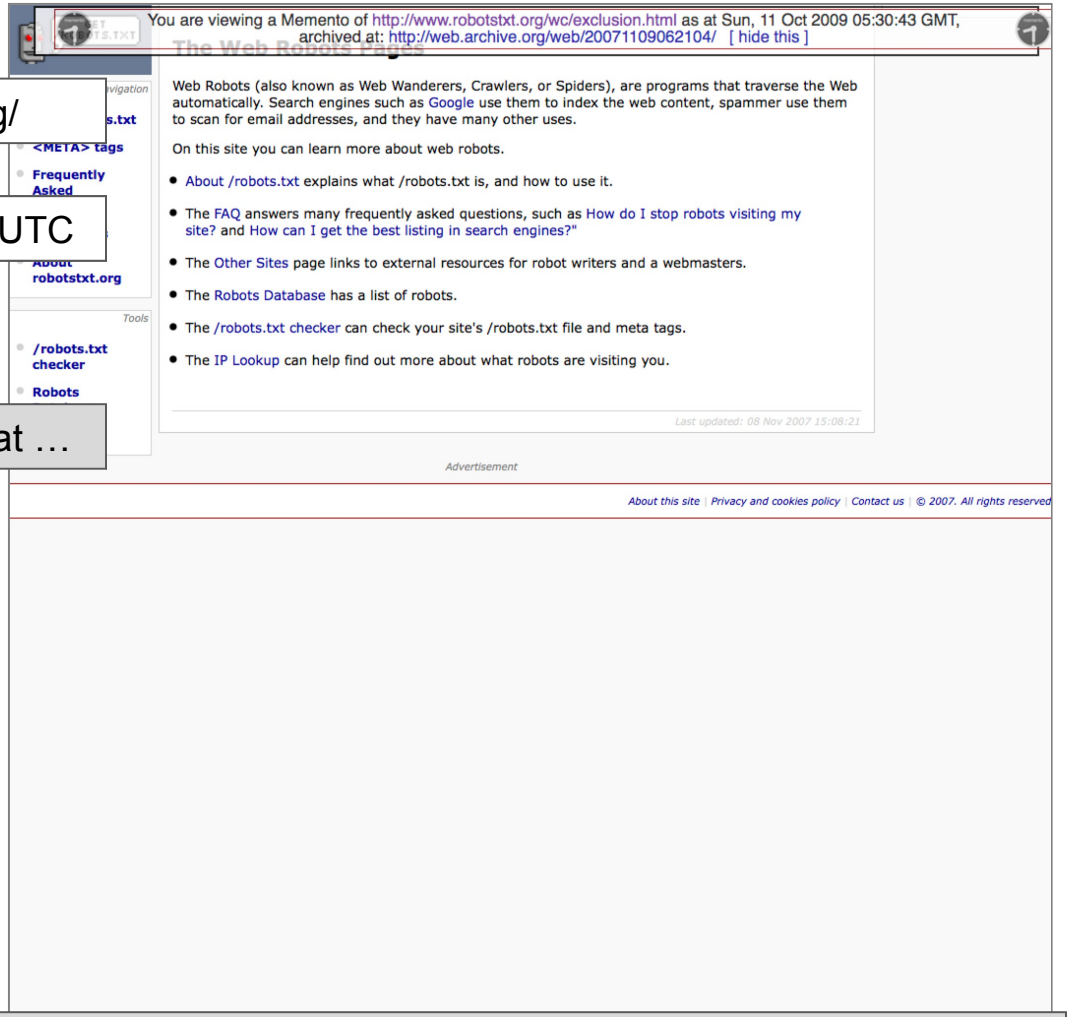


Vision: Navigate the Web of the Past

http://www.robotstxt.org/

Oct 11 2009, 05:30:33 UTC

Browser time dial still at …



From Internet Archive: Version Nov 09 2007, 06:21:04 UTC

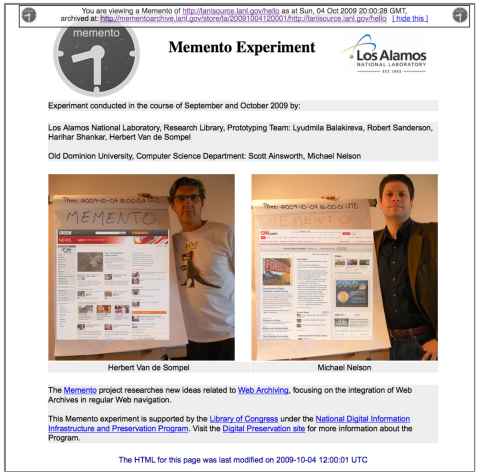
The Memento Approach

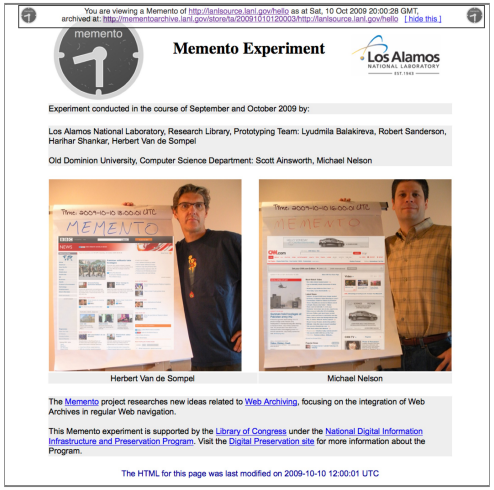
HTTP navigation to an archived resource by leveraging:

