A Framework for Aggregating Private and Public Web Archives

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OLD DOMINION UNIVERSITY

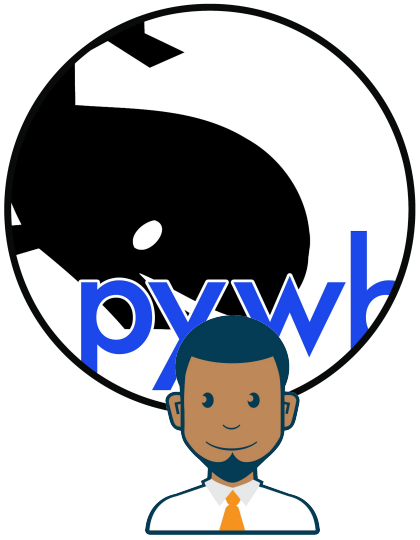
WSDL Old Dominion University

JCDL 2018
Ft. Worth, Texas

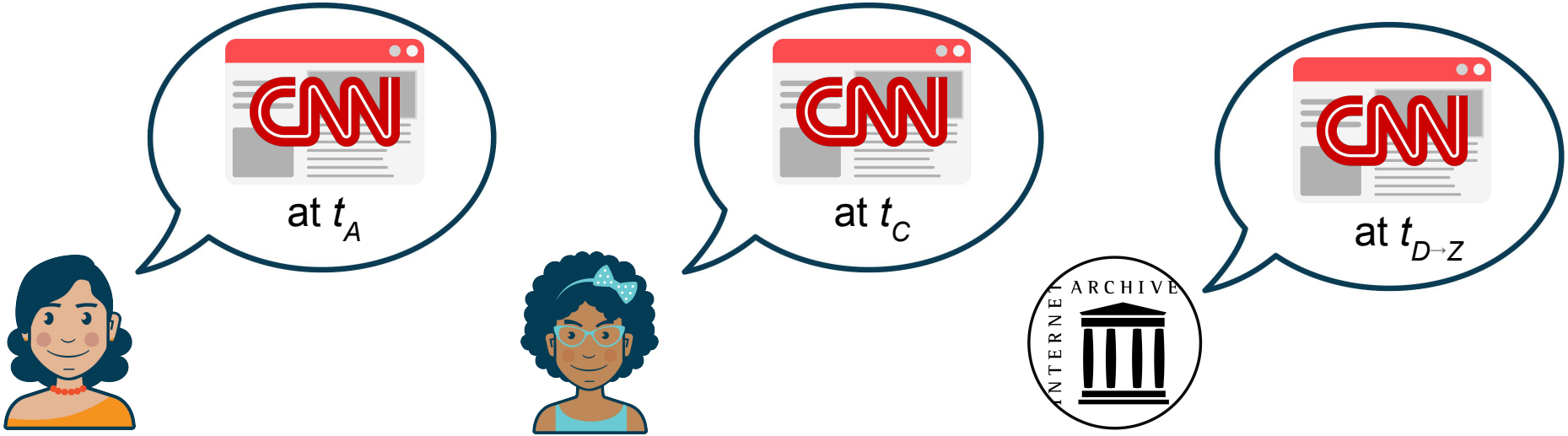
SIGIR Special Interest Group on Information Retrieval

