

# Memento: Versioning Resources to Support HTTP-based Discovery



**Herbert Van de Sompel**

Robert Sanderson

Michael L. Nelson

Lyudmila Balakireva

Harihar Shankar

Scott Ainsworth

Memento is partially funded by the  
Library of Congress



Memento  
JISC/CNI Meeting 2010, Edinburgh



# Outline

- Memento - Time Travel for the Web
- HTTP-based Versioning and Time Series Analysis
- Persistent Web-Centric Annotations
- The Value of the URI for Discovery



# Outline

- Memento - Time Travel for the Web
- HTTP-based Versioning and Time Series Analysis
- Persistent Web-Centric Annotations
- The Value of the URI for Discovery



Memento wants to make navigating the Web's Past Easy



<http://www.mementoweb.org>

<http://groups.google.com/group/memento-dev>



Memento  
JISC/CNI Meeting 2010, Edinburgh

4



Sep 11 2001, 20:36:10 UTC

Dec 20 2001, 4:51:00 UTC

# Archived Resources

**CNN.com SPECIAL REPORT**

Updated: 5:42 p.m. EDT -- 11 September 2001

**AMERICA UNDER ATTACK**  
CNN EXCLUSIVE

**Terrorists strike New York, D.C.**  
At 8:45 a.m. EDT, the first of two airliners crashed into the World Trade Center, opening a horrifying and apparently coordinated terrorist attack on the United States, which saw the collapse of the two 110-story towers into surrounding Manhattan streets and a later attack on the Pentagon.

**COMPLETE COVERAGE**

- World Trade Center towers collapse after hit
- Crash destroys part of Pentagon
- White House, Capitol evacuated
- American, United confirm losing planes
- Bush: 'We'll hunt them down' | Statement
- U.S. officials: More attacks can't be ruled out
- Attacks strike financial markets

**U.S. SCENE**

- FAA grounds all U.S. flights until noon Wednesday
- U.S. military on 'high alert'
- Major sports events postponed

**WORLD SCENE**

- Taliban statement: 'Afghanistan feels your pain'
- World in shock | Evacuations amid chaos
- Middle East, Asia condemn attacks

**RESOURCES AND RESCUE**

- Giuliani: 1,500 'walking wounded' in New York
- Emergency contact information

**VIDEO**  
Watch video of second plane crash at World Trade Center  
[More audio/video >>](#)

**PHOTO GALLERY**  
Aftermath of the attacks in New York and Washington

**CHRONOLOGY**  
At 8:45 a.m. EDT, day of disaster begins  
[Map of attacks](#)

**EXTRA INFO**  
[World Trade Center, Pentagon, 767](#)

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

**September 11 attacks**

From Wikipedia, the free encyclopedia

This is an old revision of this page, as edited by The Cunctator (talk | contribs) at 04:51, 20 December 2001. It may differ significantly from the current revision.  
(diff) ← Previous revision | Current revision (diff) | Newer revision → (diff)

**In Memoriam, September 11, 2001**

On the morning of **September 11, 2001**, what might well be the most devastating **terrorist attack** in the history of the world occurred concurrently in **New York City**, **Washington, D.C.** and near **Pittsburgh**. Four passenger jets were **hijacked** and then deliberately crashed into the **World Trade Center** and the **Pentagon**. Both towers of the World Trade Center subsequently collapsed, and part of the Pentagon was destroyed in the ensuing fire. **Casualties** are expected to be in the thousands: 265 on the planes; about 3000 people (early estimates ranged as high as 6500 people), including hundreds of firefighters who had rushed in, at the World Trade Center; and 125 at the Pentagon.

Some passengers on the doomed flights were able to make phone calls reporting on events on board. They reported that there were more than one hijacker on each plane and that they took control of the planes using **box-cutter knives**. It appears that the passengers on the fourth jet tried to overpower the hijackers and that the plane crashed in a sparsely populated area as a result, thereby missing its intended target, which may have been the **White House**.

The attack had immediate and deep global **political effects** and **economic effects** and inspired an international outpouring of **memorials and services**. The massive undertaking of **rescue and recovery**, and of providing **assistance** to the **survivors** and victims, is ongoing. There will be a great need for **donations** for a long time.

Though no group has claimed **responsibility**, the U.S. government immediately launched a full-scale **response**, stating its intentions to go to war against those responsible. On October 7, a coalition led by the United States launched an attack in Afghanistan. See **2001 U.S. Attack on Afghanistan**.

Following the attack, the United States has been on heightened alert for new terrorist attacks. In late September, **cases of anthrax** started breaking out; although, no connection to the September 11 attack has been found. See **2001 anthrax attack**.

[http://en.wikipedia.org/w/index.php?title=September\\_11\\_attacks&oldid=282333](http://en.wikipedia.org/w/index.php?title=September_11_attacks&oldid=282333)  
archived resource for  
[http://en.wikipedia.org/wiki/September\\_11\\_attacks](http://en.wikipedia.org/wiki/September_11_attacks)



# Finding Archived Resources

able here 6 months after collection. [See FAQ.](#)

Search Results for Jan 01, 1996 - May 14, 2009							
2000	2001	2002	2003	2004	2005	2006	2007
30 pages	2734 pages	231 pages	156 pages	625 pages	1186 pages	886 pages	953 pages
<a href="#">Jan 20, 2000</a>	<a href="#">Mar 01, 2001</a>	<a href="#">Jan 23, 2002</a>	<a href="#">Jan 29, 2003</a>	<a href="#">Jan 01, 2004</a>	<a href="#">Jan 01, 2005</a>	<a href="#">Jan 01, 2006</a>	<a href="#">Jan 01, 2007</a>
<a href="#">Jan 21, 2000</a>	<a href="#">Mar 02, 2001</a>	<a href="#">Feb 02, 2002</a>	<a href="#">Jan 31, 2003</a>	<a href="#">Jan 02, 2004</a>	<a href="#">Jan 01, 2005</a>	<a href="#">Jan 01, 2006</a>	<a href="#">Jan 01, 2007</a>
<a href="#">Jan 21, 2000</a>	<a href="#">Mar 05, 2001</a>	<a href="#">Feb 09, 2002</a>	<a href="#">Feb 01, 2003</a>	<a href="#">Jan 03, 2004</a>	<a href="#">Jan 02, 2005</a>	<a href="#">Jan 02, 2006</a>	<a href="#">Jan 02, 2007</a>
<a href="#">Jun 21, 2000</a>	<a href="#">Mar 07, 2001</a>	<a href="#">Feb 10, 2002</a>	<a href="#">Feb 01, 2003</a>	<a href="#">Jan 10, 2004</a>	<a href="#">Jan 02, 2005</a>	<a href="#">Jan 02, 2006</a>	<a href="#">Jan 02, 2007</a>
<a href="#">Jun 21, 2000</a>	<a href="#">Mar 09, 2001</a>	<a href="#">Feb 11, 2002</a>	<a href="#">Feb 02, 2003</a>	<a href="#">Jan 11, 2004</a>	<a href="#">Jan 03, 2005</a>	<a href="#">Jan 03, 2006</a>	<a href="#">Jan 02, 2007</a>
<a href="#">Jul 06, 2000</a>	<a href="#">Mar 31, 2001</a>	<a href="#">Feb 13, 2002</a>	<a href="#">Feb 02, 2003</a>	<a href="#">Jan 12, 2004</a>	<a href="#">Jan 04, 2005</a>	<a href="#">Jan 03, 2006</a>	<a href="#">Jan 03, 2007</a>
<a href="#">Jul 07, 2000</a>	<a href="#">Apr 10, 2001</a>	<a href="#">Feb 13, 2002</a>	<a href="#">Feb 03, 2003</a>	<a href="#">Jan 12, 2004</a>	<a href="#">Jan 05, 2005</a>	<a href="#">Jan 03, 2006</a>	<a href="#">Jan 03, 2007</a>
<a href="#">Jul 11, 2000</a>	<a href="#">Apr 13, 2001</a>	<a href="#">Feb 14, 2002</a>	<a href="#">Feb 05, 2003</a>	<a href="#">Jan 13, 2004</a>	<a href="#">Jan 06, 2005</a>	<a href="#">Jan 04, 2006</a>	<a href="#">Jan 04, 2007</a>
<a href="#">Aug 04, 2000</a>	<a href="#">Apr 13, 2001</a>	<a href="#">Feb 15, 2002</a>	<a href="#">Feb 06, 2003</a>	<a href="#">Jan 15, 2004</a>	<a href="#">Jan 06, 2005</a>	<a href="#">Jan 04, 2006</a>	<a href="#">Jan 05, 2007</a>
<a href="#">Aug 15, 2000</a>	<a href="#">Apr 13, 2001</a>	<a href="#">Feb 16, 2002</a>	<a href="#">Feb 07, 2003</a>	<a href="#">Jan 16, 2004</a>	<a href="#">Jan 06, 2005</a>	<a href="#">Jan 04, 2006</a>	<a href="#">Jan 05, 2007</a>
<a href="#">Aug 15, 2000</a>	<a href="#">Apr 14, 2001</a>	<a href="#">Feb 20, 2002</a>	<a href="#">Jan 17, 2003</a>	<a href="#">Jan 17, 2004</a>	<a href="#">Jan 07, 2005</a>	<a href="#">Jan 04, 2006</a>	<a href="#">Jan 06, 2007</a>
<a href="#">Aug 15, 2000</a>	<a href="#">Apr 14, 2001</a>	<a href="#">Feb 22, 2002</a>	<a href="#">Feb 10, 2003</a>	<a href="#">Jan 20, 2004</a>	<a href="#">Jan 07, 2005</a>	<a href="#">Jan 05, 2006</a>	<a href="#">Jan 06, 2007</a>
<a href="#">Aug 15, 2000</a>	<a href="#">Apr 14, 2001</a>	<a href="#">Feb 22, 2002</a>	<a href="#">Feb 11, 2003</a>	<a href="#">Jan 20, 2004</a>	<a href="#">Jan 08, 2005</a>	<a href="#">Jan 05, 2006</a>	<a href="#">Jan 06, 2007</a>
<a href="#">Aug 16, 2000</a>	<a href="#">Apr 18, 2001</a>	<a href="#">Feb 23, 2002</a>	<a href="#">Feb 12, 2003</a>	<a href="#">Jan 20, 2004</a>	<a href="#">Jan 09, 2005</a>	<a href="#">Jan 05, 2006</a>	<a href="#">Jan 07, 2007</a>
<a href="#">Aug 16, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Feb 23, 2002</a>	<a href="#">Feb 12, 2003</a>	<a href="#">Jan 24, 2004</a>	<a href="#">Jan 09, 2005</a>	<a href="#">Jan 06, 2006</a>	<a href="#">Jan 07, 2007</a>
<a href="#">Aug 17, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Feb 23, 2002</a>	<a href="#">Jan 27, 2003</a>	<a href="#">Jan 27, 2004</a>	<a href="#">Jan 10, 2005</a>	<a href="#">Jan 06, 2006</a>	<a href="#">Jan 07, 2007</a>
<a href="#">Aug 17, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Feb 24, 2002</a>	<a href="#">Feb 15, 2003</a>	<a href="#">Jan 28, 2004</a>	<a href="#">Jan 10, 2005</a>	<a href="#">Jan 06, 2006</a>	<a href="#">Jan 07, 2007</a>
<a href="#">Aug 18, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Feb 26, 2002</a>	<a href="#">Mar 20, 2003</a>	<a href="#">Jan 30, 2004</a>	<a href="#">Jan 10, 2005</a>	<a href="#">Jan 06, 2006</a>	<a href="#">Jan 07, 2007</a>
<a href="#">Aug 28, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Feb 27, 2002</a>	<a href="#">Jan 30, 2003</a>	<a href="#">Jan 30, 2004</a>	<a href="#">Jan 11, 2005</a>	<a href="#">Jan 07, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Sep 20, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Mar 27, 2002</a>	<a href="#">Mar 21, 2003</a>	<a href="#">Jan 31, 2004</a>	<a href="#">Jan 11, 2005</a>	<a href="#">Jan 07, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Sep 30, 2000</a>	<a href="#">May 03, 2001</a>	<a href="#">Mar 29, 2002</a>	<a href="#">Mar 24, 2003</a>	<a href="#">Feb 02, 2004</a>	<a href="#">Jan 12, 2005</a>	<a href="#">Jan 07, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Oct 18, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 25, 2002</a>	<a href="#">Mar 25, 2003</a>	<a href="#">Feb 02, 2004</a>	<a href="#">Jan 12, 2005</a>	<a href="#">Jan 07, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Nov 09, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 27, 2002</a>	<a href="#">Mar 26, 2003</a>	<a href="#">Feb 03, 2004</a>	<a href="#">Jan 13, 2005</a>	<a href="#">Jan 08, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Nov 10, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 27, 2002</a>	<a href="#">Mar 29, 2003</a>	<a href="#">Feb 04, 2004</a>	<a href="#">Jan 13, 2005</a>	<a href="#">Jan 09, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Nov 10, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 28, 2002</a>	<a href="#">Mar 29, 2003</a>	<a href="#">Feb 07, 2004</a>	<a href="#">Jan 13, 2005</a>	<a href="#">Jan 09, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Nov 17, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 29, 2002</a>	<a href="#">Mar 30, 2003</a>	<a href="#">Feb 10, 2004</a>	<a href="#">Jan 14, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 08, 2007</a>
<a href="#">Nov 18, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 30, 2002</a>	<a href="#">Mar 31, 2003</a>	<a href="#">Feb 10, 2004</a>	<a href="#">Jan 14, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 09, 2007</a>
<a href="#">Dec 04, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 30, 2002</a>	<a href="#">Apr 01, 2003</a>	<a href="#">Feb 11, 2004</a>	<a href="#">Jan 14, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 09, 2007</a>
<a href="#">Dec 04, 2000</a>	<a href="#">May 04, 2001</a>	<a href="#">May 30, 2002</a>	<a href="#">Apr 04, 2003</a>	<a href="#">Feb 13, 2004</a>	<a href="#">Jan 15, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 09, 2007</a>
<a href="#">Dec 04, 2000</a>	<a href="#">May 05, 2001</a>	<a href="#">May 31, 2002</a>	<a href="#">Apr 04, 2003</a>	<a href="#">Feb 13, 2004</a>	<a href="#">Jan 15, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 09, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jun 02, 2002</a>	<a href="#">Apr 05, 2003</a>	<a href="#">Feb 14, 2004</a>	<a href="#">Jan 15, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 10, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jun 02, 2002</a>	<a href="#">Apr 08, 2003</a>	<a href="#">Feb 14, 2004</a>	<a href="#">Jan 16, 2005</a>	<a href="#">Jan 10, 2006</a>	<a href="#">Jan 10, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jun 03, 2002</a>	<a href="#">Apr 08, 2003</a>	<a href="#">Feb 17, 2004</a>	<a href="#">Jan 16, 2005</a>	<a href="#">Jan 11, 2006</a>	<a href="#">Jan 11, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jun 03, 2002</a>	<a href="#">Apr 09, 2003</a>	<a href="#">Feb 18, 2004</a>	<a href="#">Jan 17, 2005</a>	<a href="#">Jan 11, 2006</a>	<a href="#">Jan 11, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jun 04, 2002</a>	<a href="#">Apr 09, 2003</a>	<a href="#">Feb 20, 2004</a>	<a href="#">Jan 17, 2005</a>	<a href="#">Jan 11, 2006</a>	<a href="#">Jan 12, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jun 06, 2002</a>	<a href="#">Apr 11, 2003</a>	<a href="#">Feb 21, 2004</a>	<a href="#">Jan 18, 2005</a>	<a href="#">Jan 11, 2006</a>	<a href="#">Jan 12, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jul 01, 2002</a>	<a href="#">Apr 20, 2003</a>	<a href="#">Feb 28, 2004</a>	<a href="#">Jan 18, 2005</a>	<a href="#">Jan 11, 2006</a>	<a href="#">Jan 12, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jul 02, 2002</a>	<a href="#">Apr 23, 2003</a>	<a href="#">Mar 02, 2004</a>	<a href="#">Jan 19, 2005</a>	<a href="#">Jan 11, 2006</a>	<a href="#">Jan 12, 2007</a>
	<a href="#">May 05, 2001</a>	<a href="#">Jul 03, 2002</a>	<a href="#">Apr 23, 2003</a>	<a href="#">Mar 07, 2004</a>	<a href="#">Jan 19, 2005</a>	<a href="#">Jan 12, 2006</a>	<a href="#">Jan 13, 2007</a>