- *The original resource;*
- *HTTP datetime content negotiation.*

original resource

Mementos





An HTTP-Based Versioning Mechanism for Linked Data
LDOW 2010, Raleigh, NC

Los Alamos NATIONAL LABORATORY

OLD DOMINION UNIVERSITY

DT-conneg with URI-G to get URI-M

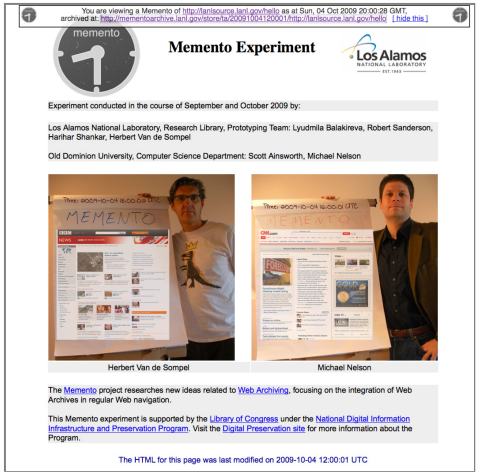
original resource

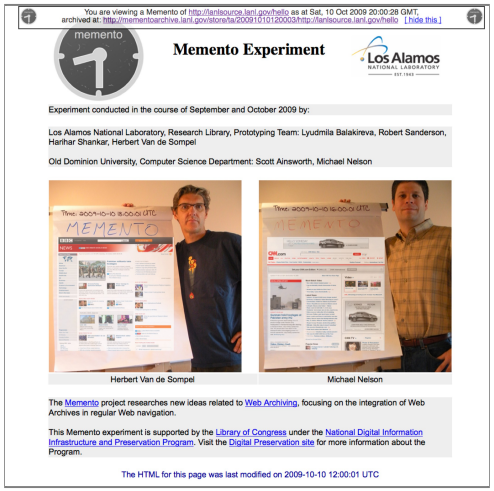
TimeGate

transparently negotiable resource

Mementos

variant resources





original server

archival server

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HTTP Link timegate

DT-conneg with URI-G to get URI-M

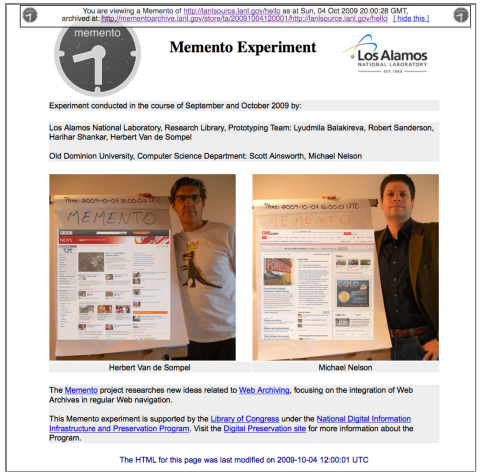
original resource

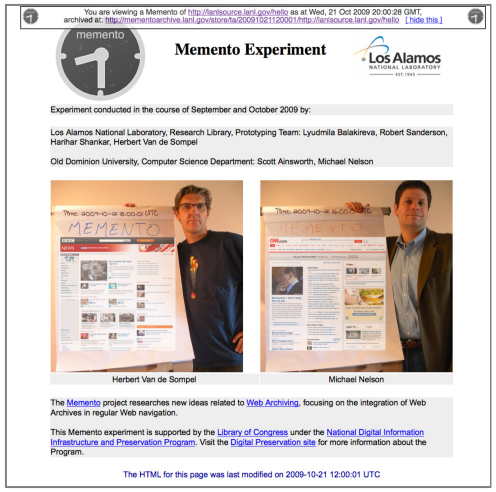
TimeGate

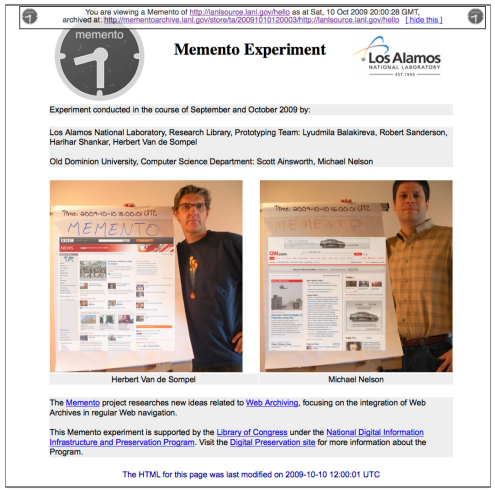
transparently negotiable resource

Mementos

variant resources







original server

archival server

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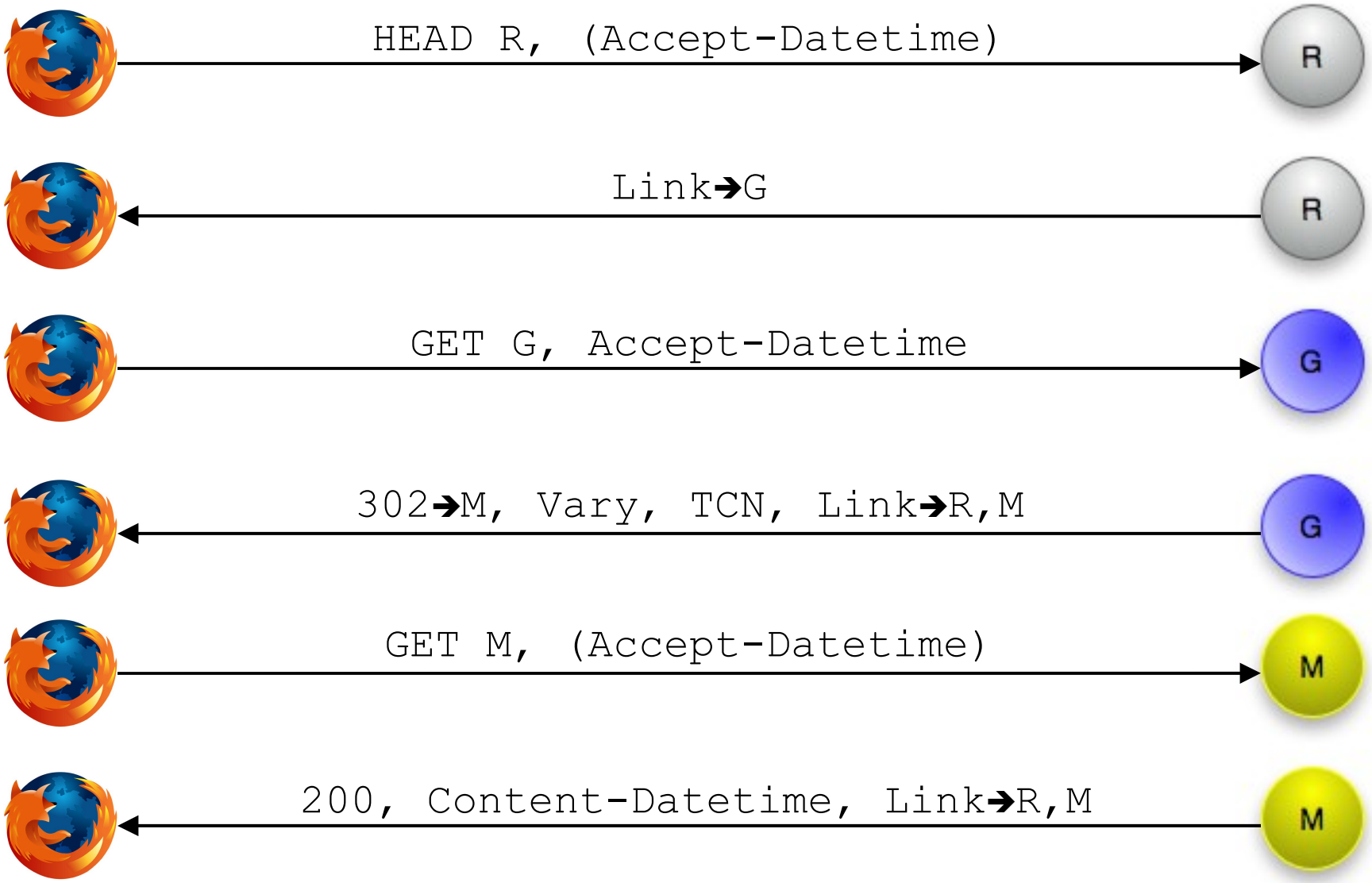
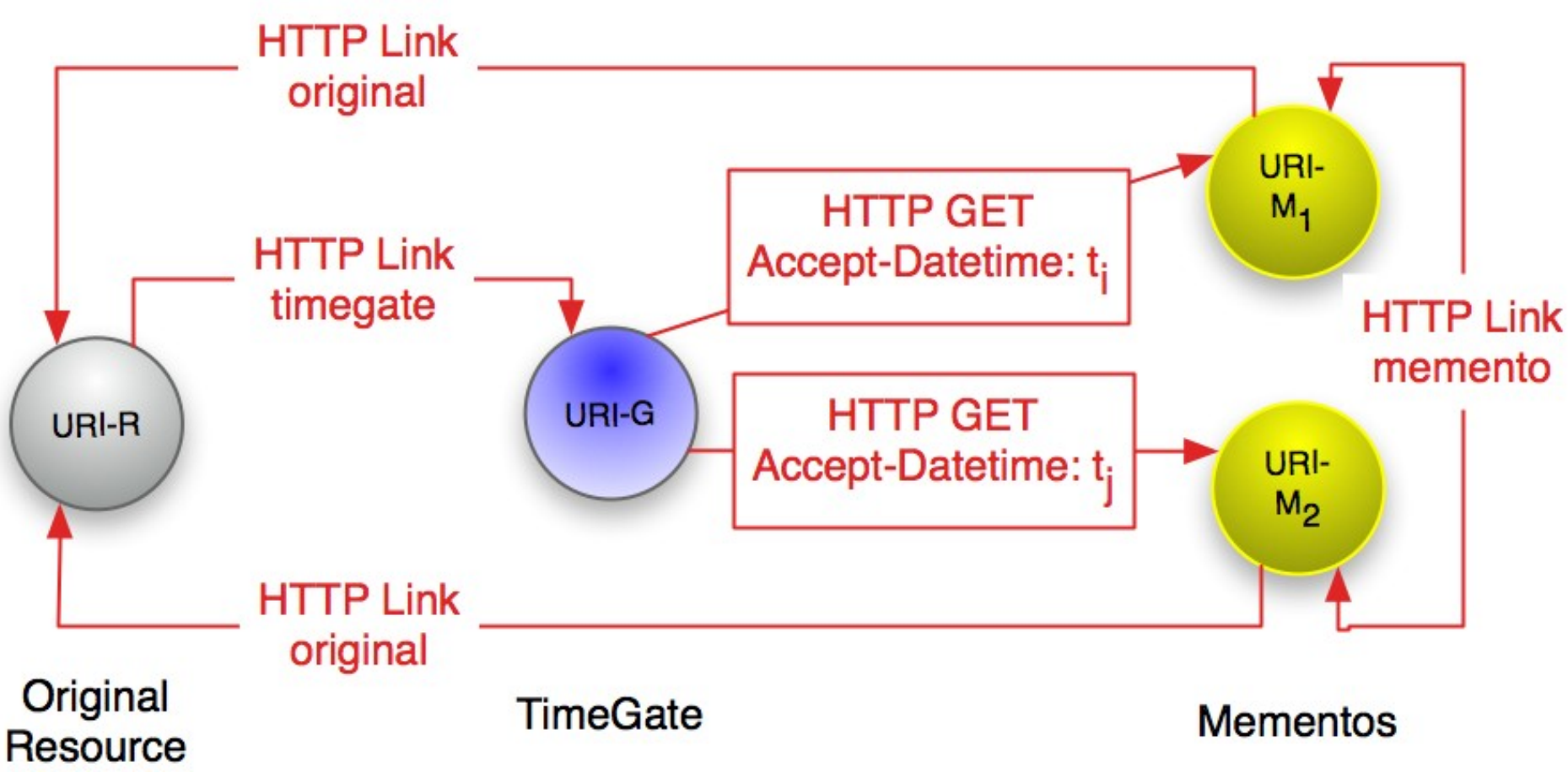
Old Dominion University