Web Archiving

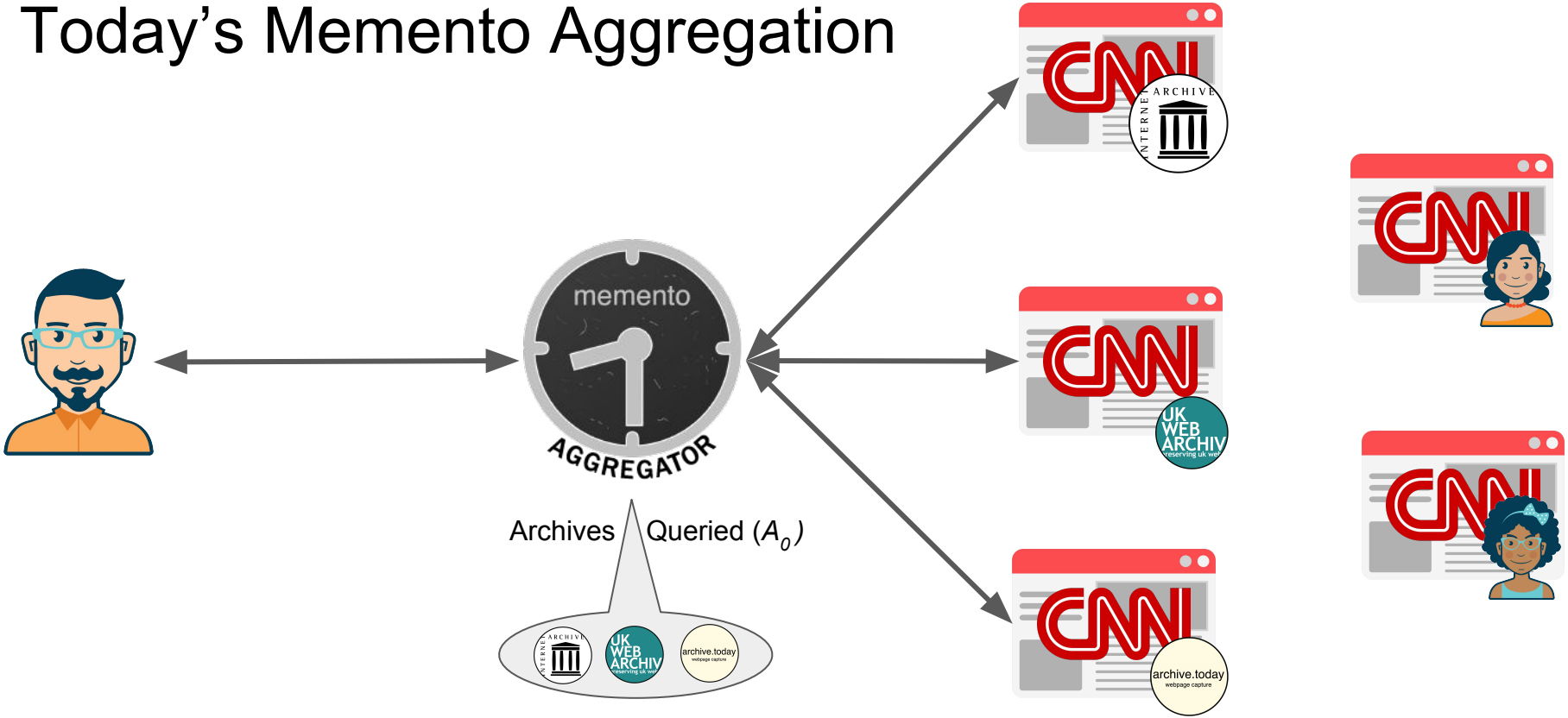
Personal + Private Web Archiving



Aggregation for a Better Picture



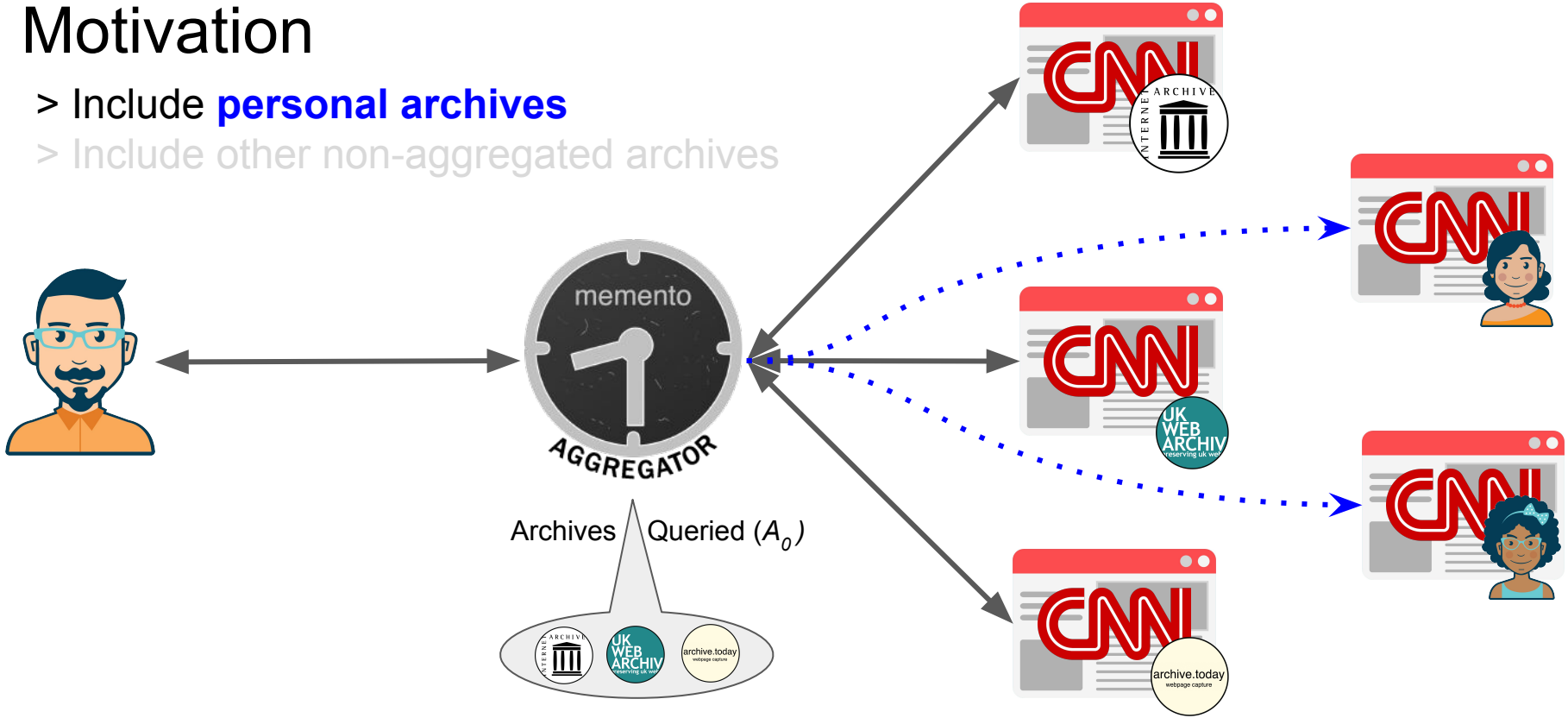