Go to <http://www.archive.org/> and search <http://cnn.com>

On [http://web.archive.org/web/\\*/http://cnn.com](http://web.archive.org/web/*/http://cnn.com), select desired datetime



# Finding Archived Resources

The screenshot shows the main article page for "September 11 attacks" on Wikipedia. The article text describes the coordinated suicide attacks by Al-Qaeda on September 11, 2001, in New York City and Arlington, Virginia. A table titled "September 11, 2001 Attacks" provides key details:

<b>Location</b>	New York City; Arlington County, Virginia; and near Shanksville, Pennsylvania.
<b>Date</b>	Tuesday, September 11, 2001 8:46 am – 10:28 am (UTC-4)
<b>Attack type</b>	Aircraft hijacking, Mass murder, Suicide attack
<b>Death(s)</b>	2,995 (including 19 hijackers)
<b>Injured</b>	6,000+
<b>Perpetrator(s)</b>	al-Qaeda led by Osama bin Laden, see also Responsibility and Hijackers.

The screenshot shows the "Revision history of September 11 attacks" page. It features a search bar with filters for "From year (and earlier):" and "From month (and earlier):" set to "all". Below the search bar, a list of revisions is displayed, including:

- (cur) (prev) 18:20, 9 November 2009 InnerParty (talk | contribs) (133,903 bytes) (→ Conspiracy theories: adding 9/11 opinion polls)
- (cur) (prev) 23:01, 8 November 2009 InnerParty (talk | contribs) (133,650 bytes) (→ 9/11 Commission: extrapolating)
- (cur) (prev) 22:27, 8 November 2009 WordyGirl90 (talk | contribs) (133,608 bytes) (→ Planning of the attacks: wikilink needed, methinks)
- (cur) (prev) 22:20, 8 November 2009 WordyGirl90 (talk | contribs) (133,604 bytes) (→ Attackers and their motivation: mv excess wikilinking)
- (cur) (prev) 02:09, 7 November 2009 DaleEastman (talk | contribs) (133,612 bytes)
- (cur) (prev) 12:07, 6 November 2009 LawBot (talk | contribs) m (133,541 bytes) (Bot: Removed unnecessary and invalid "<span>";)
- (cur) (prev) 14:32, 3 November 2009 Ohnoitsjamie (talk | contribs) (133,548 bytes) (restored sourced material from cbsnews and the Guardian)
- (cur) (prev) 11:25, 3 November 2009 InnerParty (talk | contribs) m (132,453 bytes) (Undid revision 323549441 by The Original Wildbear (talk) I have no idea what are you talking about...)
- (cur) (prev) 21:36, 2 November 2009 The Original Wildbear (talk | contribs) (133,548 bytes) (Undid revision 323502267 by InnerParty) Exactly; it IS outlandish. We should represent history as it is; not put lipstick on a pig)



Go to  
[http://en.wikipedia.org/wiki/September\\_11\\_attacks](http://en.wikipedia.org/wiki/September_11_attacks)  
 and click History

Browse History



Dec 20 2001, 4:51:00 UTC

current

# Navigating Archived Resources

<b>Type</b>	Headquarters
<b>Coordinates</b>	<span><span><span><span><span>38°52′15.56″N</span> <span>77°3′21.46″W</span></span></span><span><span>﻿</span> / <span>﻿</span></span><span><span>38.8709722°N 77.0557111°W</span><span><span>﻿</span> / <span>38.8709722; -77.0557111</span></span></span></span></span>
<b>Built</b>	1943 (broke ground on September 11, 1941)
<b>Height</b>	Five floors above ground and Two floors below ground
<b>In use</b>	1943–present

[http://en.wikipedia.org/w/index.php?title=September\\_11\\_attacks&oldid=282333](http://en.wikipedia.org/w/index.php?title=September_11_attacks&oldid=282333) archived resource for [http://en.wikipedia.org/wiki/September\\_11\\_attacks](http://en.wikipedia.org/wiki/September_11_attacks)

[http://en.wikipedia.org/wiki/The\\_Pentagon](http://en.wikipedia.org/wiki/The_Pentagon)





Sep 11 2001, 20:36:10 UTC

Sep 11 2001, 21:38:55 UTC

# Navigating Archived Resources

**CNN.com SPECIAL REPORT**

Updated: 5:42 p.m. EDT -- 11 September 2001

**AMERICA UNDER ATTACK**

CNN EXCLUSIVE

**Terrorists strike New York, D.C.**

At 8:45 a.m. EDT, the first of two airliners crashed into the World Trade Center, opening a horrifying and apparently coordinated terrorist attack on the United States, which saw the collapse of the two 110-story towers into surrounding Manhattan streets and a later attack on the Pentagon.

[FULL STORY >>](#)

[SPECIAL REPORT >>](#)

**COMPLETE COVERAGE**

- World Trade Center towers collapse after hit
- Crash destroys part of Pentagon
- White House, Capitol evacuated
- American, United confirm losing planes
- Bush: 'We'll hunt them down' | Statement
- U.S. officials: More attacks can't be ruled out
- Attack strikes financial markets

**U.S. SCENE**

- FAA grounds all U.S. flights until noon Wednesday
- U.S. military on 'high alert'
- Major sports events postponed

**WORLD SCENE**

- Taliban statement: 'Afghanistan feels your pain'
- World in shock | Evacuations amid chaos
- Middle East, Asia condemn attacks

**RESOURCES AND RESCUE**

Giuliani: 1,500 'walking wounded' in New York

[Emergency contact information](#)

**VIDEO**

Watch video of second plane crash at World Trade Center

[More audio/video >>](#)

**PHOTO GALLERY**

Aftermath of the attacks in New York and Washington

**CHRONOLOGY**

At 8:45 a.m. EDT, day of disaster begins

[Map of attacks](#)

**EXTRA INFO**

[World Trade Center, Pentagon, 767](#)

**SPACE**

**CNN.com / SPACE**

Updated: 04:56 PM EDT 20:56 GMT -- 11 Sep 2001

[Cool star chills stellar theories](#)

**TOP STORIES**

- NASA shuts down in wake of attacks
- Sleuths try to unmask new spy satellites
- Probe limps to close encounter with comet
- Report: Plane tracking satellites can be jammed

[More News >](#)

**Cool star chills stellar theories**

A star besieged by unbelievably hot waves of nuclear explosions is ten times cooler than expected, forcing astronomers to rethink their ideas about stellar physics.

[FULL STORY #](#)

**ALPHA EXTRA**

Space correspondent Miles O'Brien on the space station tour

**SCENES FROM SPACE**

A NASA telescope is marking a milestone

**RESOURCES:**

**SPACE AGENCY NEWS**

The latest news releases from worldwide space agencies.

[Hit the links](#)

**SPACE CALENDARS**

Calendars of upcoming launches and other events from worldwide space agencies.

[Calendar list](#)

**INTERACTIVE LIBRARY**

Your window to the universe -- launch video, 360-degree photo tours and more.

**NASA WEBCAMS**

Live pictures of NASA projects.

[Launch it](#)

**SPACE PROBES**

A guide to active unmanned missions.

[Probe list](#)

**MORE NEWS**

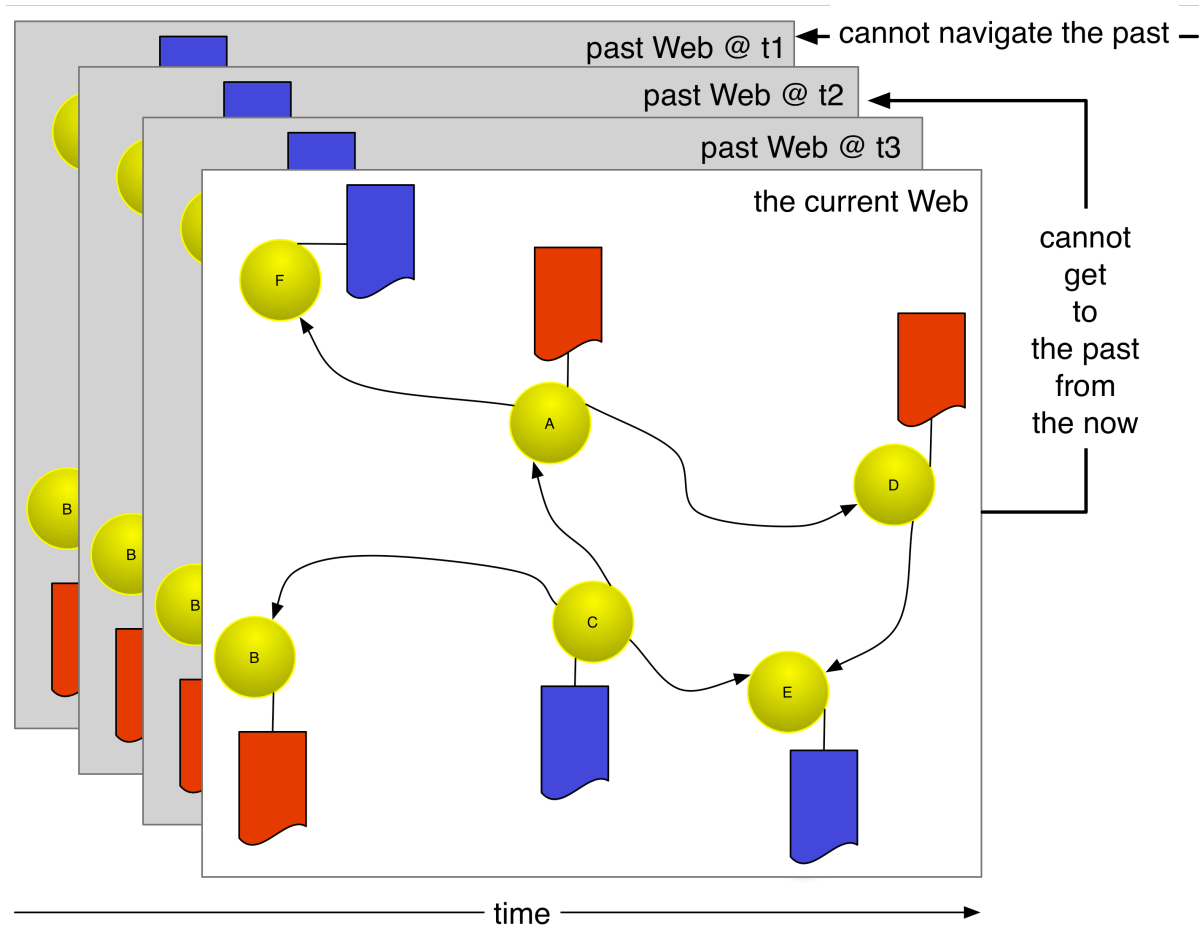
Space program subject of 'Astronaut's pilot'

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

<http://web.archive.org/web/20010911213855/www.cnn.com/TECH/space/>



# 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.



# The Memento Approach

*HTTP navigation to an archived resource by leveraging:*

- *The HTTP URI of the original resource;*
- *HTTP datetime content negotiation.*