Memento HTTP Flow



The Memento Framework



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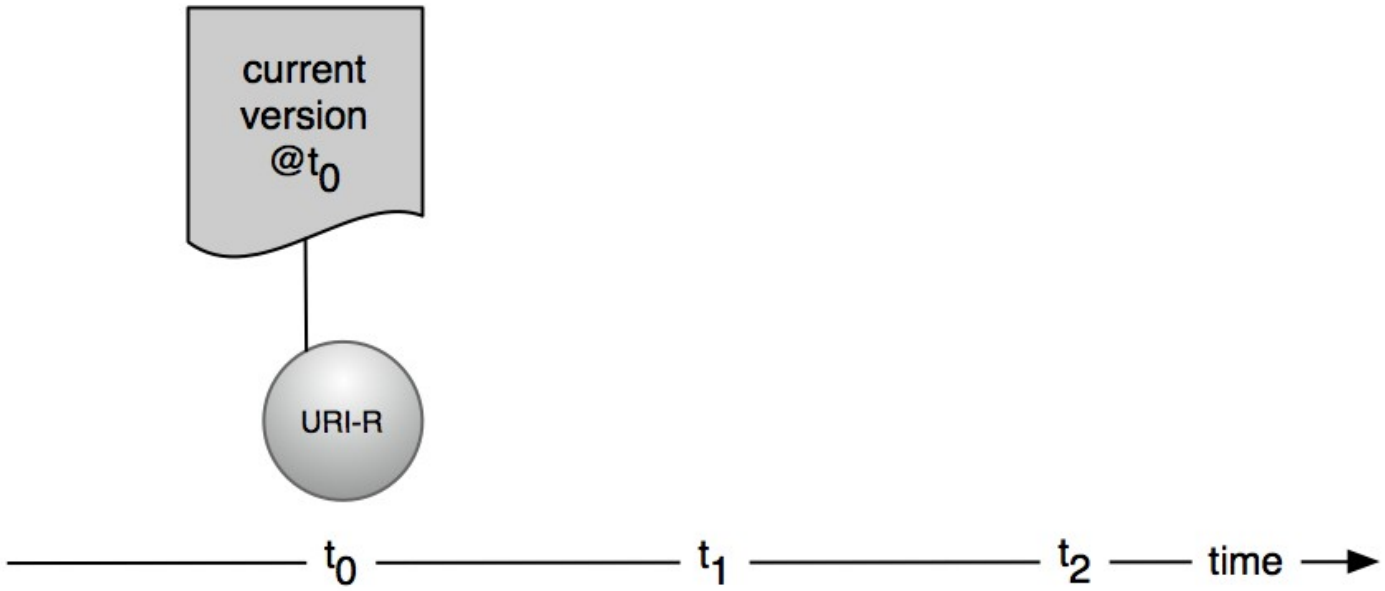
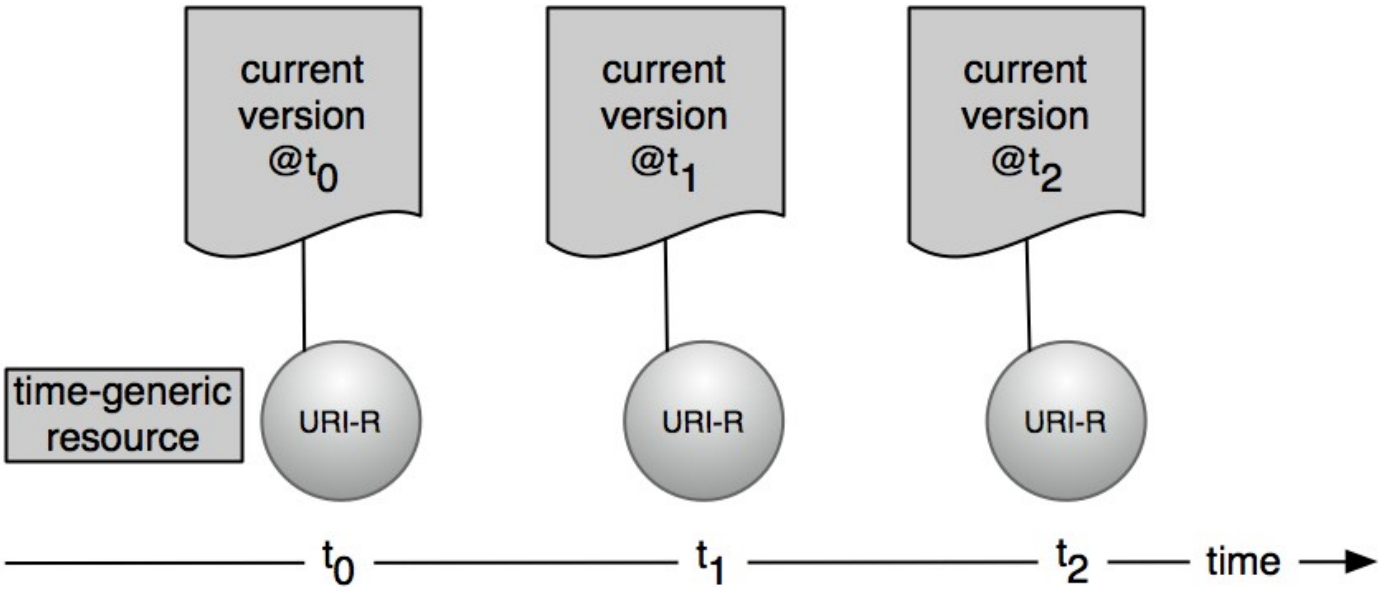
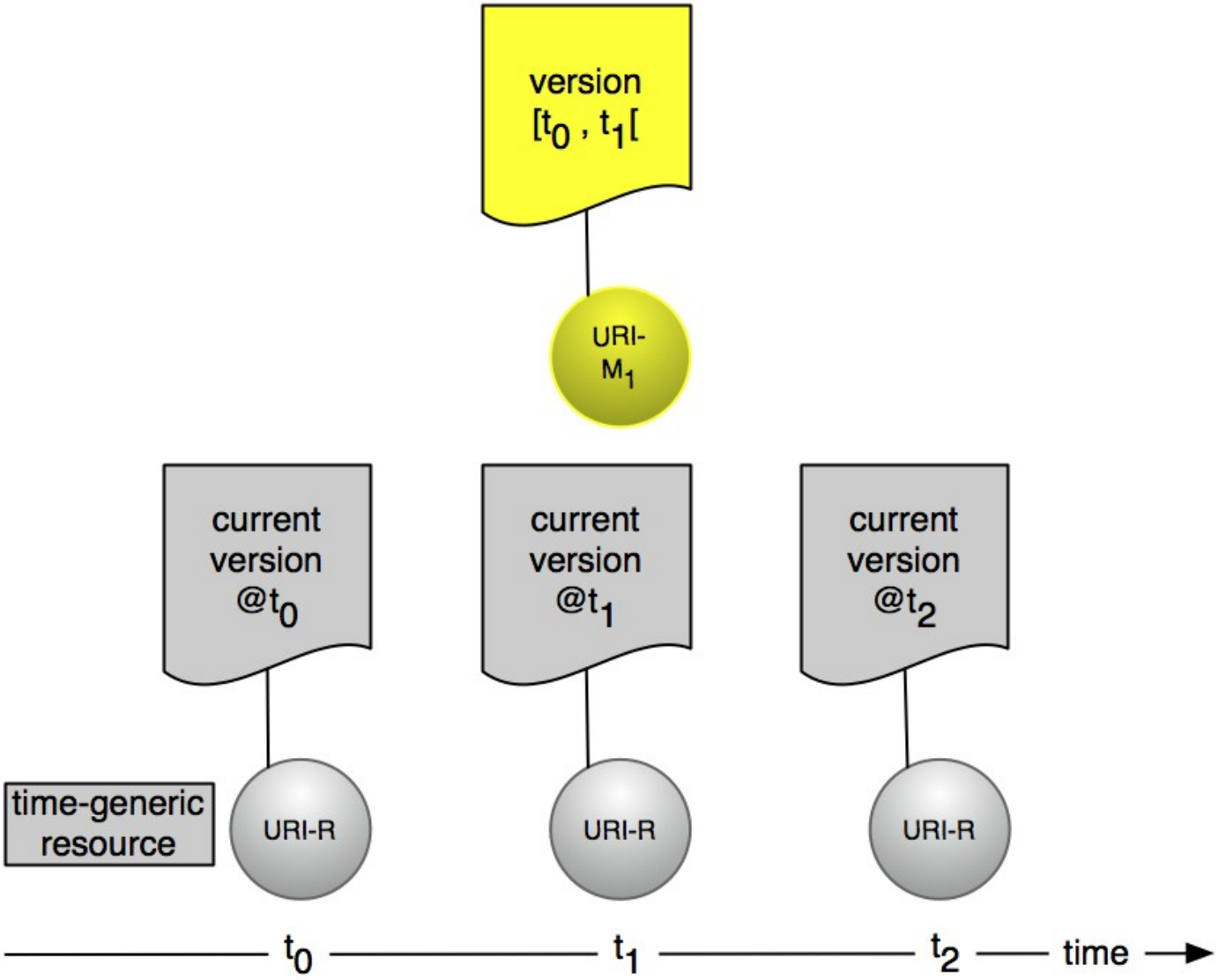
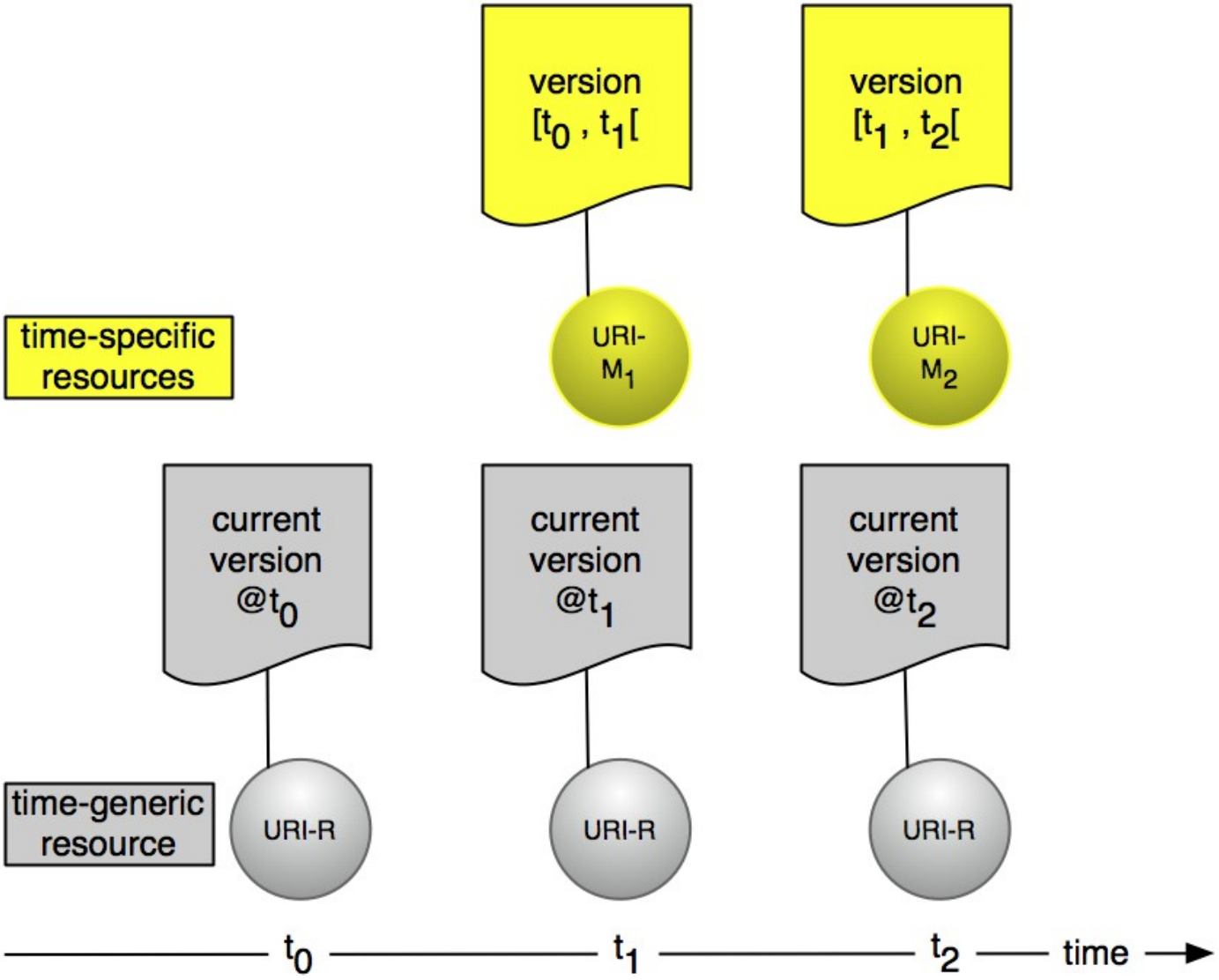
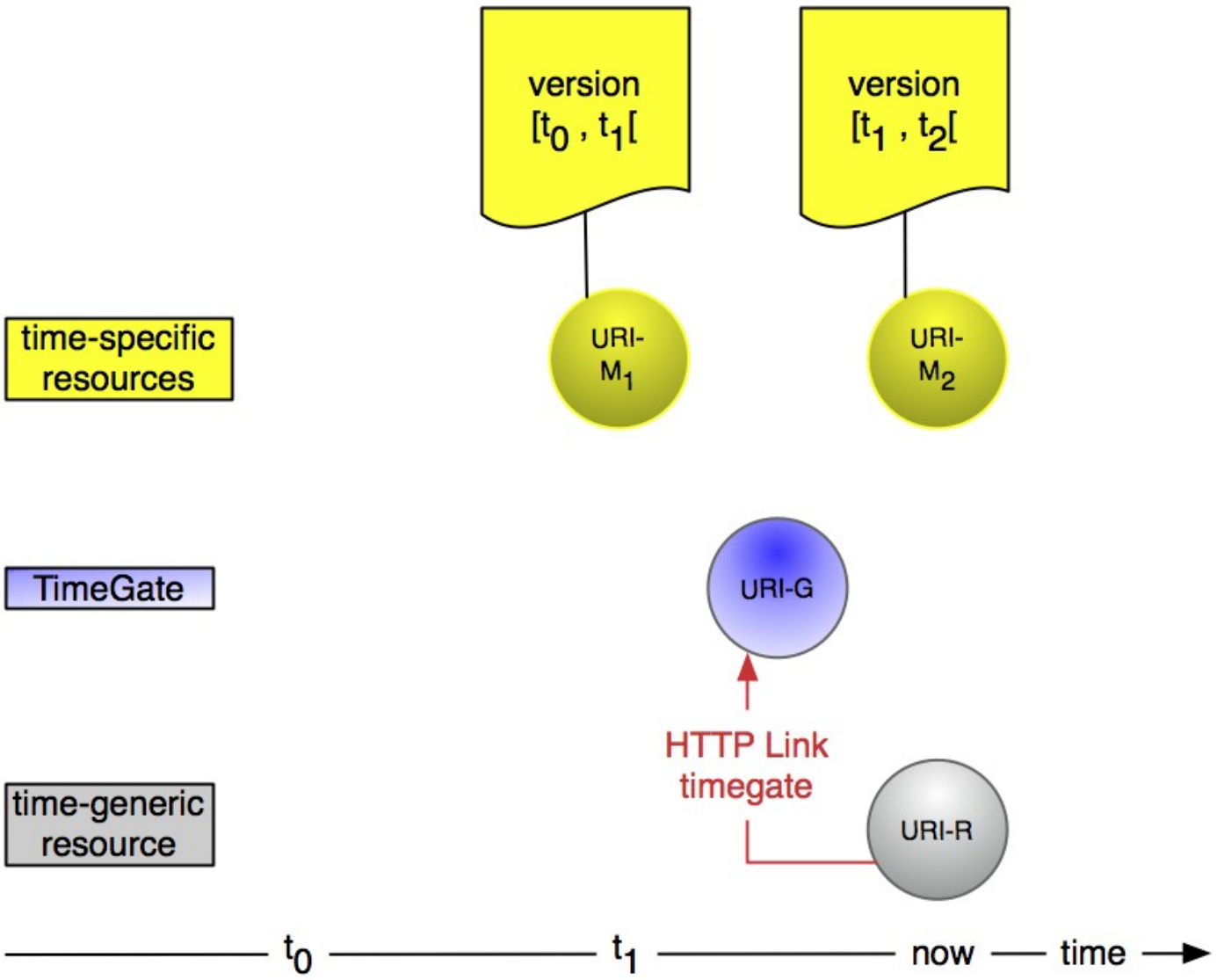
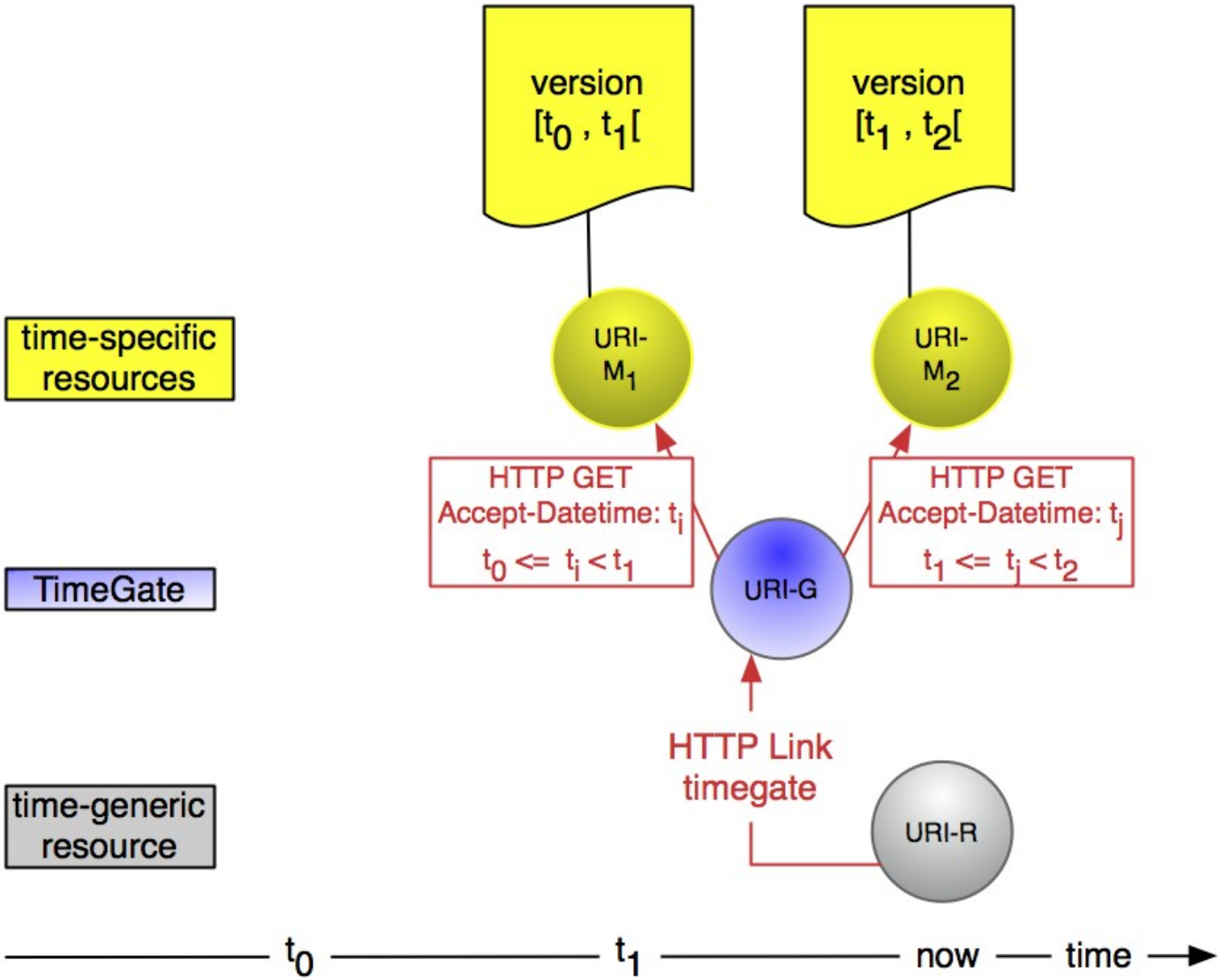