Today's Memento Aggregation



Motivation

> Include **personal archives**

> Include other non-aggregated archives



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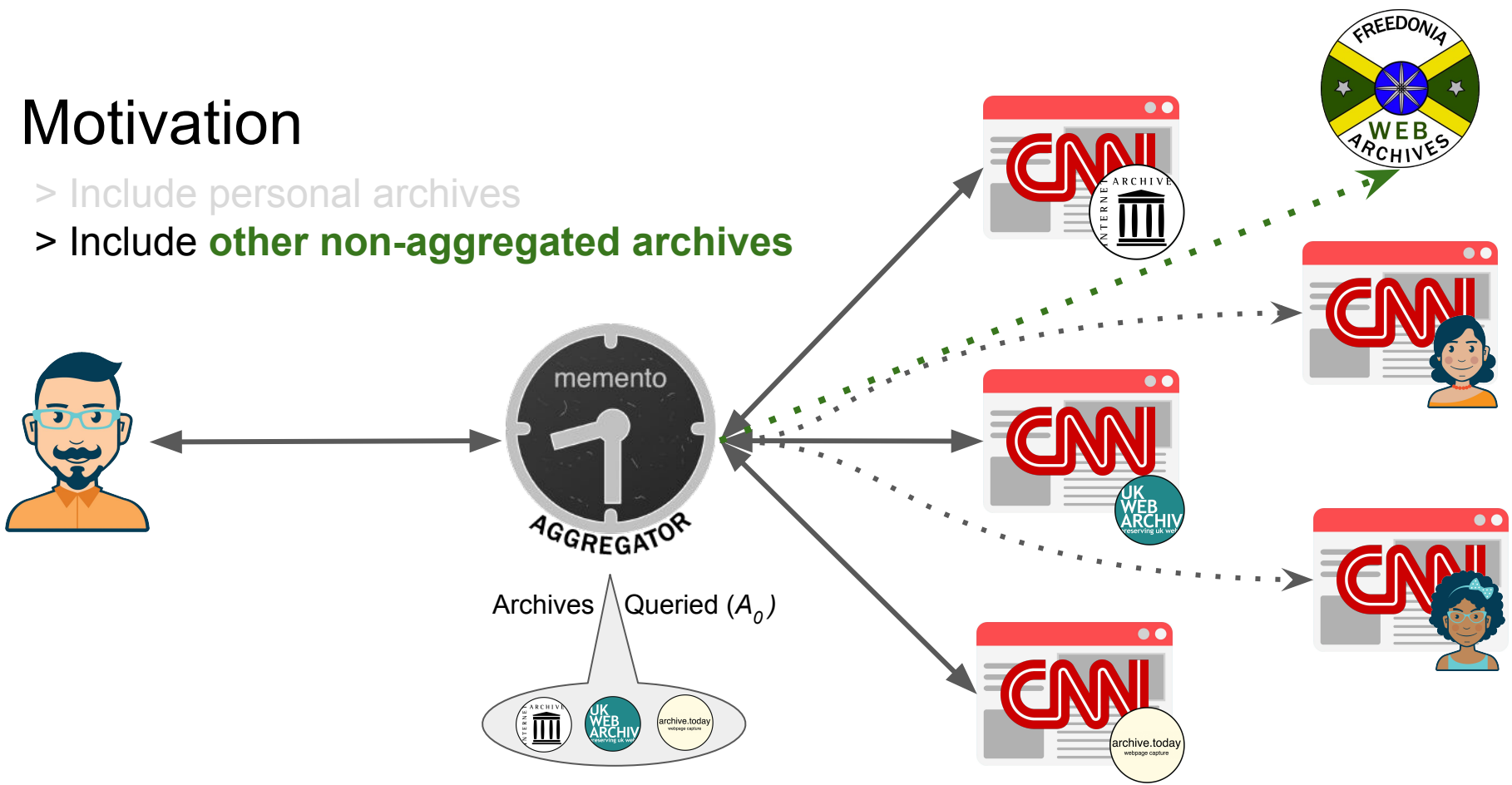
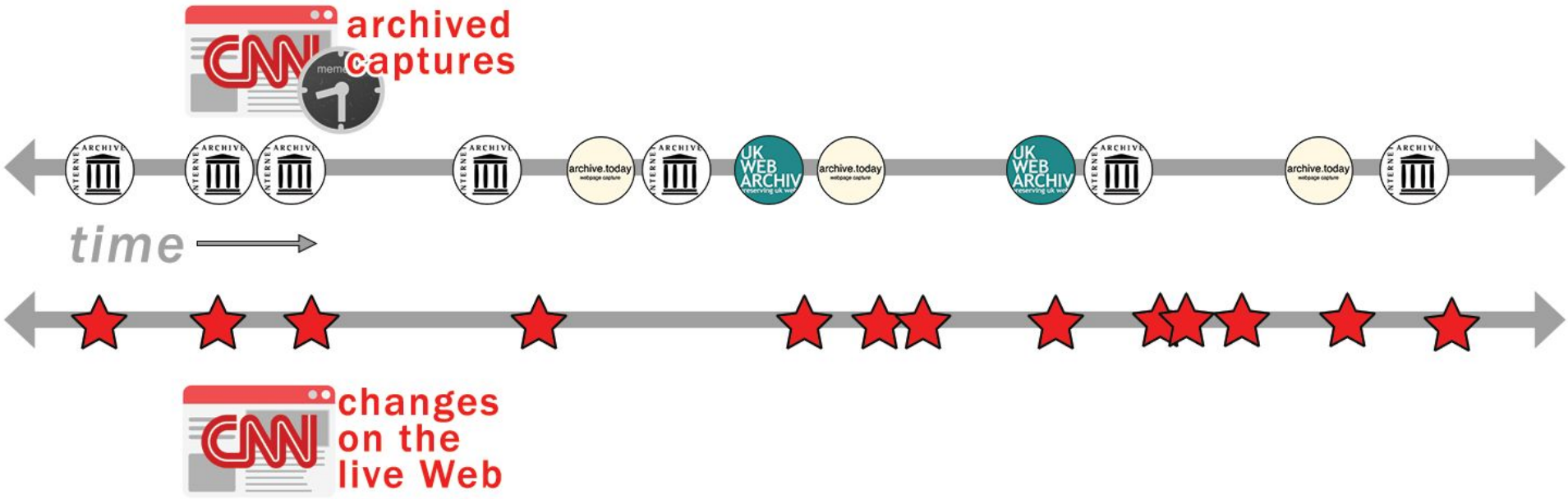
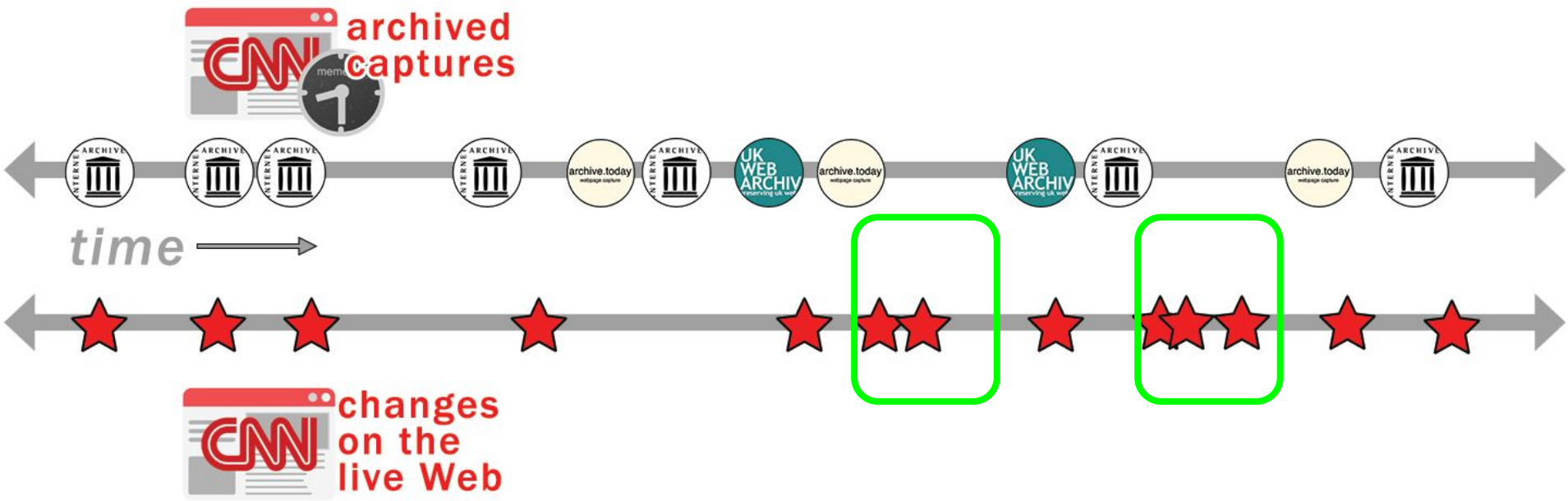