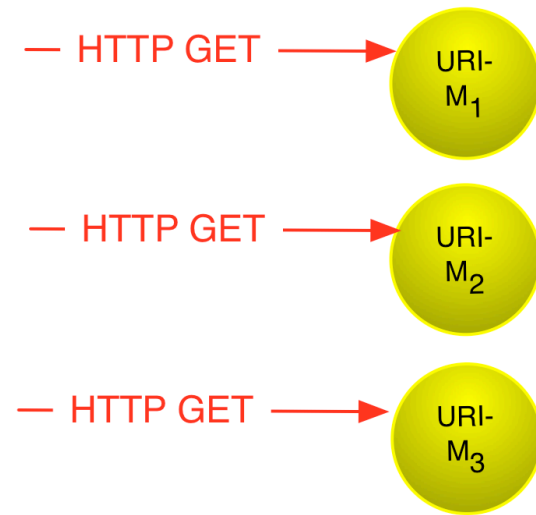
# The Web without a Time Dimension



Original  
resource



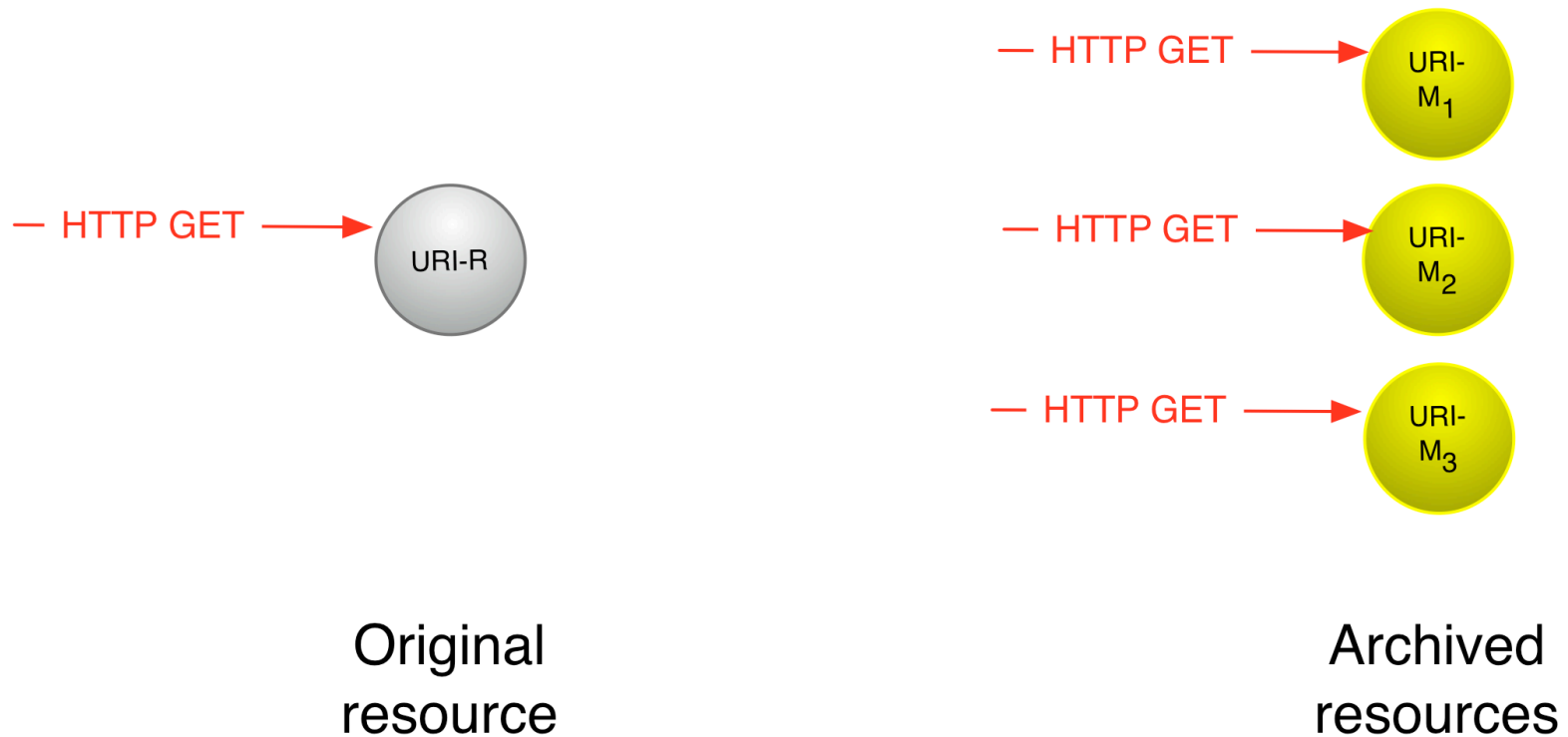
# The Web without a Time Dimension



Archived  
resources



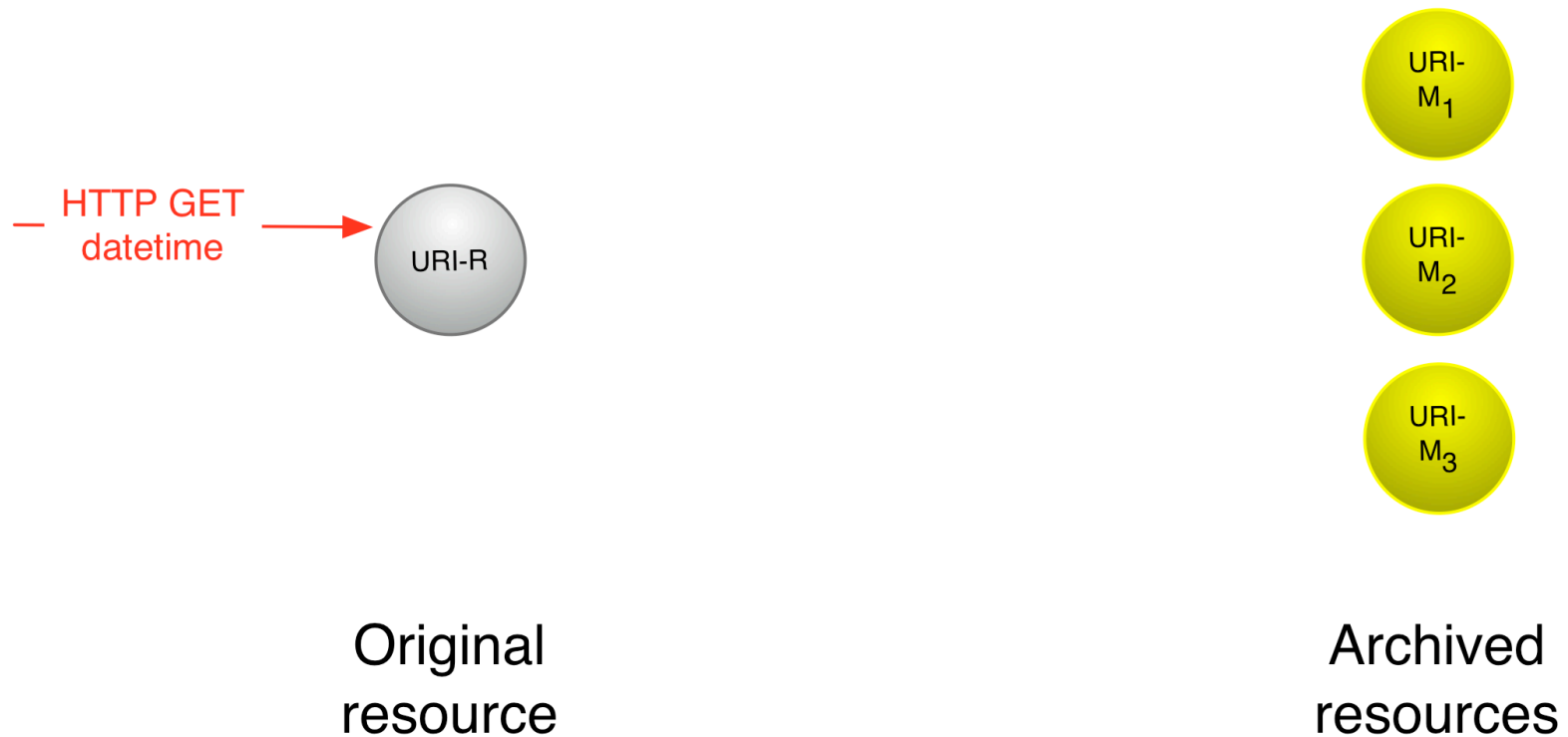
# The Web without a Time Dimension



Need to use a different URI to access archived versions of a resource and its current version



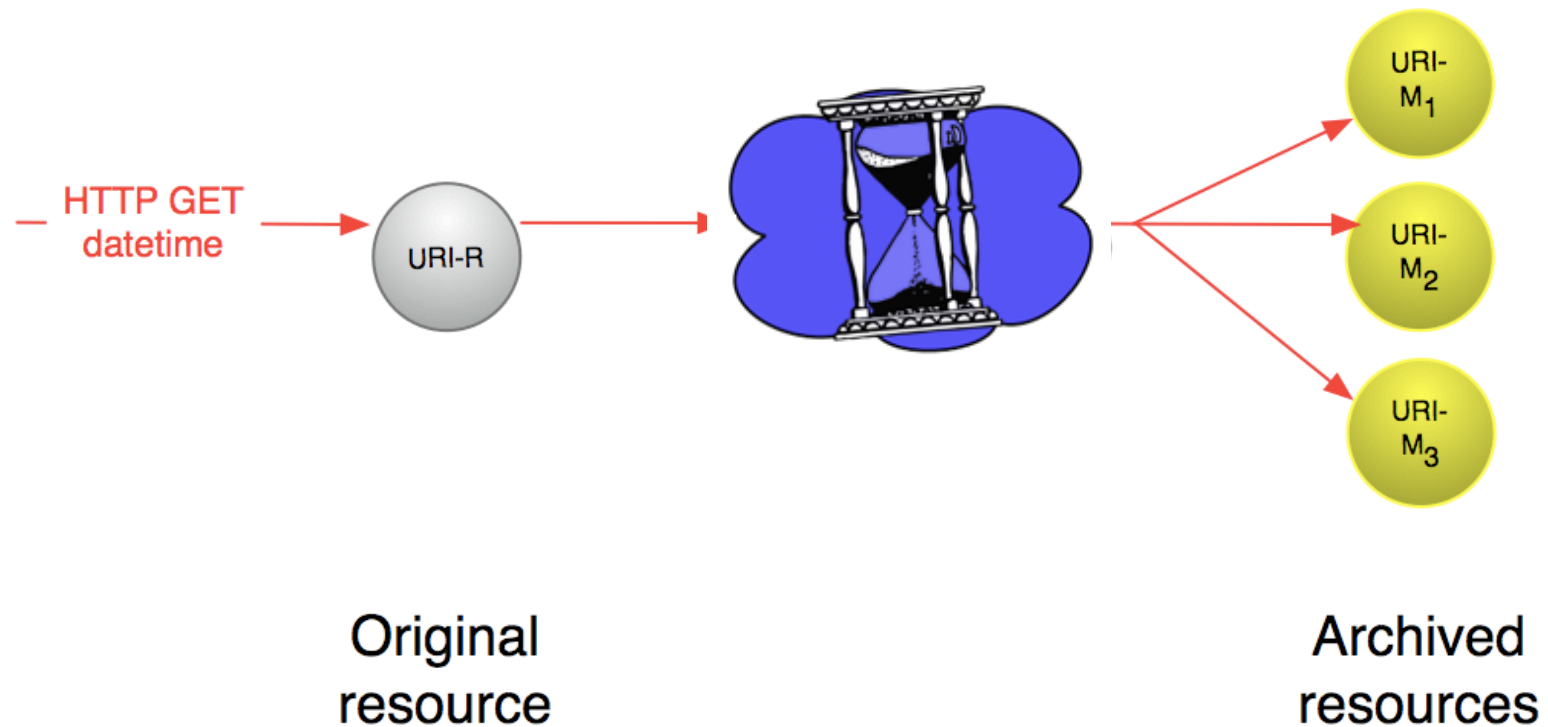
# The Web with Time Dimension added by Memento



In Memento: use URI of the current version to access archived versions, but qualify it with datetime



# The Web with Time Dimension added by Memento



... and magically arrive at an archived version





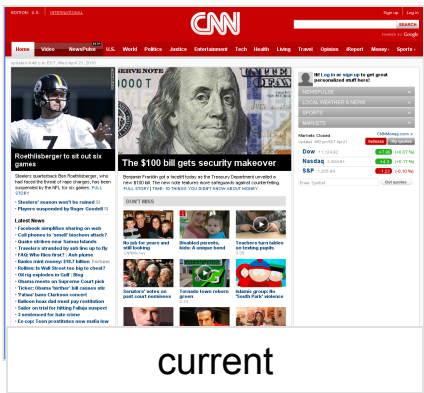
## Content Negotiation in the datetime dimension

- Many systems support content negotiation for media type:
  - Your client by default asks for HTML and gets HTML;
  - But it could get PDF *via the same URI*.
- Memento proposes a new dimension for content negotiation – time:
  - Your client by default asks for the current time, and gets it
  - But it could get an older version *via the same URI*
- Can be accomplished with two new HTTP headers:
  - Request header: `Accept-Datetime`
    - Conveys datetime of content requested by client
  - Response header: `Content-Datetime`
    - Conveys datetime of content returned by server