current
version
@t0
URI-R
t0
t1
t2
time

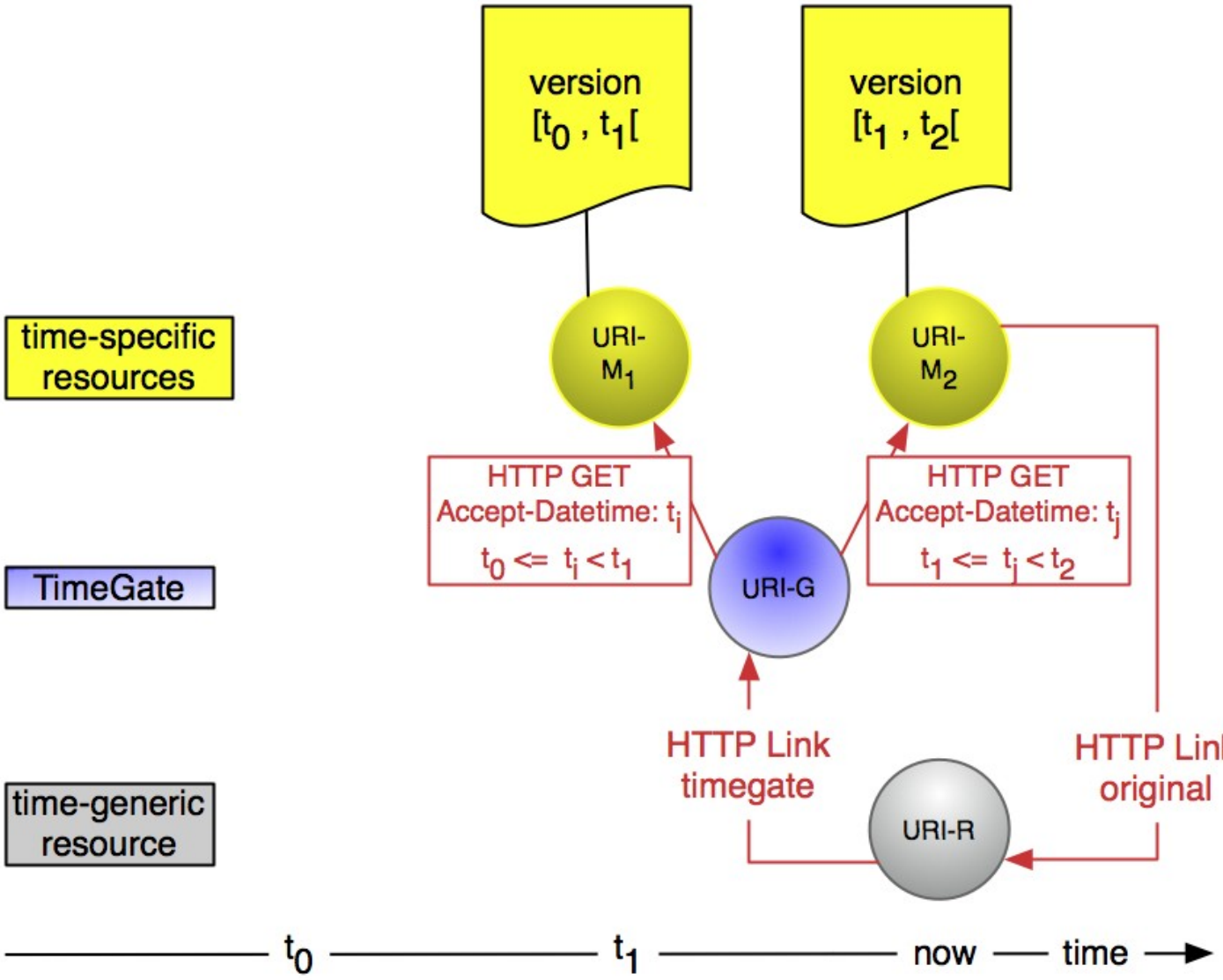

current version @t0
current version @t1
current version @t2
time-generic resource
URI-R
URI-R
URI-R
t0
t1
t2
time


version
[t0 , t1[
URI-
M1
current
version
@t0
current
version
@t1
current
version
@t2
time-generic
resource
URI-R
URI-R
URI-R
t0
t1
t2
time


version
[t0 , t1[
version
[t1 , t2[
time-specific
resources
URI-
M1
URI-
M2
current
version
@t0
current
version
@t1
current
version
@t2
time-generic
resource
URI-R
URI-R
URI-R
t0
t1
t2
time


version
[t0 , t1[
version
[t1 , t2[
time-specific
resources
URI-
M1
URI-
M2
TimeGate
URI-G
HTTP Link
timegate
time-generic
resource
URI-R
t0
t1
now
time


version
[t0 , t1[
version
[t1 , t2[
time-specific resources
URI-M1
URI-M2
HTTP GET
Accept-Datetime: ti
t0 <= ti < t1
HTTP GET
Accept-Datetime: tj
t1 <= tj < t2
TimeGate
URI-G
HTTP Link
timegate
time-generic resource
URI-R
t0
t1
now
time


version
[t0 , t1[
version
[t1 , t2[
time-specific resources
URI-M1
URI-M2
HTTP GET
Accept-Datetime: ti
t0 <= ti < t1
HTTP GET
Accept-Datetime: tj
t1 <= tj < t2
TimeGate
URI-G
HTTP Link
timegate
HTTP Link
original
time-generic resource
URI-R
t0
t1
now
time