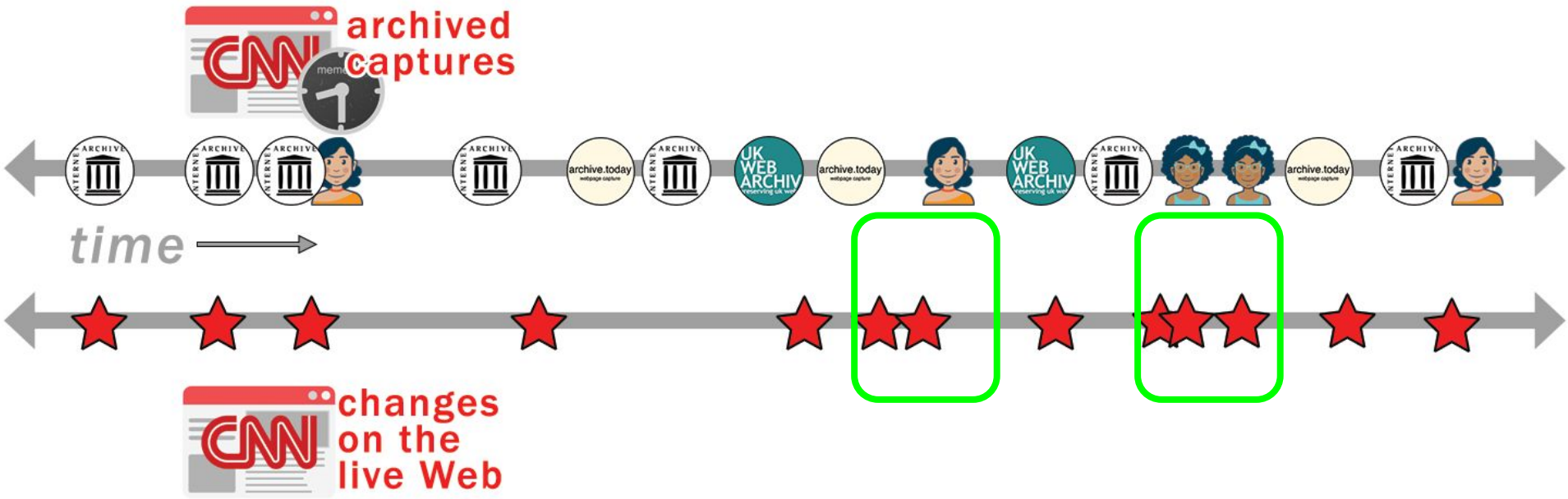
Rapidly Changing Pages May Not Be Comprehensively Captured