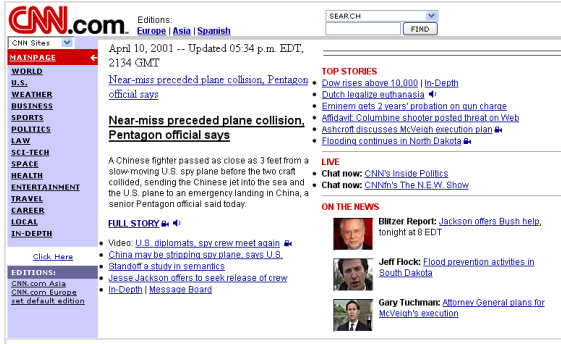
original resource



current



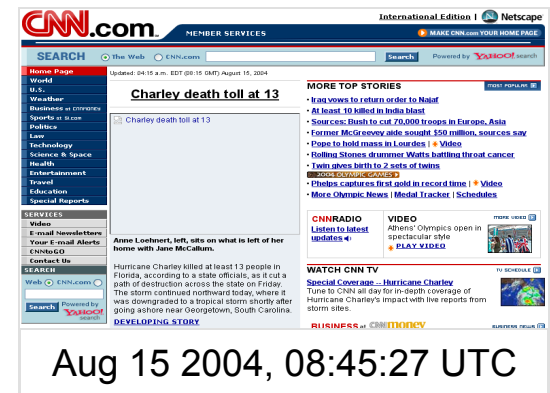
Mementos



Apr 10 2001, 21:39:30 UTC



Aug 15 2007, 19:21:58 UTC



Aug 15 2004, 08:45:27 UTC

← http://cnn.com →

← http://web.archive.org →



Memento  
JISC/CNI Meeting 2010, Edinburgh

18

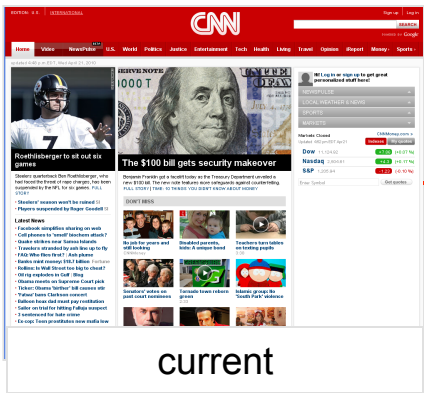




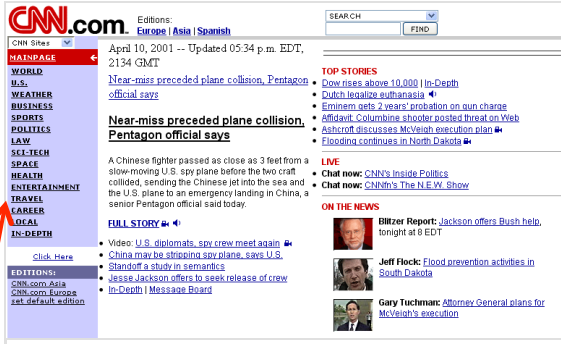
original resource



Mementos



current



Apr 10 2001, 21:39:30 UTC



Aug 15 2007, 19:21:58 UTC



Aug 15 2004, 08:45:27 UTC

← http://cnn.com →

← http://web.archive.org →



Memento  
JISC/CNI Meeting 2010, Edinburgh

19





original resource

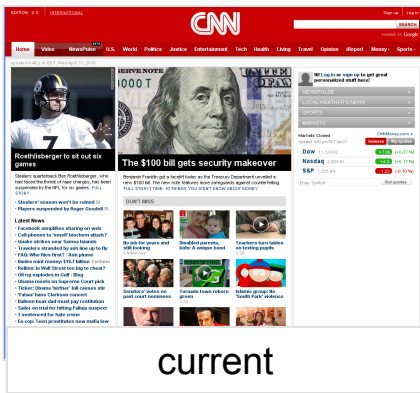


TimeGate

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



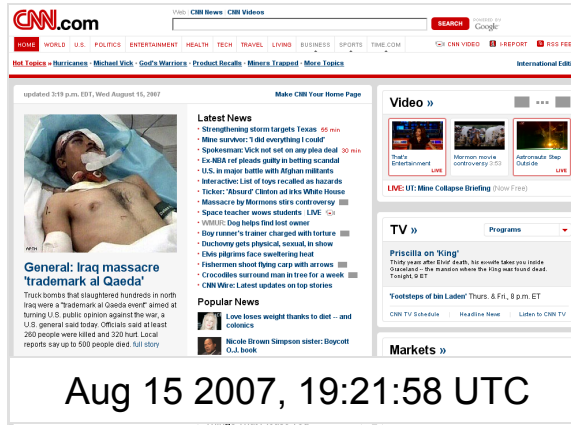
Mementos



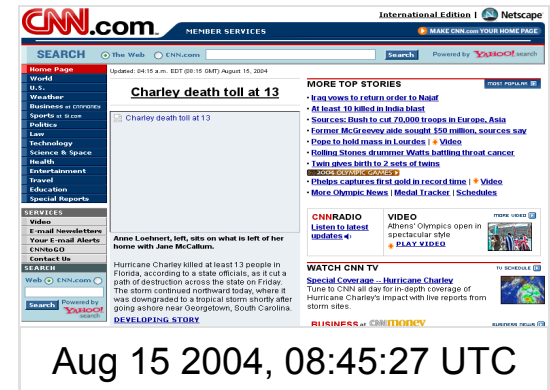
current



Apr 10 2001, 21:39:30 UTC



Aug 15 2007, 19:21:58 UTC



Aug 15 2004, 08:45:27 UTC

http://cnn.com

http://web.archive.org



Memento JISC/CNI Meeting 2010, Edinburgh

20





HTTP Link