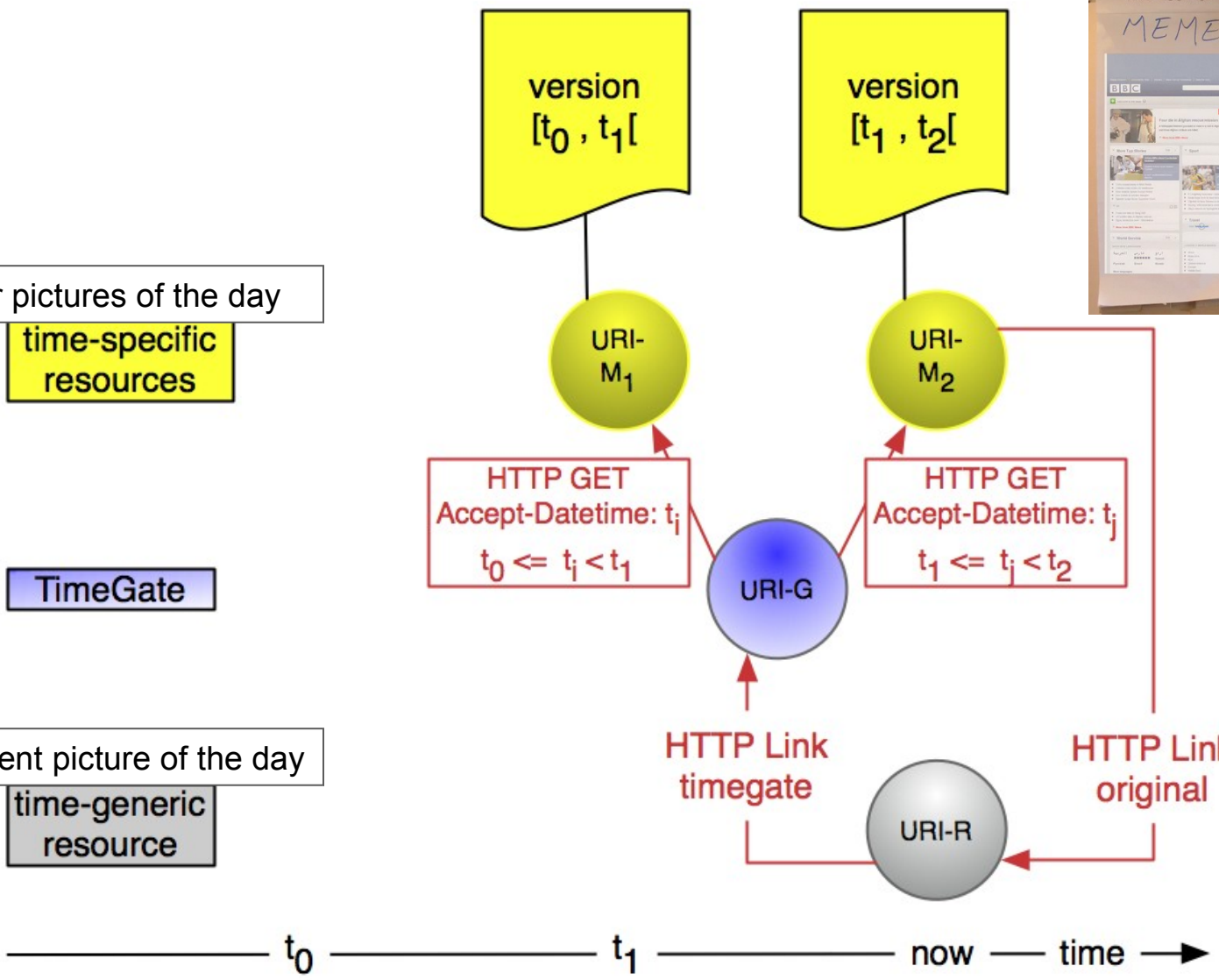
Prior pictures of the day

time-specific resources

TimeGate

Current picture of the day

time-generic resource



Time Travel across Versions of a *Picture of the Day*

Data collected through HTTP Navigation

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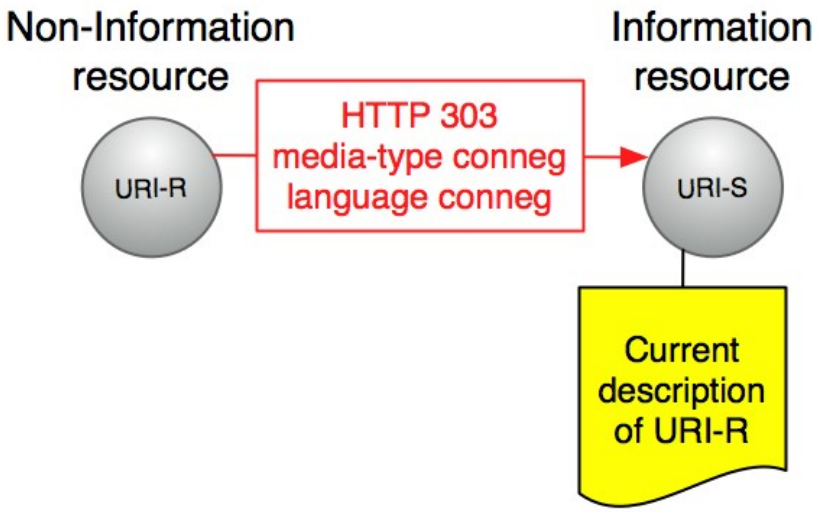
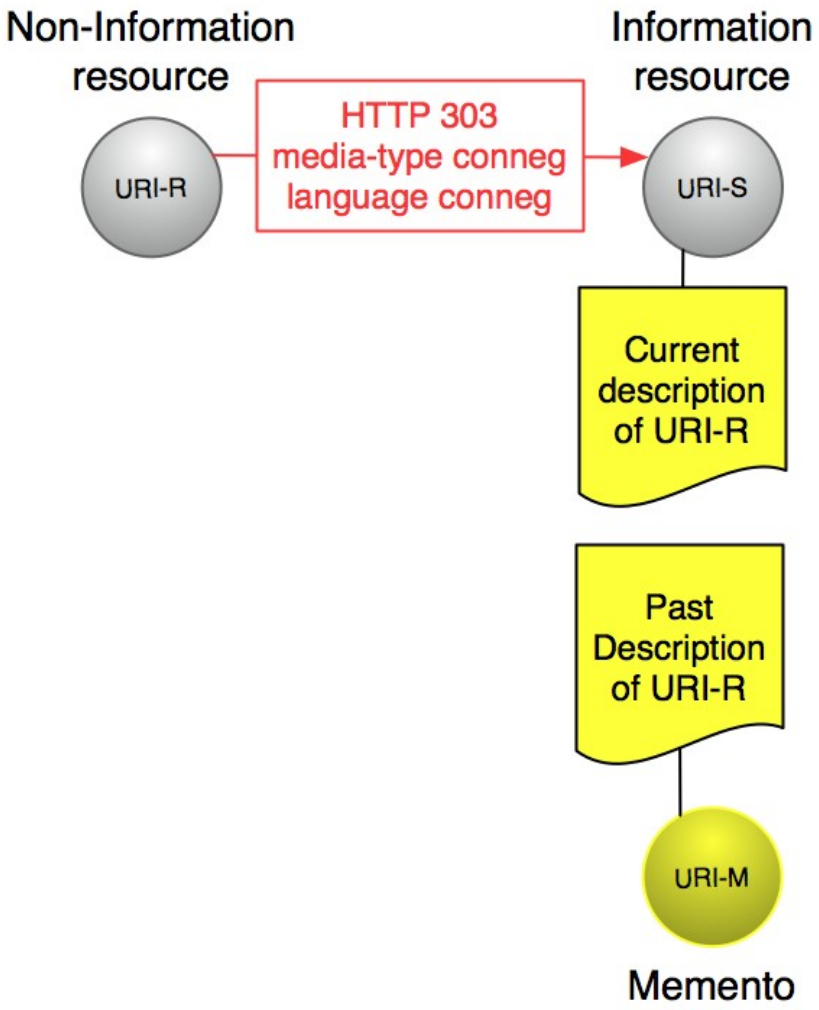
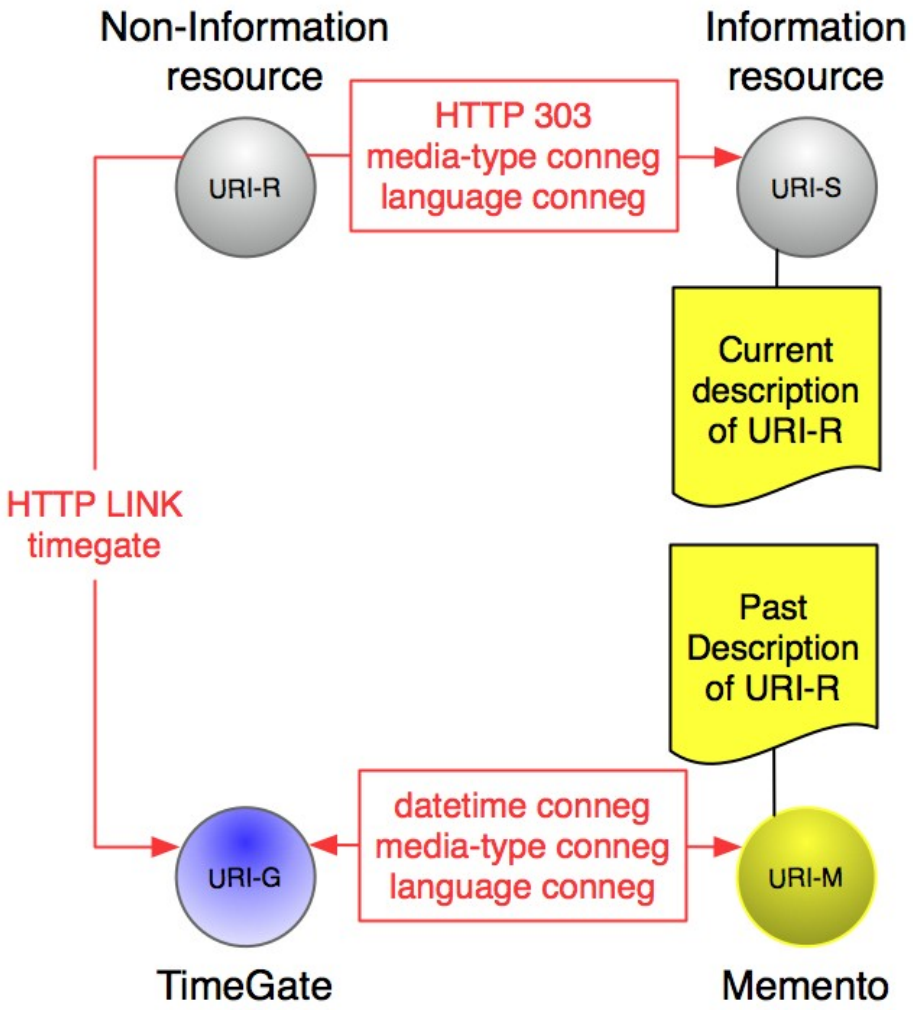
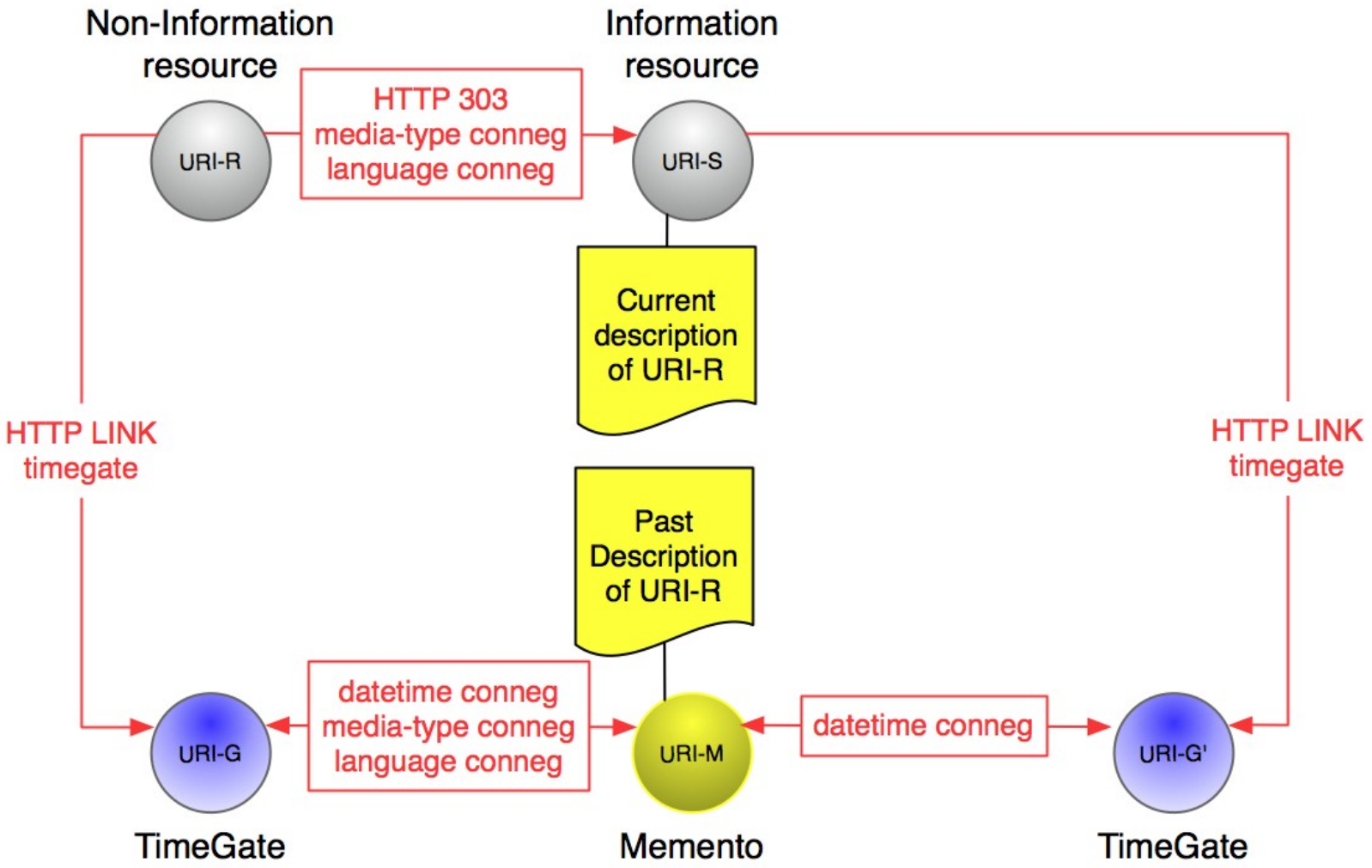

Non-Information resource
Information resource
HTTP 303
media-type conneg
language conneg
URI-R
URI-S
Current description of URI-R


Non-Information resource
Information resource
HTTP 303
media-type conneg
language conneg
URI-R
URI-S
Current description of URI-R
Past Description of URI-R
URI-M
Memento


Non-Information resource
Information resource
HTTP 303
media-type conneg
language conneg
URI-R
URI-S
Current description of URI-R
HTTP LINK
timegate
Past Description of URI-R
datetime conneg
media-type conneg
language conneg
URI-G
URI-M
TimeGate
Memento


Non-Information resource
Information resource
HTTP 303
media-type conneg
language conneg
URI-R
URI-S
Current description of URI-R
HTTP LINK timegate
HTTP LINK timegate
Past Description of URI-R
datetime conneg
media-type conneg
language conneg
datetime conneg
URI-G
URI-M
URI-G'
TimeGate
Memento
TimeGate

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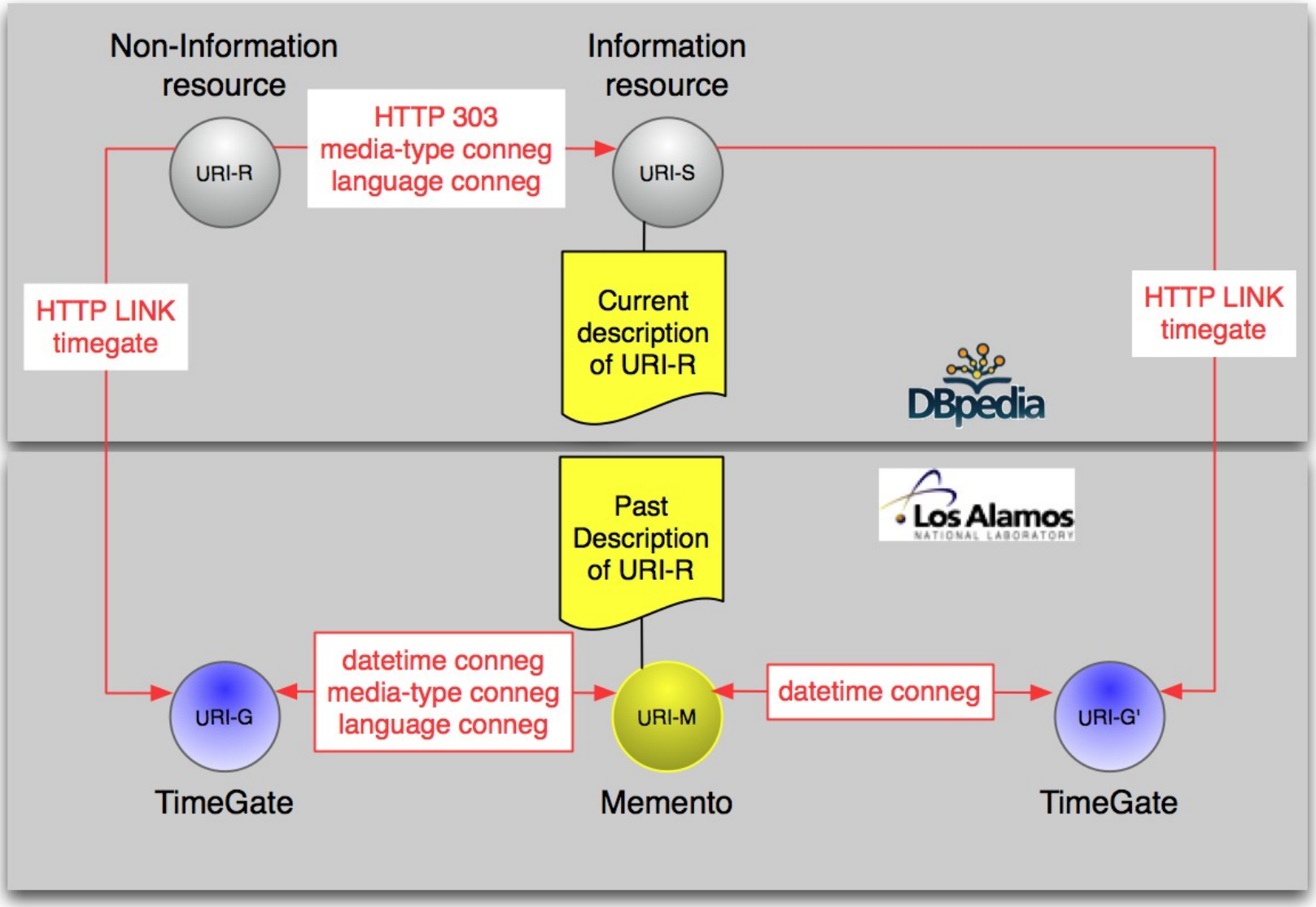
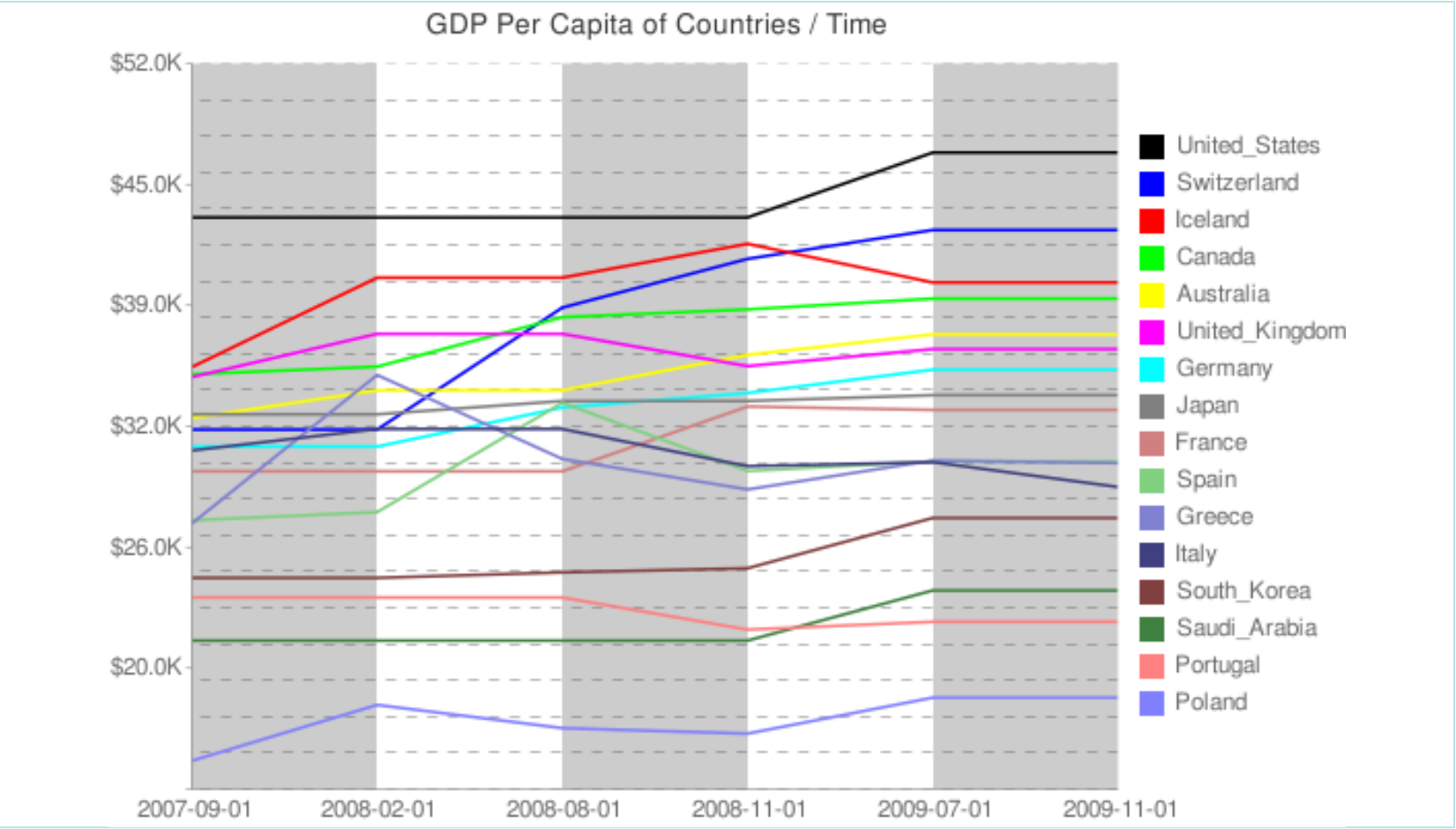
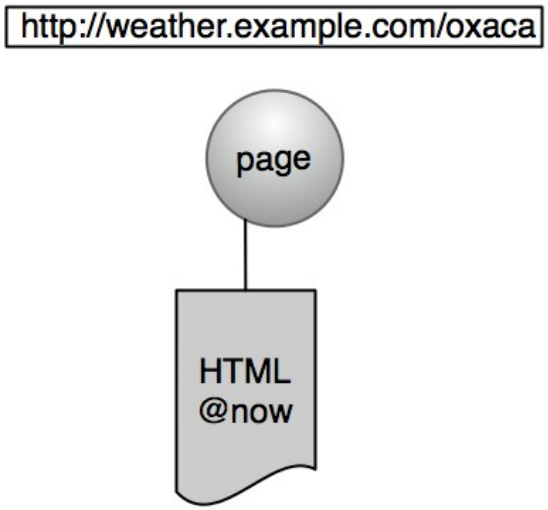