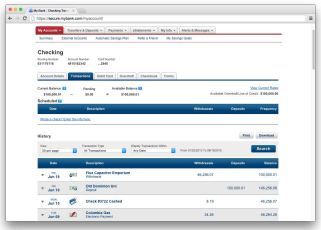
Missed Changes

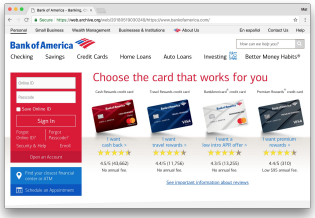


Archiving More Archives Provides a Better Picture of the Web

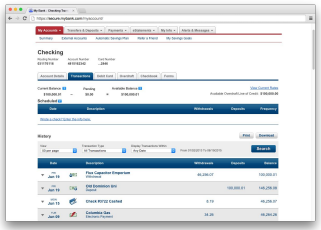


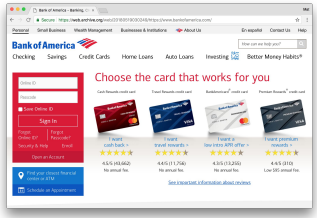
Private & Public Archives May Differ for the Same URI

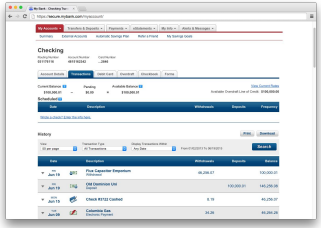




Should Public Archives *Really* Capture the Private Web?







A Framework for Aggregating Private and Public Web Archives

Outline

- Background and Related Work
- Memento Aggregation State of the Art
- More Expressive TimeMaps
- Query Precedence and Short-Circuiting
- Mementities & Mementity Dynamics
- Future Work and Conclusions

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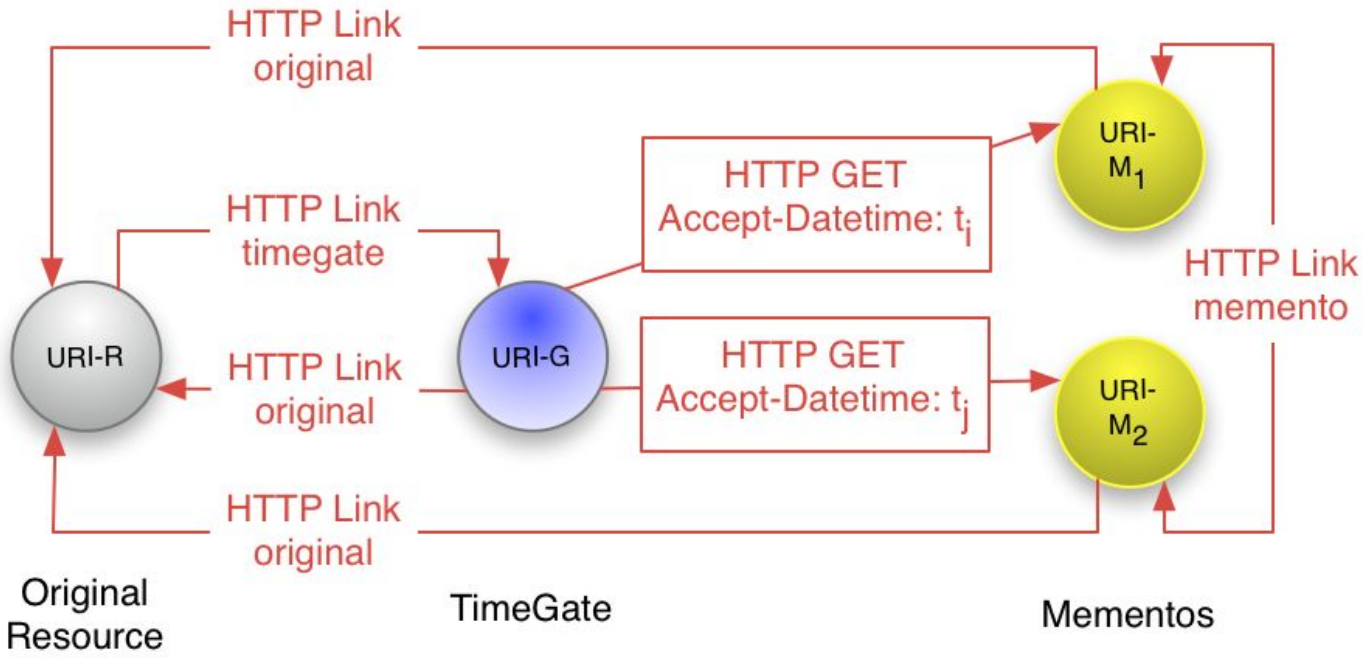
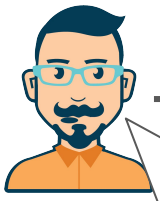
Background