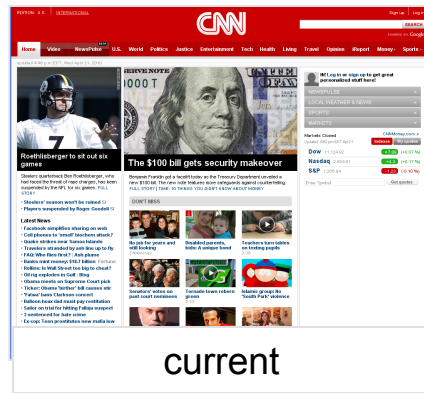
DT-conneg with URI-G to get URI-M



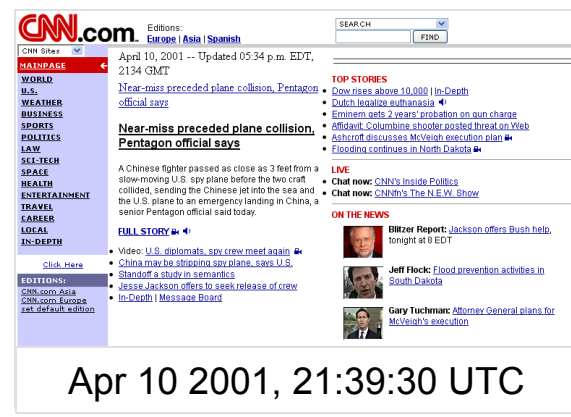
original resource

TimeGate

Mementos



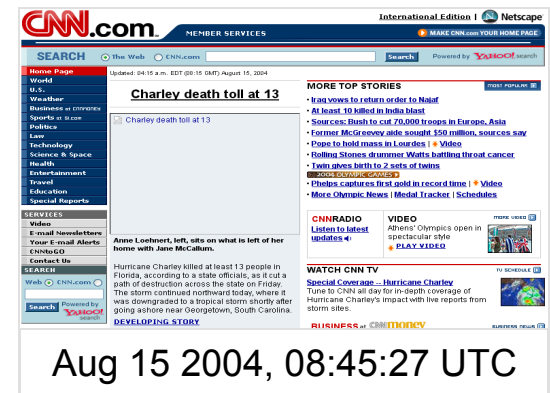
current



Apr 10 2001, 21:39:30 UTC



Aug 15 2007, 19:21:58 UTC



Aug 15 2004, 08:45:27 UTC

http://cnn.com

http://web.archive.org



Memento  
JISC/CNI Meeting 2010, Edinburgh

21





HTTP Link



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



original resource

TimeGate

Mementos

original resource

TimeGate

Mementos

Dec 20 2001, 4:51:00 UTC

Dec 31 2004, 20:46:00 UTC

TimeGate

Dec 20 2008, 22:21:00 UTC

variant resources

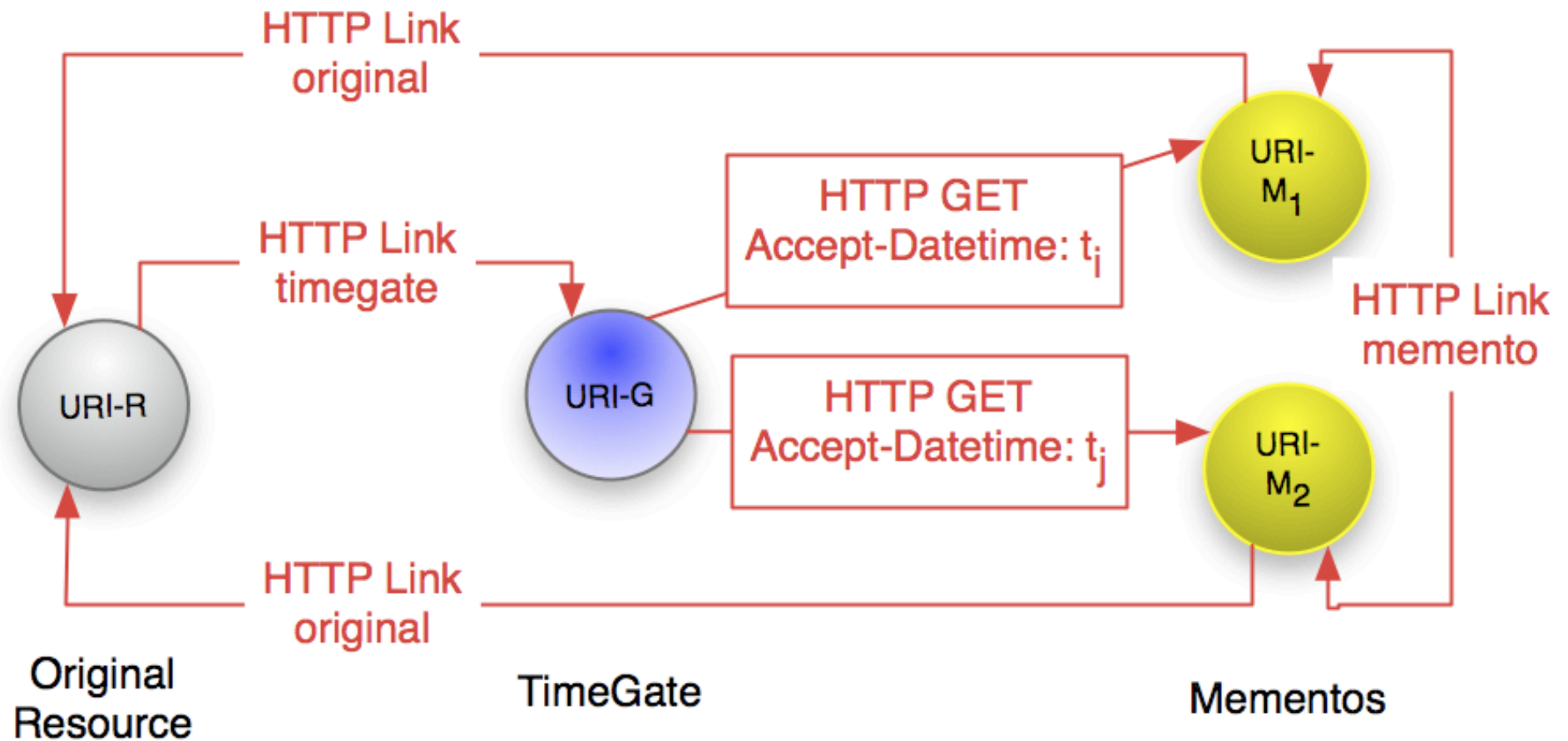
http://wikipedia.org



Memento JISC/CNI Meeting 2010, Edinburgh



# The Memento Framework

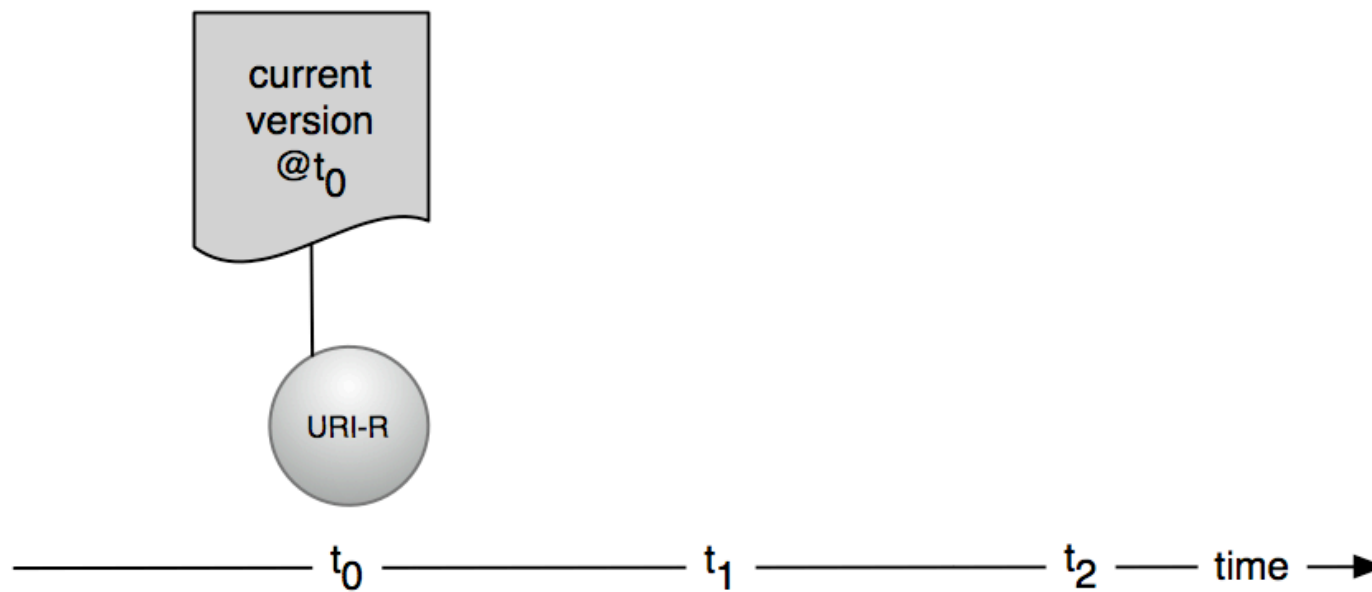


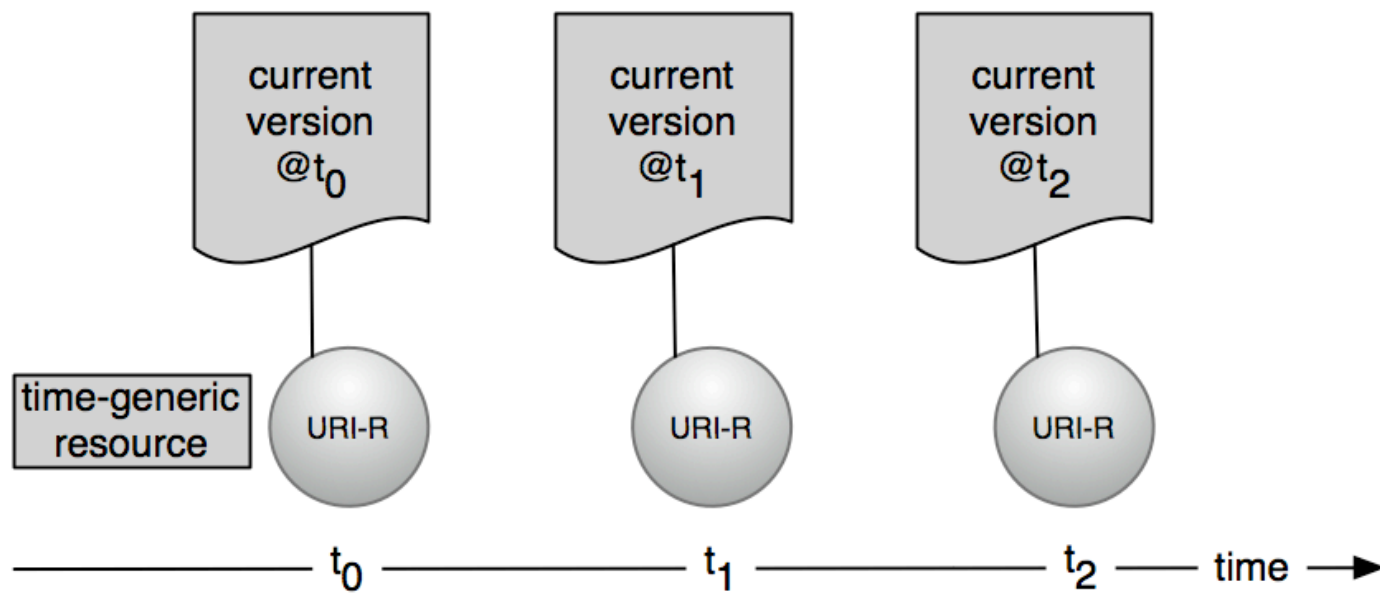
# Outline

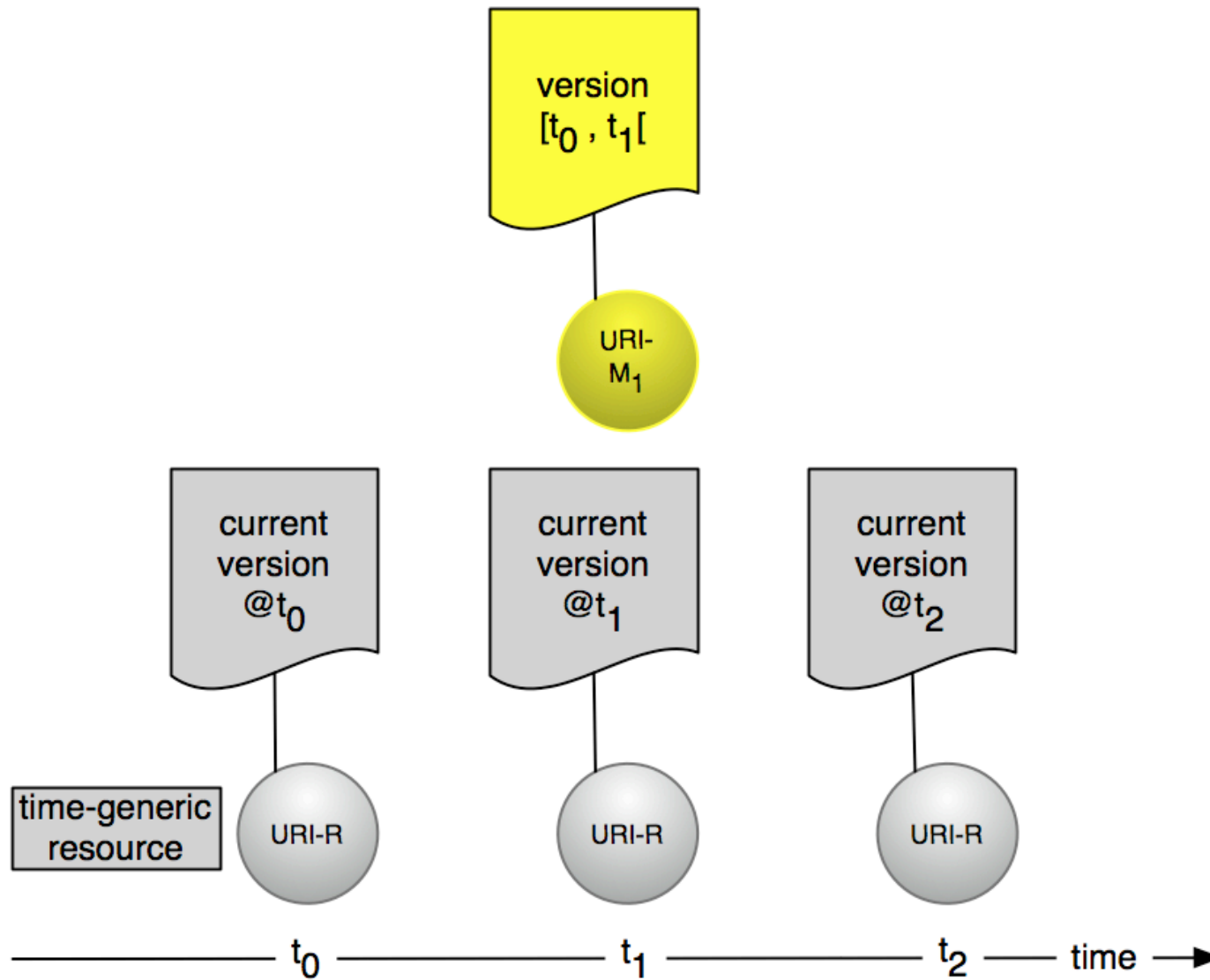
- Memento - Time Travel for the Web
- HTTP-based Versioning and Time Series Analysis
- Persistent Web-Centric Annotations
- The Value of the URI for Discovery