Non-Information resource
Information resource
HTTP 303
media-type conneg
language conneg
URI-R
URI-S
HTTP LINK
timegate
Current description of URI-R
HTTP LINK
timegate
DBpedia
Past Description of URI-R
Los Alamos
NATIONAL LABORATORY
datetime conneg
media-type conneg
language conneg
datetime conneg
URI-G
URI-M
URI-G'
TimeGate
Memento
TimeGate

Time-Series Analysis across DBpedia Versions



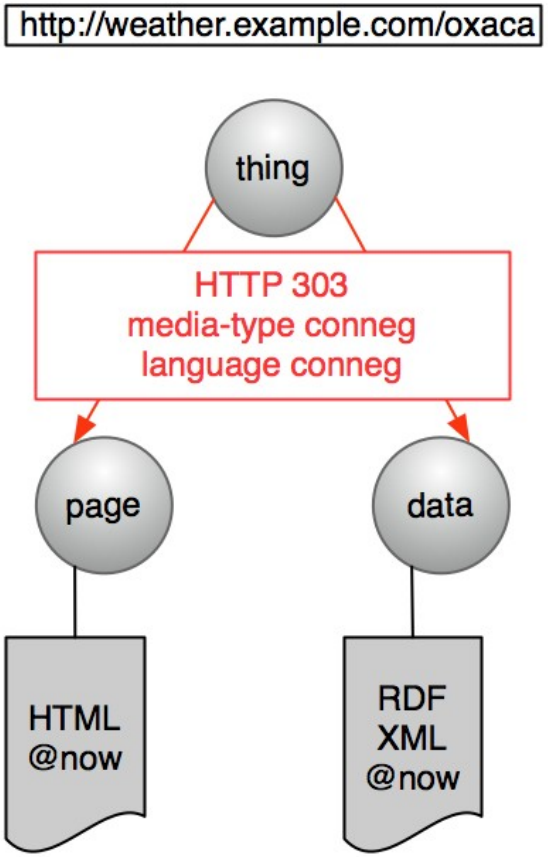
Data collected through HTTP Navigation

Conclusions



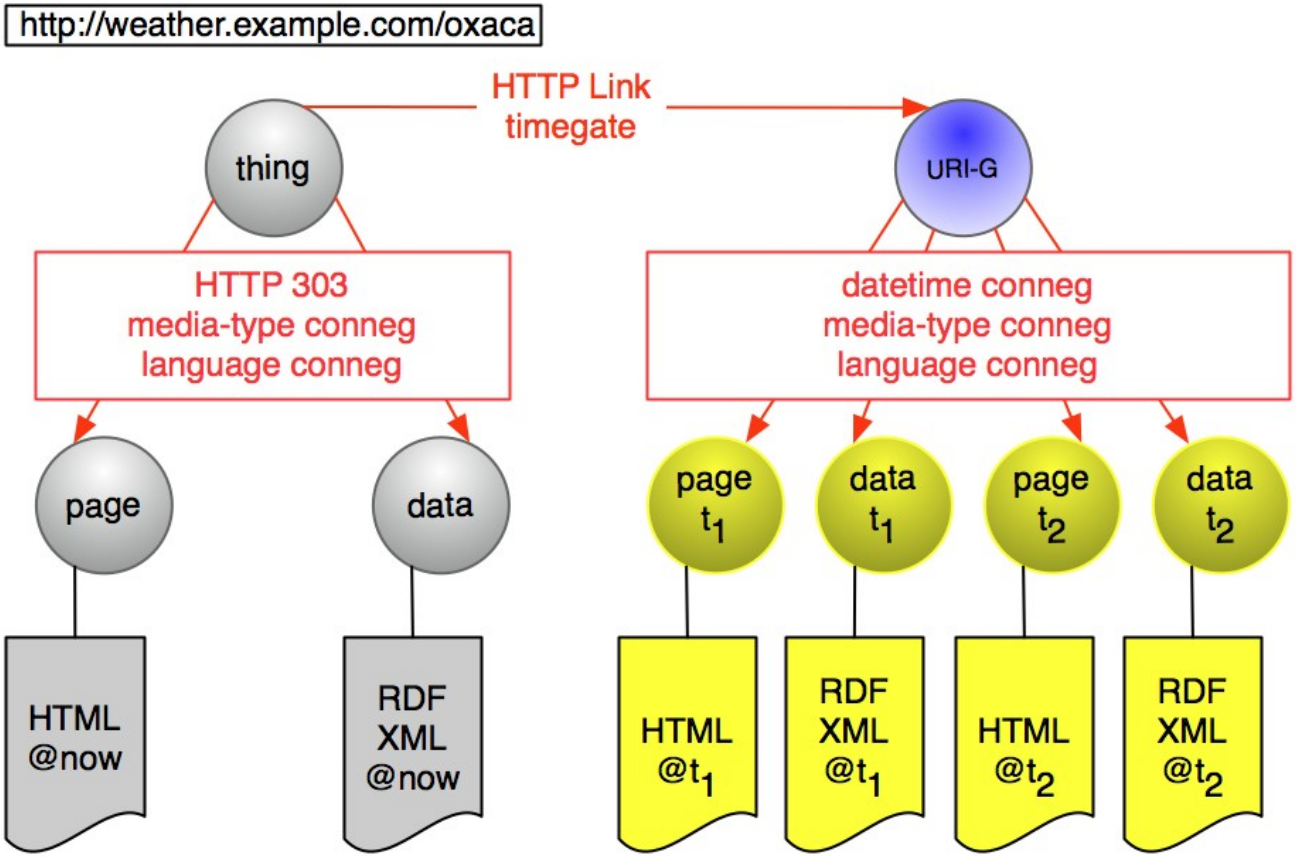
URI as access point to page

Conclusions



Increased value: URI as access point to page and data

Conclusions



Increased value: URI as access point to current & historical page and data

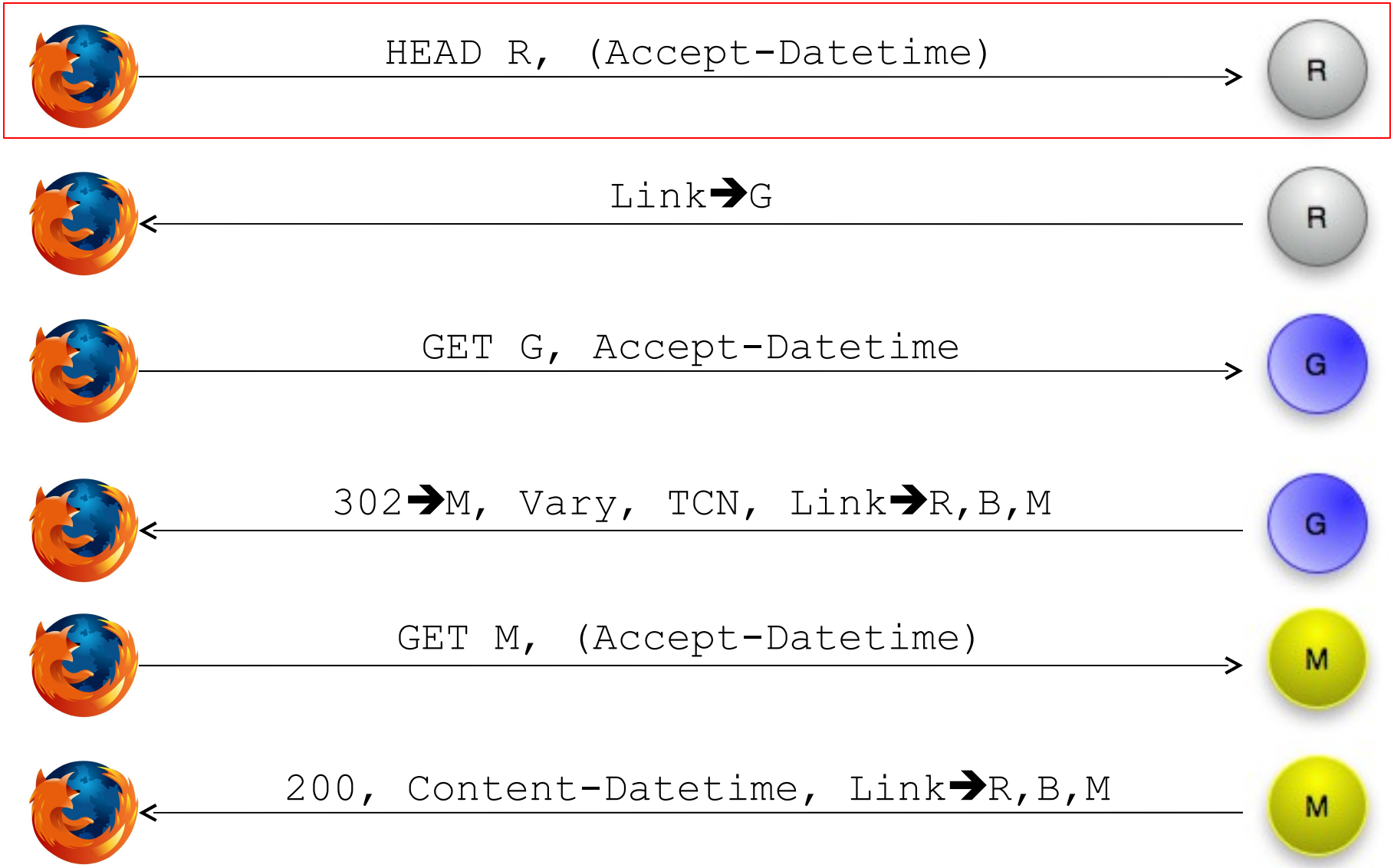
Memento wants to make navigating the Web's Past Easy

http://www.mementoweb.org
http://groups.google.com/group/memento-dev

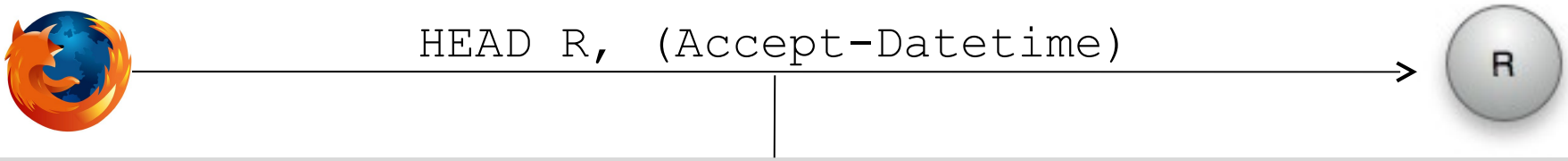
References

- Tim Berners-Lee (1996,2000) Generic Resources.
  http://www.w3.org/DesignIssues/Generic.html
- Van de Sompel, H., Sanderson, R., Nelson, M.L., Balakireva, L., Ainsworth, S., Shankar, H. (2010) An HTTP-Based Versioning Mechanism for Linked Data. Proceedings of the 3rd Workshop on Linked Data on the Web.
  http://arxiv.org/abs/1003.3661
- Sanderson, R., and Van de Sompel, H. (2010) Making Web Annotations Persistent over Time. Proceedings of the 10th ACM/IEEE-CS Joint Conference on Digital libraries.
  http://arxiv.org/abs/1003.2643
- Van de Sompel, H., Nelson, M.L., Sanderson, R., Balakireva, L., Ainsworth, S., Shankar, H. (2009) Memento: Time Travel for the Web.
  http://arxiv.org/abs/0911.1112