Memento Guide: Introduction. http://www.mementoweb.org/guide/quick-intro/, January 2015.

Memento Request Example



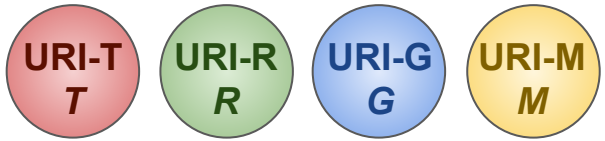
Request `cnn.com` at Sept 11, 2001 at 9am EST

HTTP Request

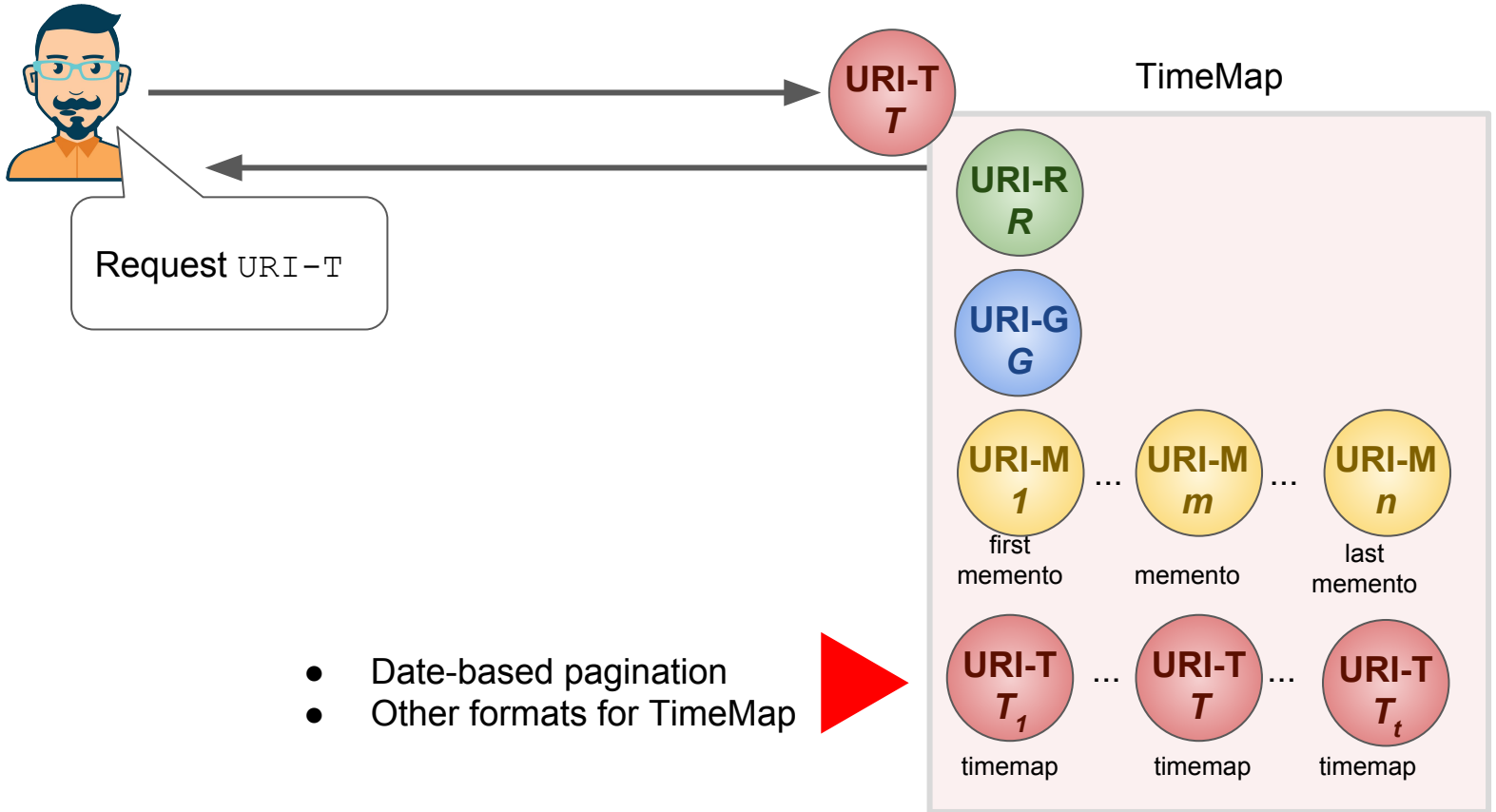
- Accept-Datetime: Tue, 11 Sep 2001 13:00:00 GMT
- GET: http://web.archive.org/web/http://www.cnn.com