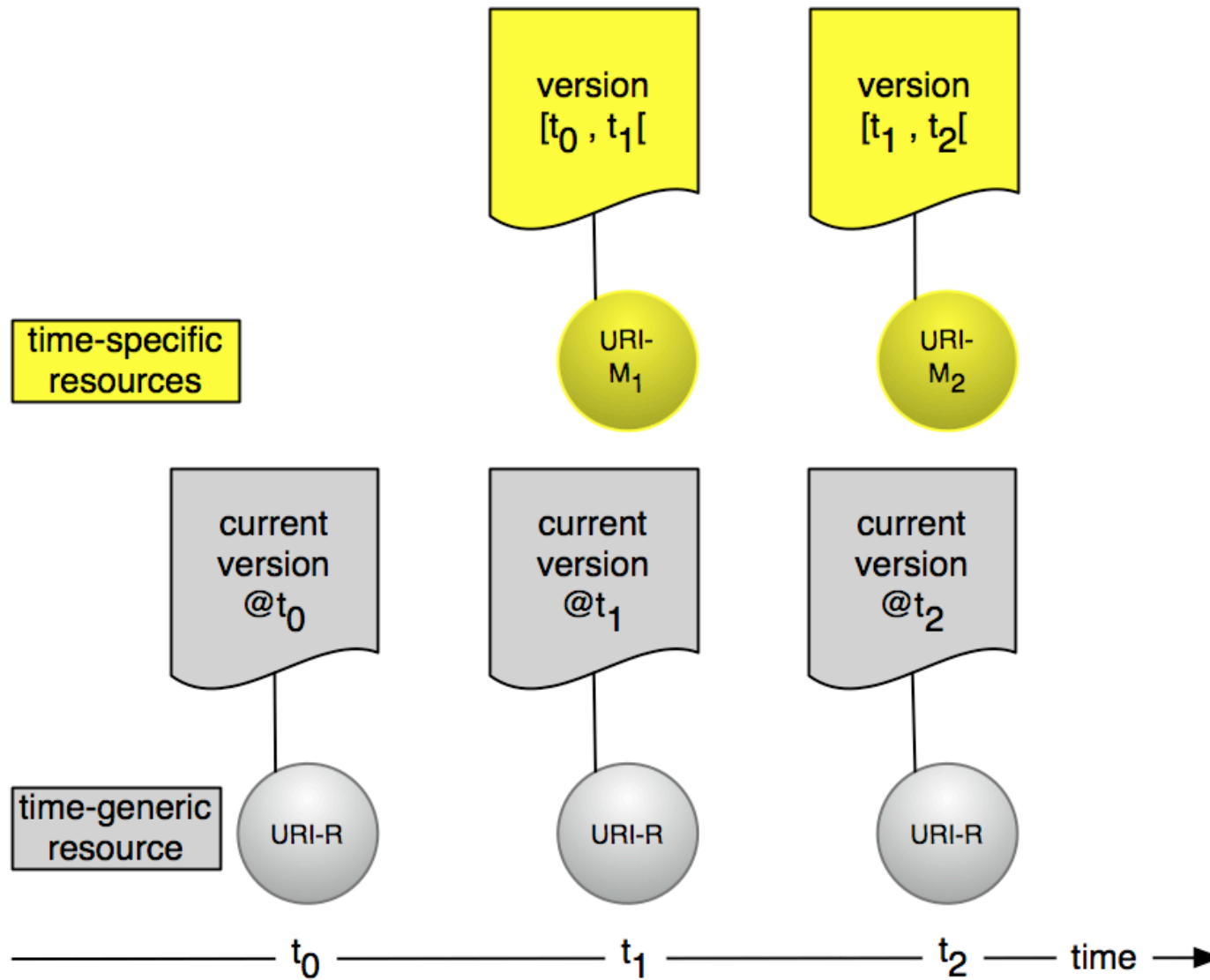


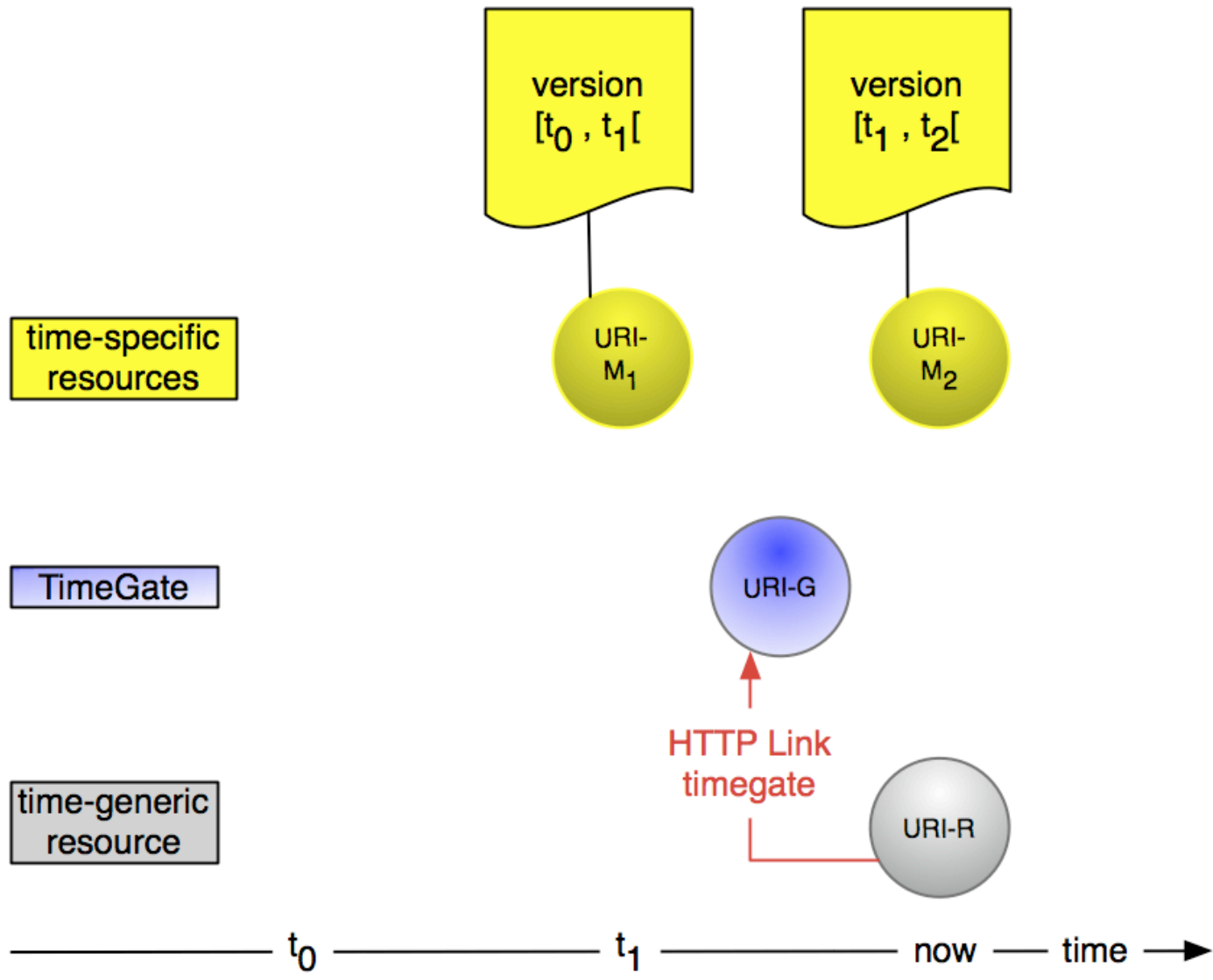


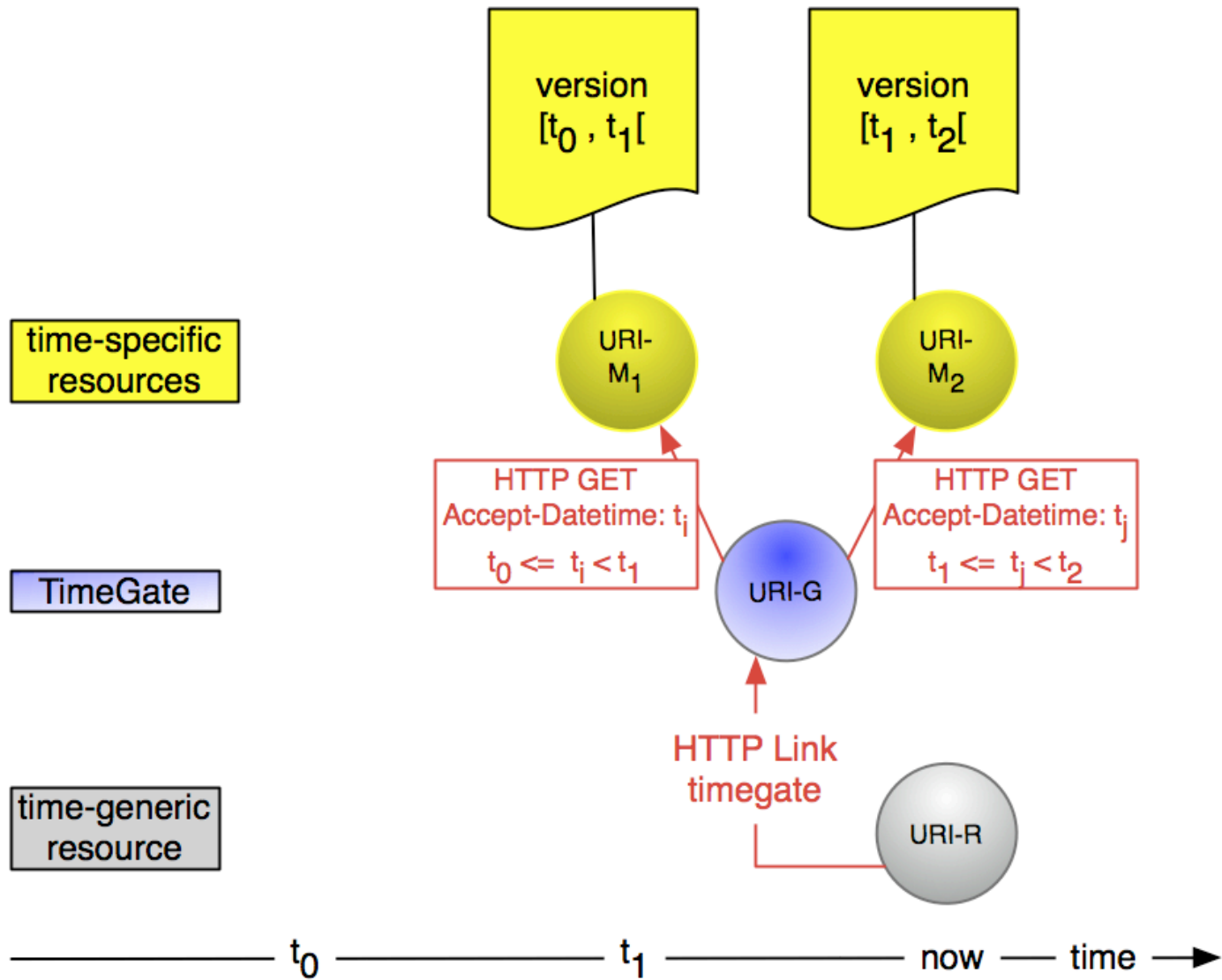


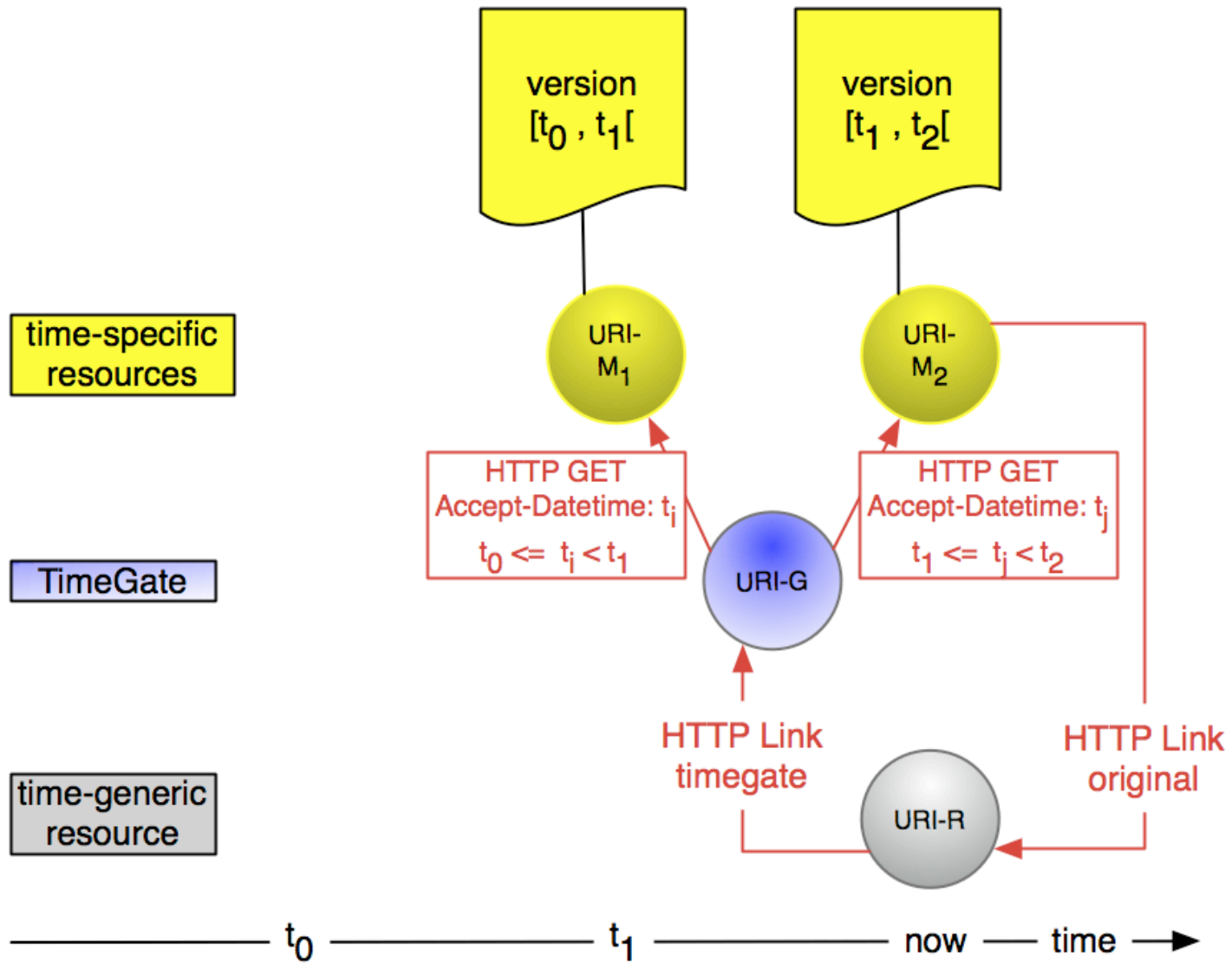


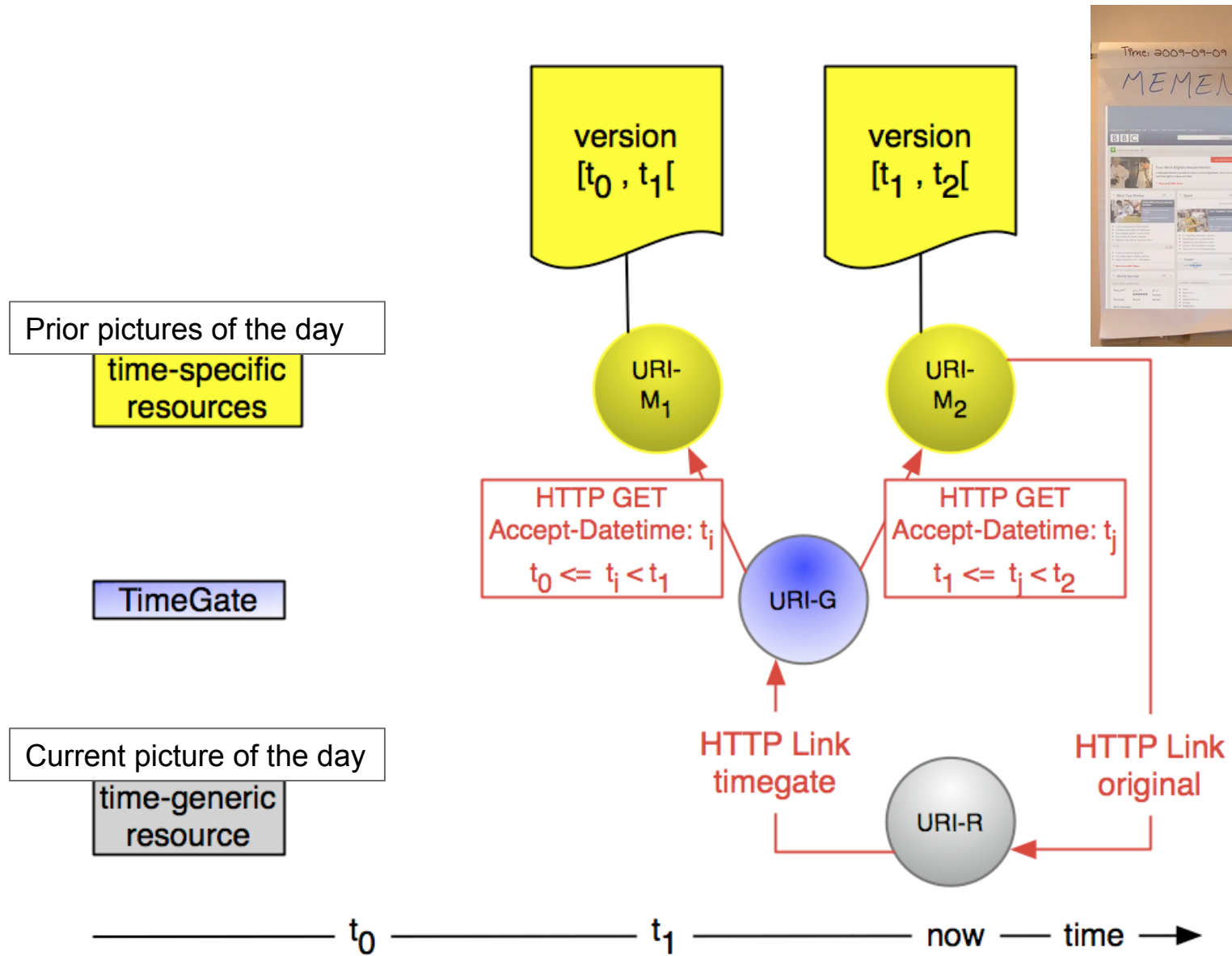














# Time Travel across Versions of a *Picture of the Day*



Data collected through HTTP Navigation



Memento  
JISC/CNI Meeting 2010, Edinburgh

33



Prior DBpedia description of France

time-specific resources

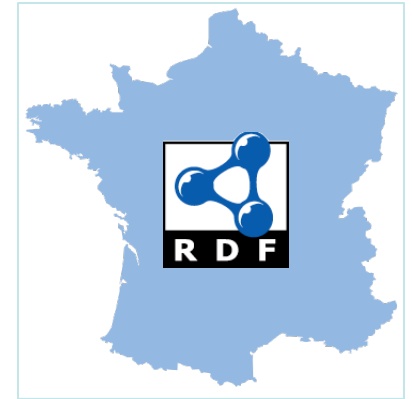
TimeGate

Current DBpedia description of France

time-generic resource

version  $[t_0, t_1[$

version  $[t_1, t_2[$



URI-M<sub>1</sub>

URI-M<sub>2</sub>

HTTP GET  
Accept-Datetime:  $t_j$   
 $t_0 \leq t_j < t_1$

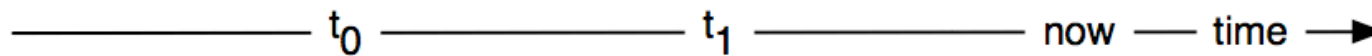
HTTP GET  
Accept-Datetime:  $t_j$   
 $t_1 \leq t_j < t_2$