Memento HTTP Flow

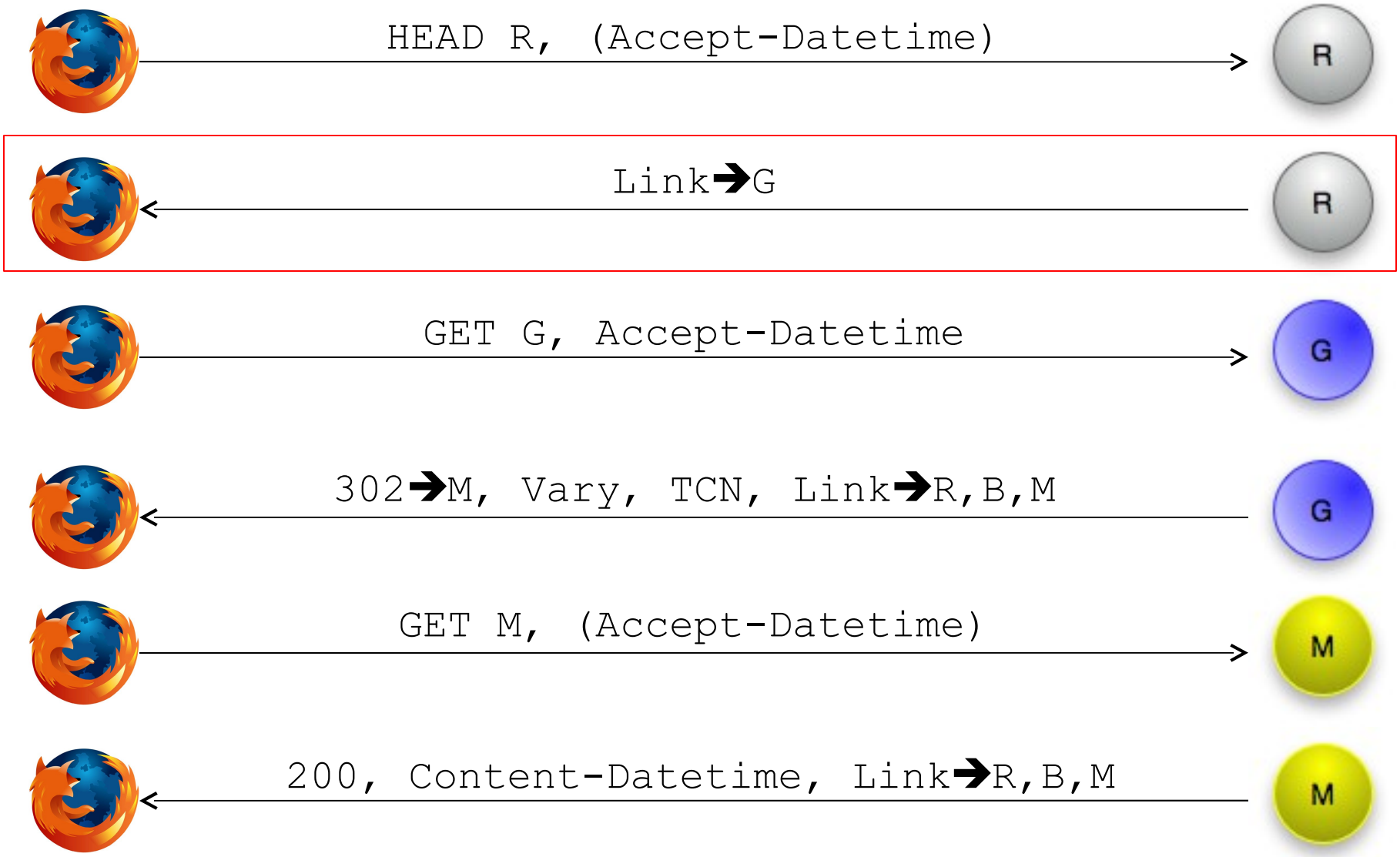


Memento HTTP Flow: URI-R

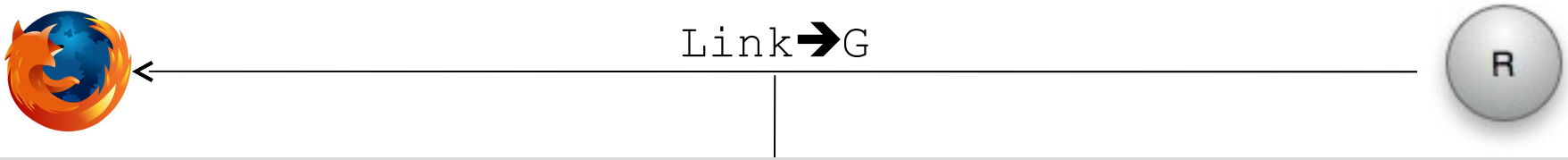



```
HEAD /resource/France HTTP/1.1
Host: dbpedia.org
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
```

Memento HTTP Flow

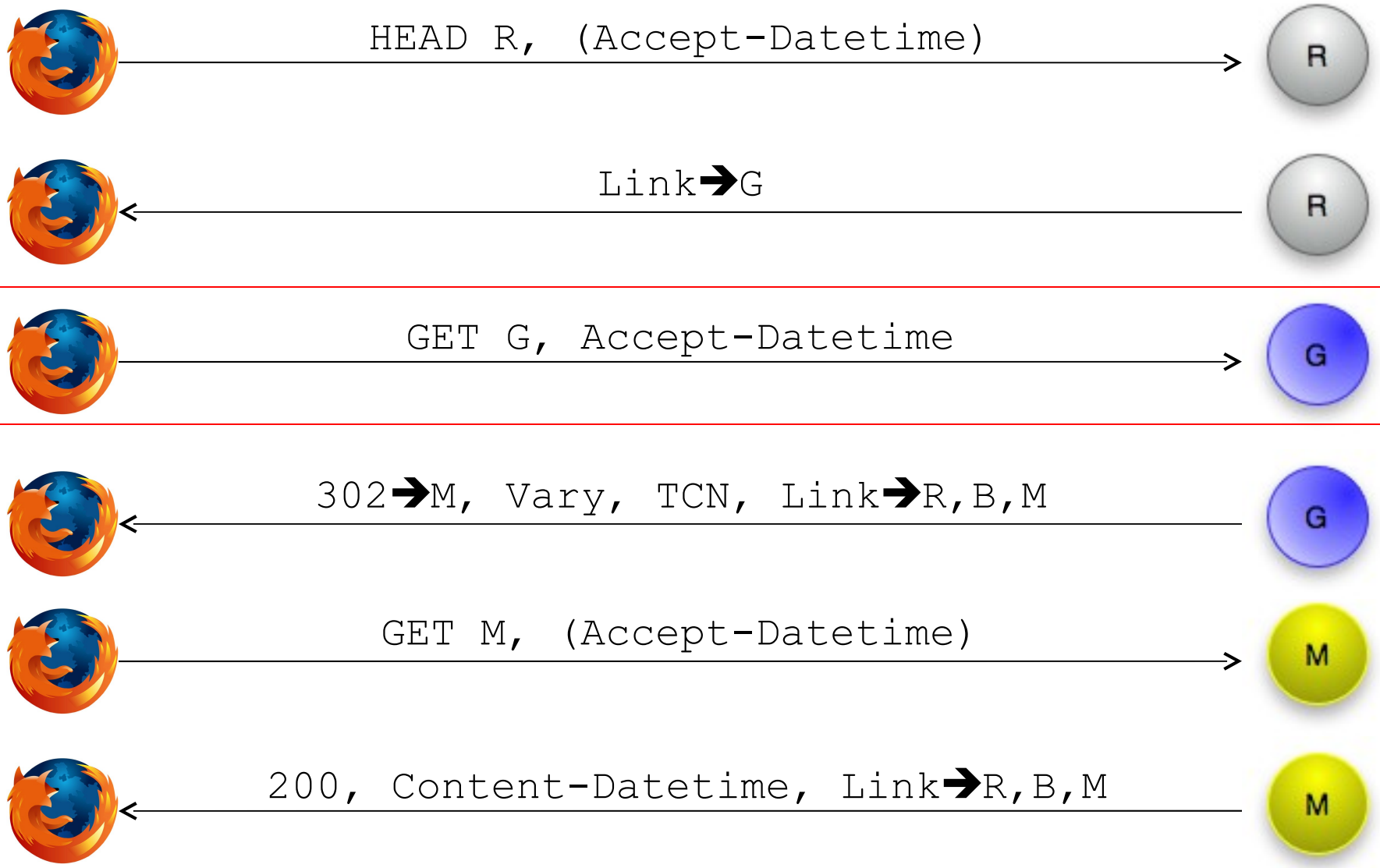


Memento HTTP Flow: Success – URI-R

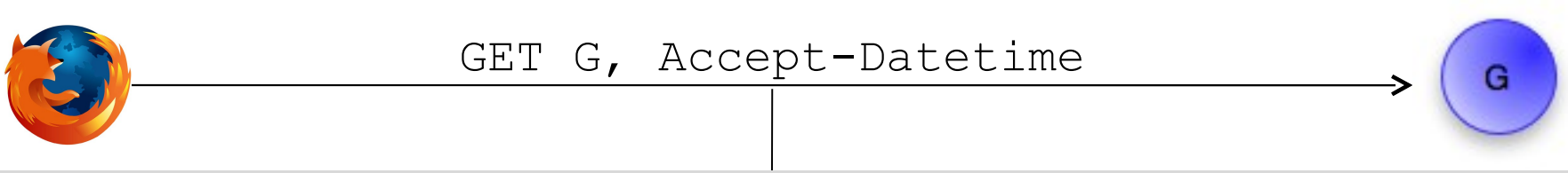



```
HTTP/1.1 303 See Other
Server: Virtuoso/06.01.3127 (Solaris) x86_64-sun-solaris2.10-64  VDB
Connection: close
Content-Type: text/html; charset=UTF-8
Date: Tue, 20 Apr 2010 16:48:51 GMT
Accept-Ranges: bytes
Location: http://dbpedia.org/page/France
Transfer-Encoding: chunked
Content-Encoding: gzip
Link:
<http://mementoarchive.lanl.gov/dbpedia/timegate/http://dbpedia.org/resource/France>
; rel="timegate"
```

Memento HTTP Flow

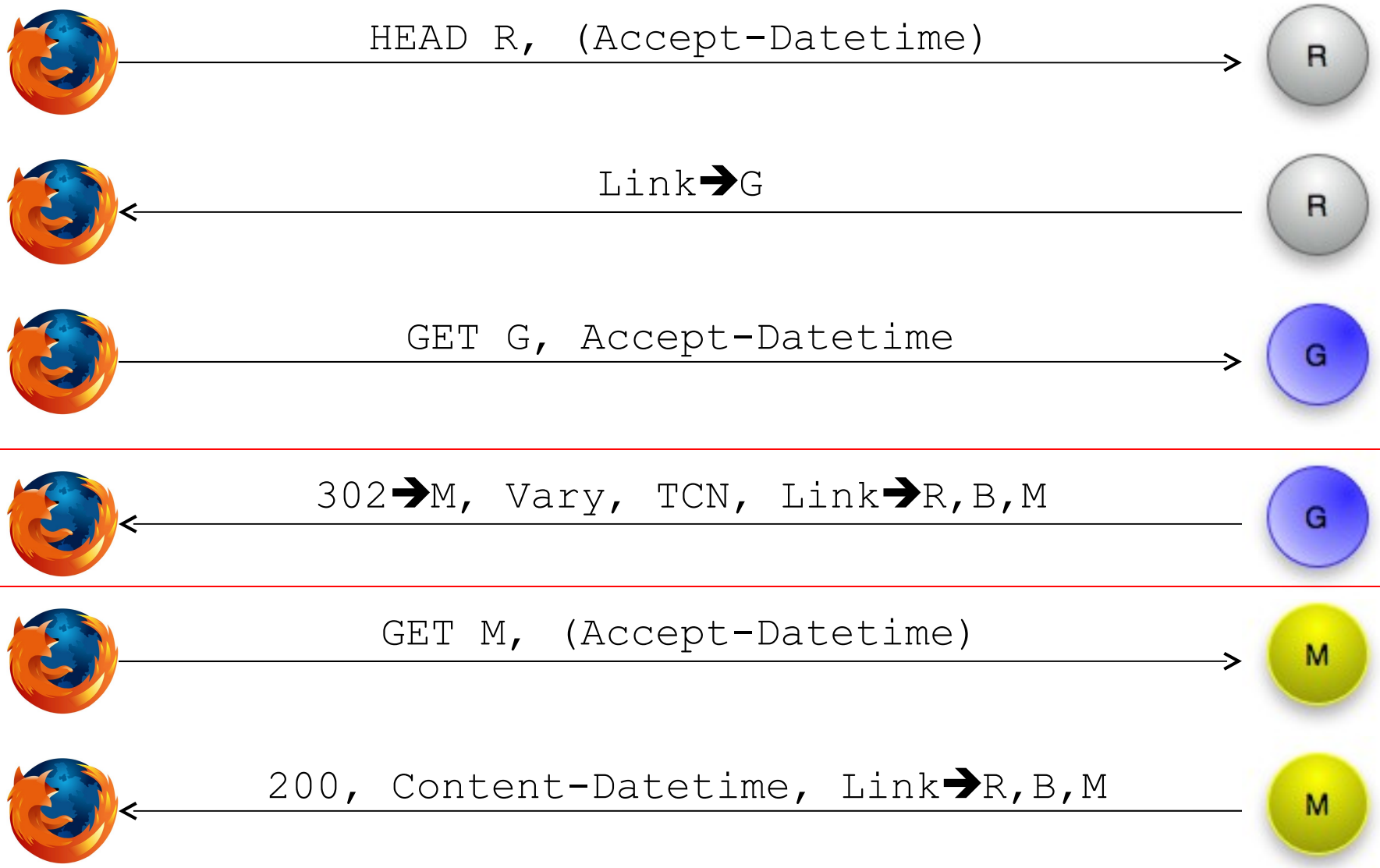


Memento HTTP Flow: URI-G

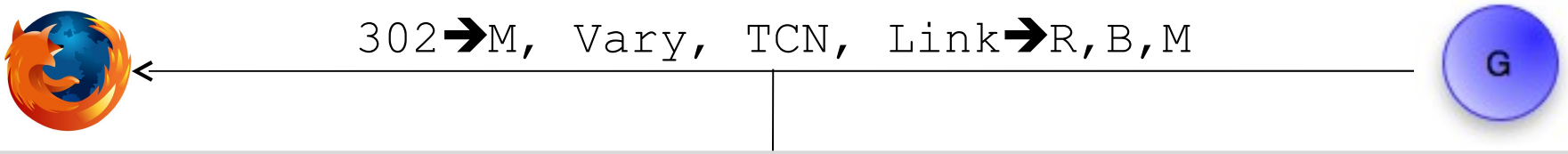



```
GET /dbpedia/timegate/http://dbpedia.org/resource/France HTTP/1.1
Host: mementoarchive.lanl.gov
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
Accept-Datetime: Wed, 08 Jul 2009 06:00:00 GMT
```

Memento HTTP Flow

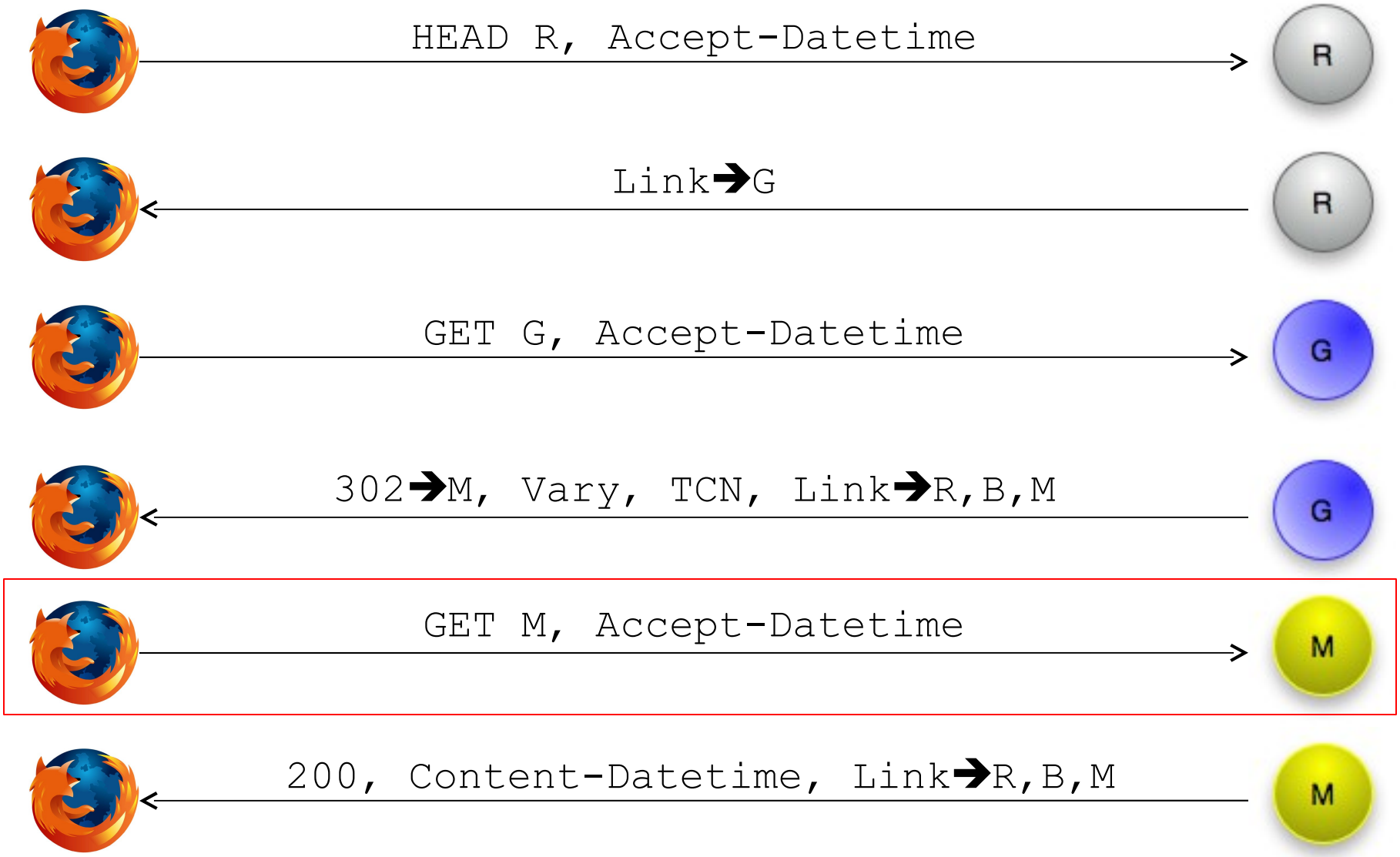


Memento HTTP Flow: Success – URI-G

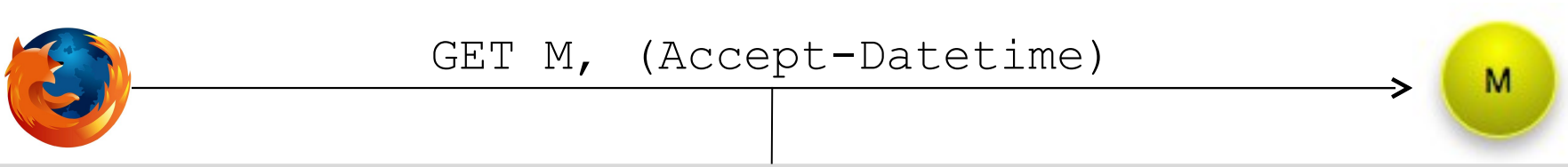



```
HTTP/1.1 302 Found
Date: Tue, 20 Apr 2010 17:51:00 GMT
Server: Apache
TCN: choice
Vary: negotiate, Accept-Datetime
Location:
http://mementoarchive.lanl.gov/dbpedia/memento/20090701/http://dbpedia.org/page/Fran
ce.html
Link:
 <http://dbpedia.org/resource/France>;rel="original",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20070901/http://dbpedia.org/page/
  France.html>;rel="first-memento";datetime="Sat, 01 Sep 2007 00:00:00 GMT",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20091101/http://dbpedia.org/page/
  France.html>;rel="last-memento next-memento";datetime="Sun, 01 Nov 2009 00:00:00
  GMT",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20081101/http://dbpedia.org/page/
  France.html>;rel="prev-memento";datetime="Sat, 01 Nov 2008 00:00:00 GMT",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20090701/http://dbpedia.org/page/
  France.html>;rel="memento";datetime="Wed, 01 Jul 2009 00:00:00 GMT”,
 <http://mementoarchive.lanl.gov/dbpedia/timebundle/http://dbpedia.org/page/
  France>;rel="timebundle”
Transfer-Encoding: chunked
```

Memento HTTP Flow

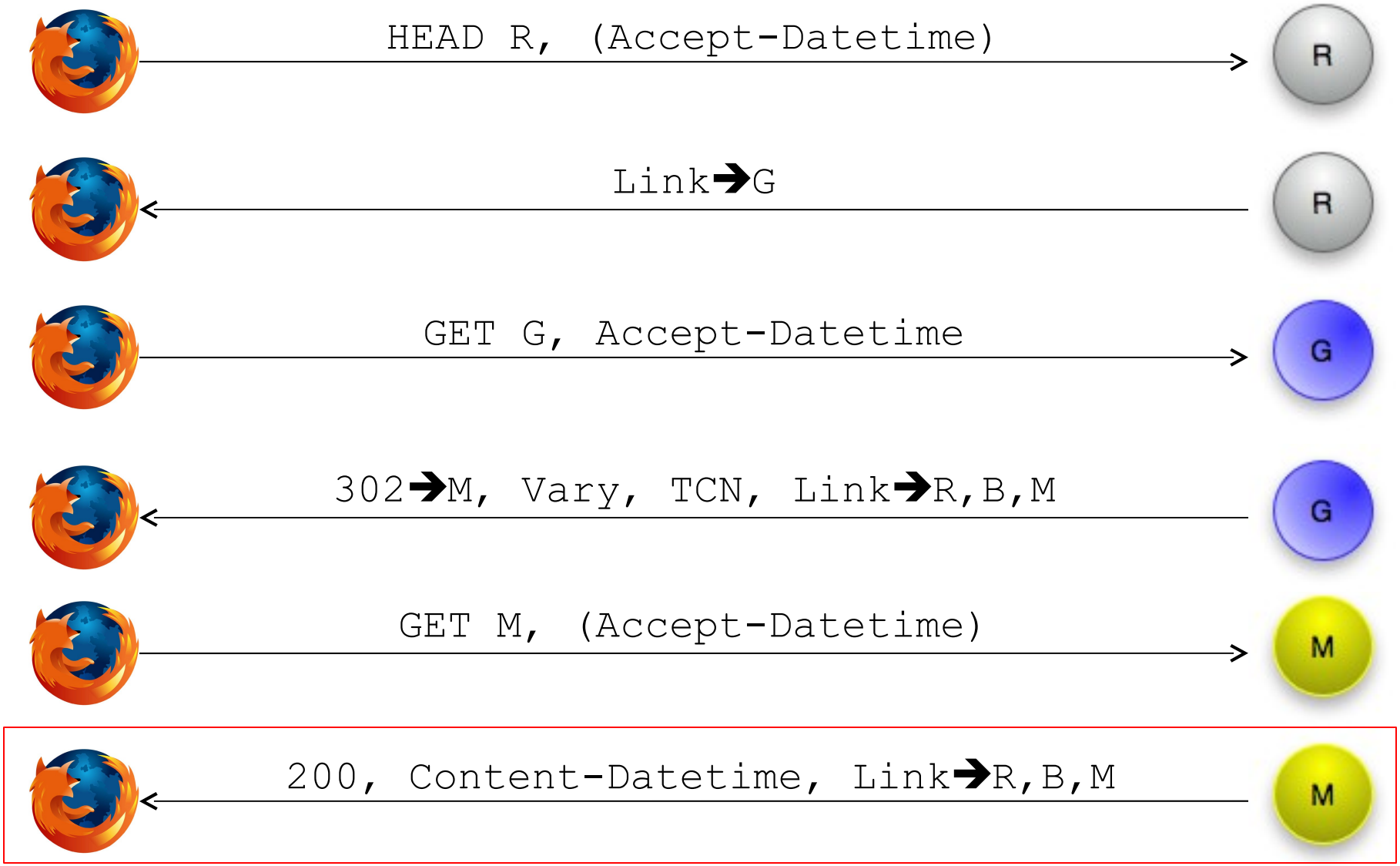


Memento HTTP Flow: URI-M




```
GET /dbpedia/memento/20090701/http://dbpedia.org/page/France.html HTTP/1.1
Host: mementoarchive.lanl.gov
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
Connection: close
```

Memento HTTP Flow



Memento HTTP Flow: Success – URI-M

200, Content-Datetime, Link➔R,B,M


```
HTTP/1.1 200 OK
Date: Tue, 20 Apr 2010 17:51:00 GMT
Server: Apache
Content-Datetime: Wed, 01 Jul 2009 00:00:00 GMT
Link:
 <http://mementoarchive.lanl.gov/dbpedia/timegate/http://dbpedia.org/page/
  France.html>;rel="timegate",
 <http://dbpedia.org/page/France.html>;rel="original",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20070901/http://dbpedia.org/page/
  France.html>;rel="first-memento";datetime="Sat, 01 Sep 2007 00:00:00 GMT",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20091101/http://dbpedia.org/page/
  France.html>;rel="last-memento next-memento";datetime="Sun, 01 Nov 2009 00:00:00
  GMT",
 <http://mementoarchive.lanl.gov/dbpedia/memento/20081101/http://dbpedia.org/page/
  France.html>;rel="prev-memento";datetime="Sat, 01 Nov 2008 00:00:00
 <http://mementoarchive.lanl.gov/dbpedia/timebundle/http://dbpedia.org/page/
  France.html>;rel="timebundle"
Connection: close
Transfer-Encoding: chunked
Content-Type: text/html; charset=UTF-8
```