URI-G

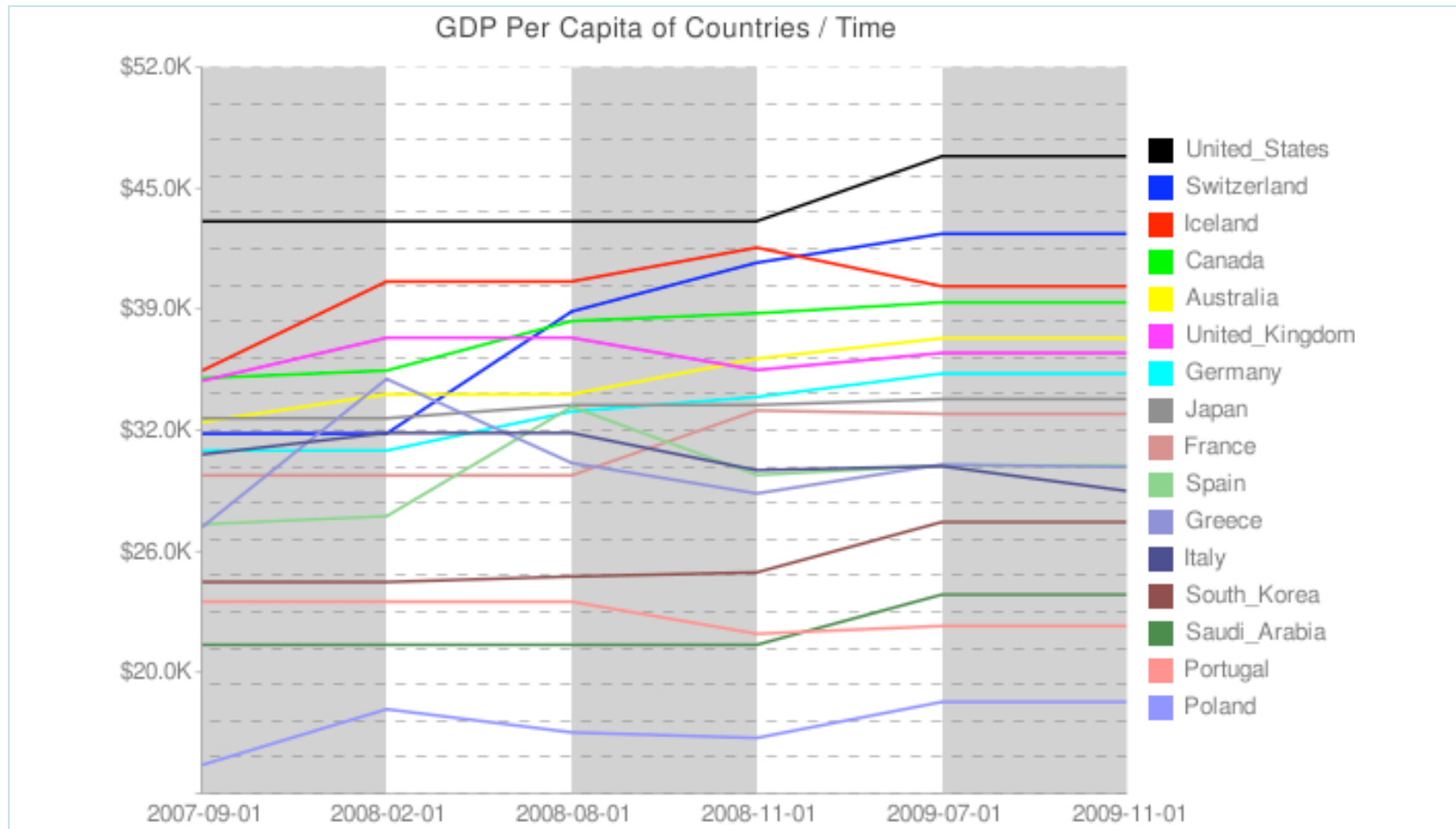
HTTP Link  
timegate

HTTP Link  
original

URI-R



# Time-Series Analysis across DBpedia Versions



Data collected through HTTP Navigation



Memento  
JISC/CNI Meeting 2010, Edinburgh

35



# Outline

- Memento - Time Travel for the Web
- HTTP-based Versioning and Time Series Analysis
- **Persistent Web-Centric Annotations**
- The Value of the URI for Discovery



# Web-Centric Annotation: No Persistence

The image shows a screenshot of a BBC News website with a user annotation overlaid on the left side. The annotation is a yellow box containing text from Paul Murray, dated Mar 8, 2010. The text discusses the lead story of the day, an earthquake, and criticizes the BBC's choice of lead story. The main content of the page includes a navigation bar (Home, News, Sport, Weather, TV, Radio), a 'Watch ONE-MINUTE WORLD NEWS' button, a timestamp 'Page last updated at 21:59 GMT, Monday, 14 June 2010 22:59 UK', a 'LATEST' headline about a Colombian hostage, and a featured article titled 'Obama calls for clean energy push' with a sub-headline 'DEEPWATER HORIZON RESPONSE' and a list of related links.

**Paul Murray** - Mar 8, 2010

**Lead story this morning.**

With a magnitude six earthquake, attacks around the world killing hundreds and a domestic civil servants strike, I find it very odd that the BBC website should have chosen to lead with "Oscar triumph for The Hurt Locker".

In my opinion entertainment awards barely scrape the definition of news let alone trump the many real stories available today. BBC Radio 2 ran the story at the very end of its bulletin.

Useful? [Yes](#) (0) [No](#) (0)  
[Report abuse](#) [Share](#) ▼

me News Sport Weather TV Radio

[Watch](#) **ONE-MINUTE WORLD NEWS**

Page last updated at 21:59 GMT, Monday, 14 June 2010 22:59 UK

**LATEST:** Fourth Colombian hostage found alive after three fellow captives

**DEEPWATER HORIZON RESPONSE**

**Obama calls for clean energy push**

US President Obama asks supporters to back a campaign for clean energy, as he visits areas affected by the BP oil spill.

- Mapping the oil slick
- In graphics: Tackling the leak
- Q&A: Scale of BP oil spill

Google Sidewiki Annotation on <http://news.bbc.co.uk/> as of 2010-06-14

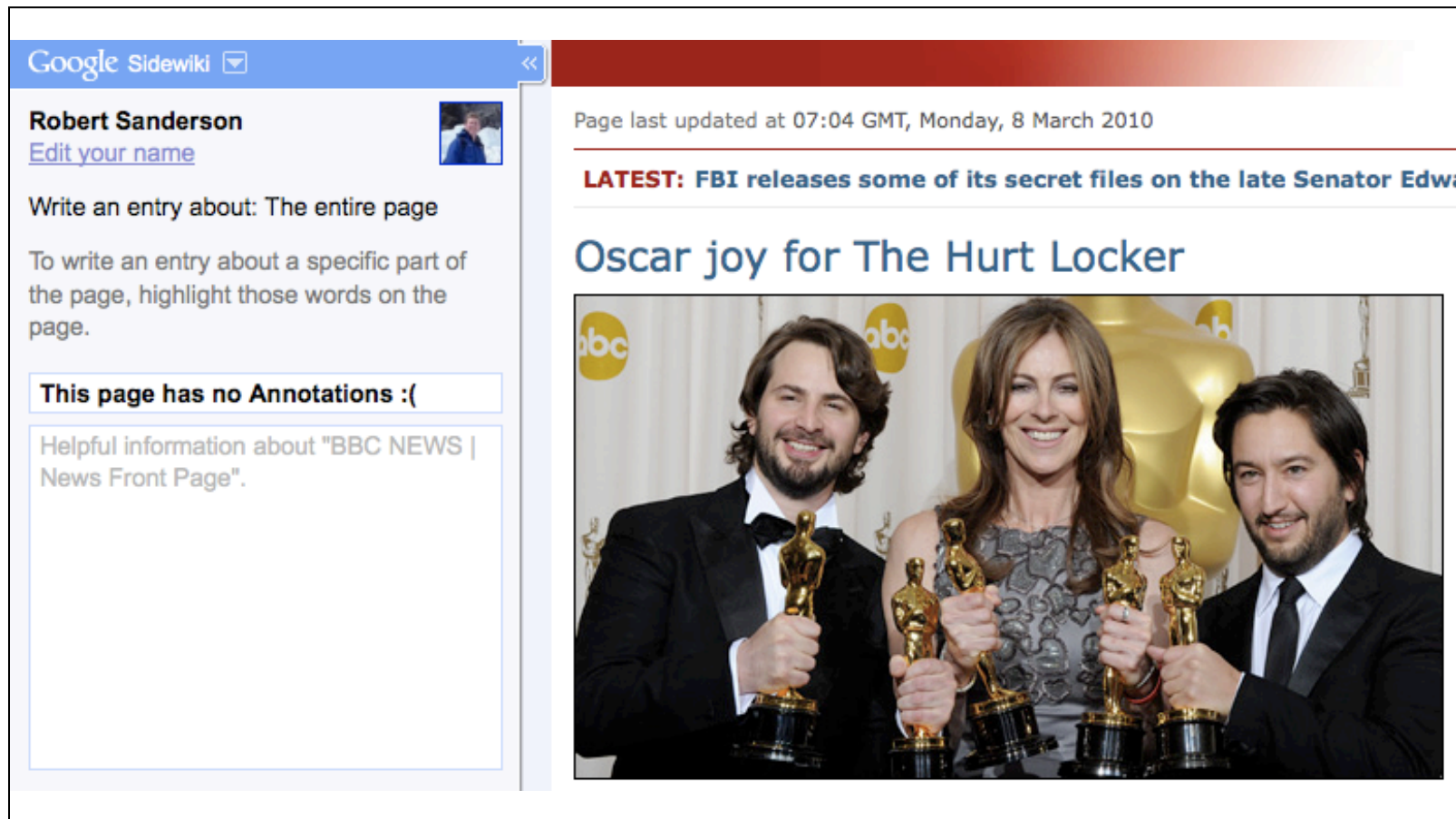


Memento  
JISC/CNI Meeting 2010, Edinburgh

37



# Web-Centric Annotation: No Persistence




The screenshot shows a web browser window with a sidebar on the left and a main content area on the right. The sidebar is titled "Google Sidewiki" and features a user profile for "Robert Sanderson" with a small profile picture and a link to "Edit your name". Below the profile, there is a text area for writing an entry about the page, with instructions: "Write an entry about: The entire page" and "To write an entry about a specific part of the page, highlight those words on the page." A box below this text area states "This page has no Annotations :(". At the bottom of the sidebar, there is a link for "Helpful information about 'BBC NEWS | News Front Page'". The main content area shows a news article with the headline "Oscar joy for The Hurt Locker" and a sub-headline "LATEST: FBI releases some of its secret files on the late Senator Edwa". The article is dated "Page last updated at 07:04 GMT, Monday, 8 March 2010". Below the text is a photograph of three people (two men and one woman) holding multiple Oscar statuettes on a red carpet. The background of the photo includes "abc" logos and a large golden Oscar statue.

Archived page from:

<http://www.dracos.co.uk/work/bbc-news-archive/2010/03/08/07.05.html>



# Web-Centric Annotation: Desired Persistence

[Paul Murray](#) - Mar 8, 2010 

**Lead story this morning.**

With a magnitude six earthquake, attacks around the world killing hundreds and a domestic civil servants strike, I find it very odd that the BBC website should have chosen to lead with "Oscar triumph for The Hurt Locker".


In my opinion entertainment awards barely scrape the definition of news let alone trump the many real stories available today. BBC Radio 2 ran the story at the very end of its bulletin.

Useful? [Yes](#) (0) [No](#) (0)  
[Report abuse](#) [Share](#) ▼

Page last updated at 07:04 GMT, Monday, 8 March 2010

**LATEST: FBI releases some of its secret files on the late Senator**

## Oscar joy for The Hurt Locker



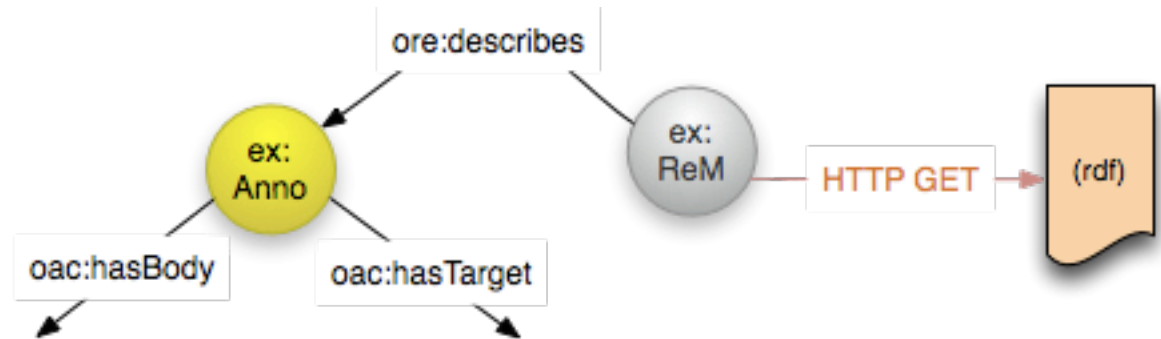
## OAC: Open Annotation Collaboration

- Focus: Annotation interoperability to enable sharing of annotations across the boundary of collections, clients.
- Foundation: Architecture of the World Wide Web
- Framework: Linked Data Guidelines
- Funding: Mellon Foundation for 18 months





# OAC Model: Basics



ex:HDFV



ex:HDFI-1



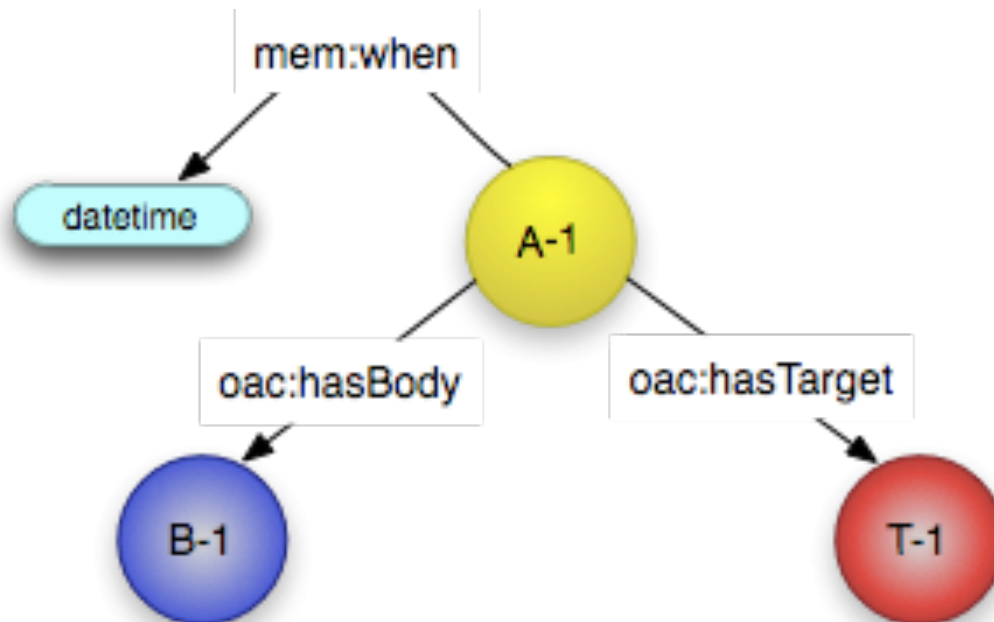
## OAC: Dealing with Web Time

- As regular web resources, Body and Target of an Annotation have representations that can change over time.
- Body and Target can change independently of each other.
- If an Annotation involves resources as they existed at a particular point in time, this needs to be recorded.
- The OAC model provides hooks for doing so:
  - Timeless Annotations;
  - **Uniform Time Annotations;**
  - Varied Time Annotations.



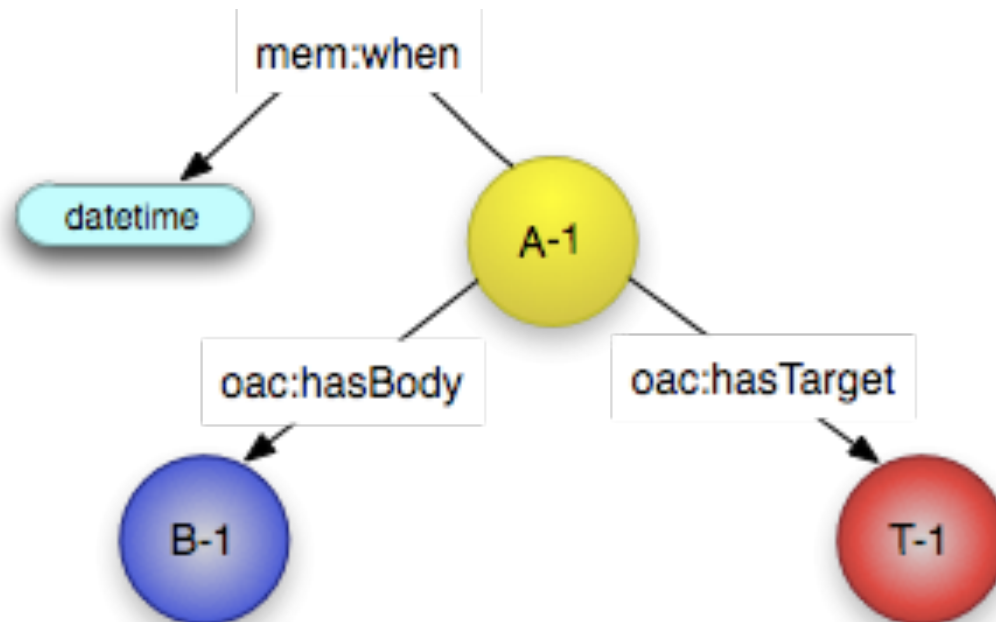
## OAC: Uniform Time Annotations

- The Annotation is not always applicable, but pertains to the state of the Body and Target at a single moment in time.
- Add `mem:when` property to the Annotation.



## Memento + OAC: Persistent Annotations

- In order to reconstruct the Annotation as intended: Use Memento to obtain an archived representation of B-1 and T-1 as they existed at the `mem:when` datetime.



# Create an Annotation

The screenshot shows a Wikipedia portal page titled "Portal:Current events/2010 January 23". The page includes navigation tabs for "portal", "discussion", "edit this page", and "history". The main content area displays the date "23 January 2010 (Saturday)" and a link to "Categories: 2010 by day". A pink rectangular annotation tool is overlaid on the page, with a white box containing the text "23 January 2010 (Saturday)" and another white box containing "Categories: 2010 by day". The annotation tool also features a "Go" button and a "Search" button. The page layout includes a sidebar with navigation links (Main page, Contents, Featured content, Current events, Random article), a search box, and an interaction section (About Wikipedia, Community portal, Recent changes, Contact Wikipedia, Donate to Wikipedia, Help). The bottom right corner of the page shows a form for creating an annotation, with fields for "Title:", "Comment:", "Type:" (set to "General"), and "Post To:" (with radio buttons for "Rob's Annotations" and "Contextualification"). The form also includes checkboxes for "Comment is URL:" and "About Whole Image:", and buttons for "+Segment", "-Segment", "Create", "Logout", and "Close".



# Reconstruct the Annotation without Memento

The screenshot shows a Wikipedia portal page titled "Portal:Current events/2010 January". The page content is partially obscured by a green rectangular annotation box. The annotation contains the following text:

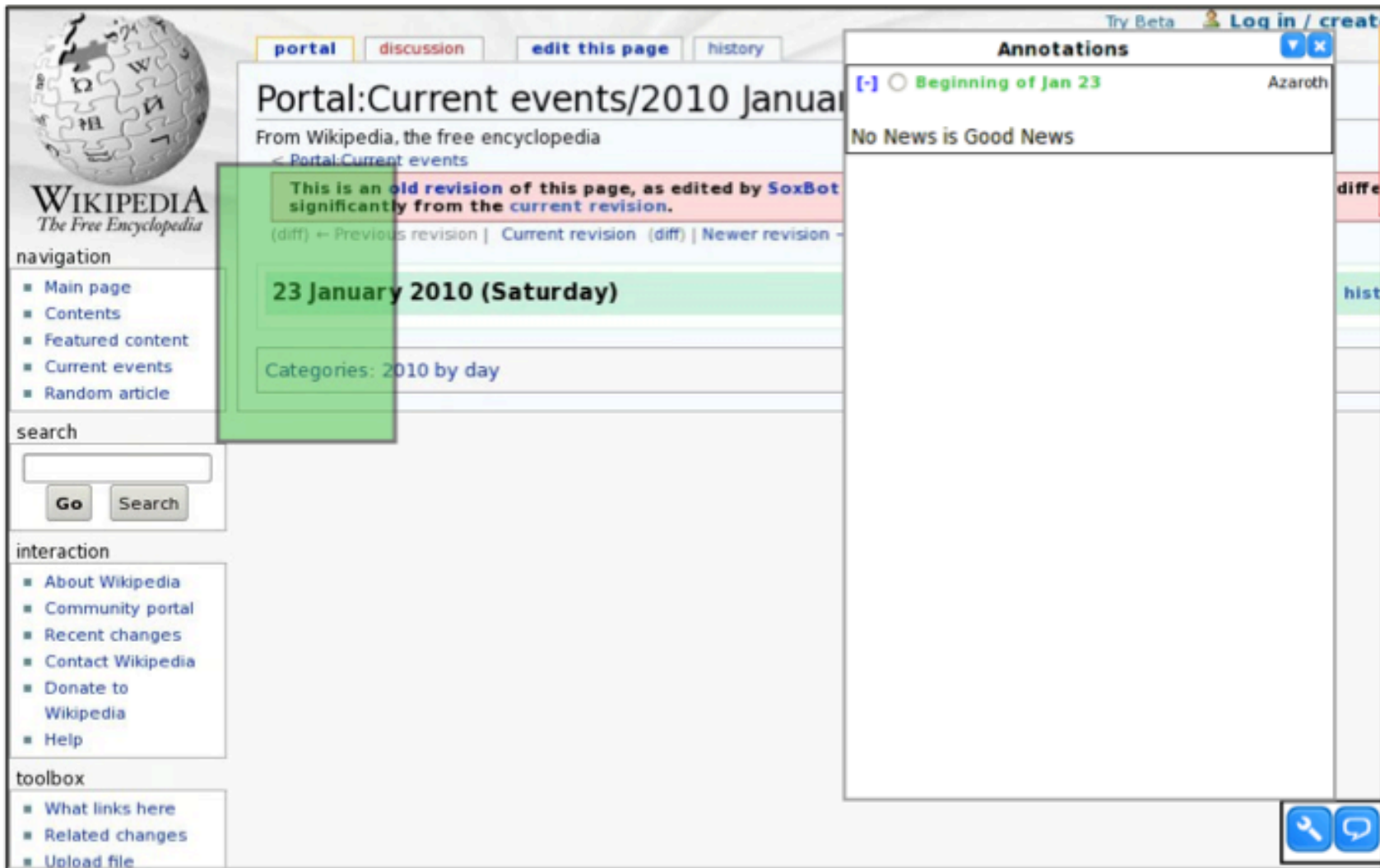
**23 January 2010 (Saturday)**

- Aftermath of the 2010 Haiti earthquake:
  - The Haitian government declares earthquake rescue operation
  - The government announces a first precise death toll of 230,000 (after the 2004 Indian Ocean earthquake). (CNN)
- Joe Biden's visit to Iraq:
  - U.S. Vice President Joe Biden holds talks with Iraqi politicians
  - Biden says the U.S. government will appeal in the Black
- Thousands of protesters demonstrate in Venezuela for an reevaluation and energy shortages in the country. (Reuters)
- Eight people are killed and 13 missing after flash floods and landslides in China. (Post)
- Between 100 and 150 bodies are found stuffed in wells in Nigeria. (AFP)
- A passenger train in Iran derails, killing at least eight people. (Reuters) (RTÉ) (The Canadian Press)
- Japanese prosecutors question Representative Ichirō Ozawa. (Bulletin)
- The American Civil Liberties Union condemns a U.S. Justice Department report that should be held indefinitely without trial. (BBC)
- Jim McCormick, the director of the U.K. company manufacturing the controversial ADE 651 bomb detector, is under suspicion of fraud. (BBC)

The annotation box is overlaid on the main content of the page. The page also features a navigation sidebar on the left with sections for navigation, search, and interaction. On the right, there is an "Annotations" panel with a single entry: "[+] 0 Beginning of Jan 23" by user "Azaroth". The entry title is "No News is Good News".



# Reconstruct the Annotation with Memento



# Outline

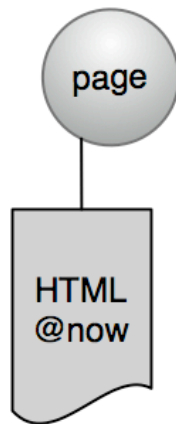
- Memento - Time Travel for the Web
- HTTP-based Versioning and Time Series Analysis
- Persistent Web-Centric Annotations
- The Value of the URI for Discovery





# The Value of the URI for Discovery

`http://weather.example.com/oxaca`

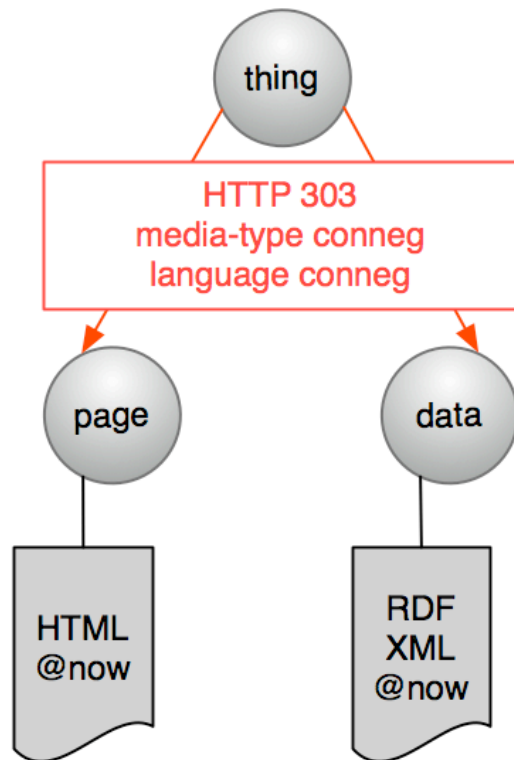


URI as access point to page



# The Value of the URI for Discovery

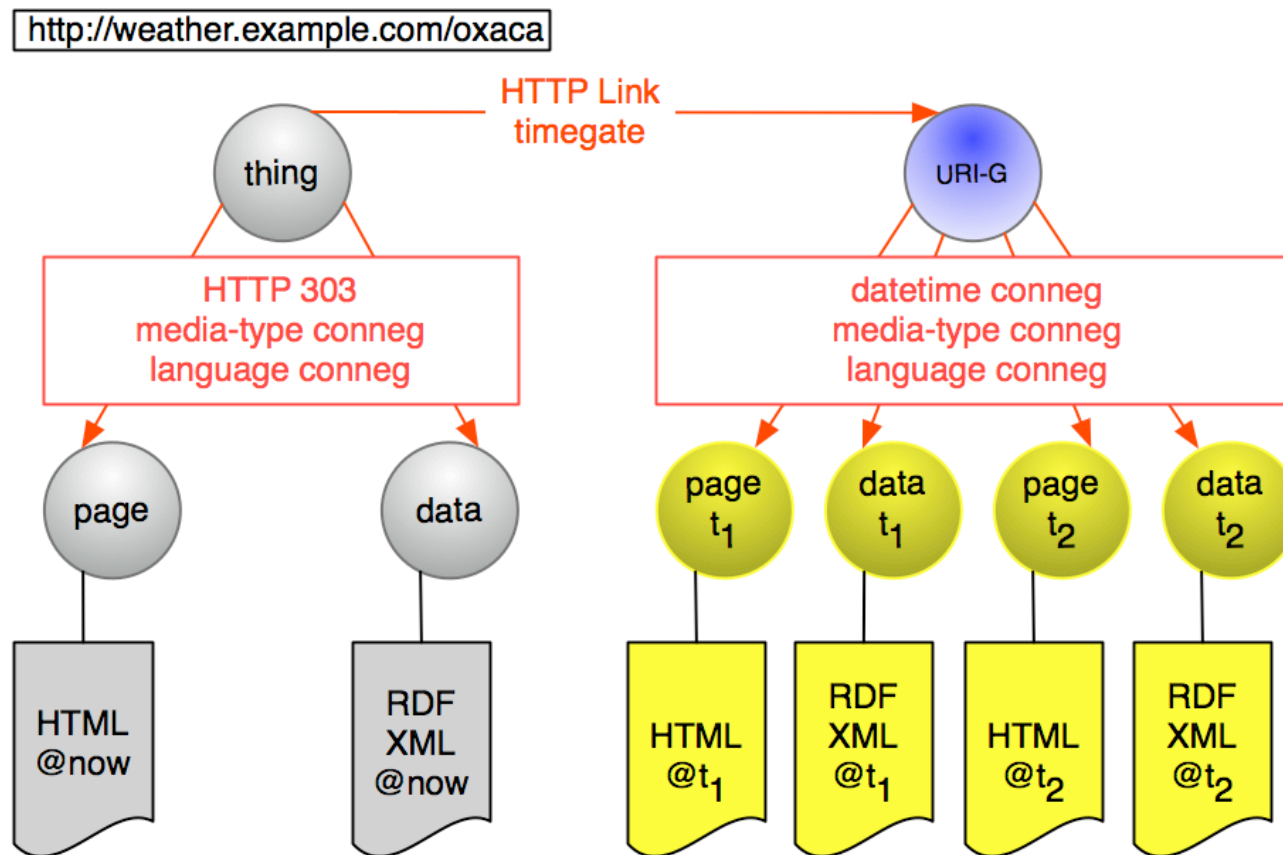
<http://weather.example.com/oxaca>



Increased value: URI as access point to page and data



# The Value of the URI for Discovery



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



## 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>