HTTP Response (302)

- Memento-Datetime: Tue, 11 Sep 2001 20:03:18 GMT
- Location: http://web.archive.org/web/20010911200318/http://www.cnn.com:80/
- Link:



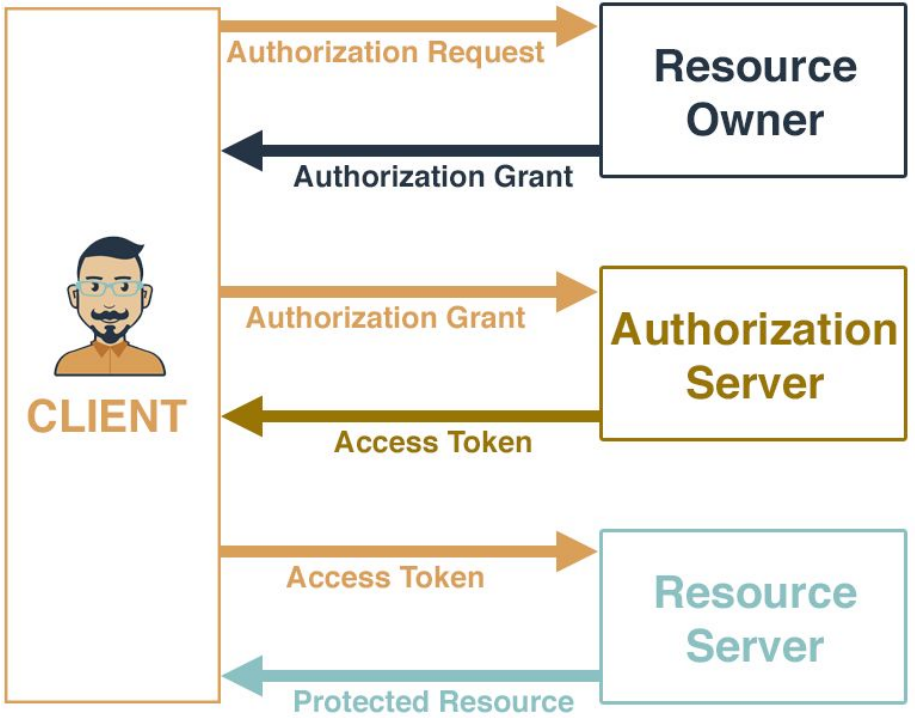
Dereferencing a TimeMap at URI-T



- Date-based pagination
- Other formats for TimeMap

Background - Privacy and Security

- Web users question trusting institutions to preserve private Web contents[1]
- OAuth 2.0 (RFC 6749) facilitates authentication cohesion of entities



[1] Marshall and Shipman., "On the Institutional Archiving of Social Media", JCDL 2012

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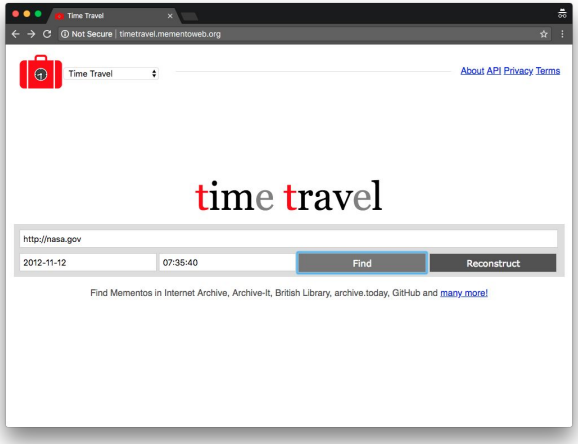
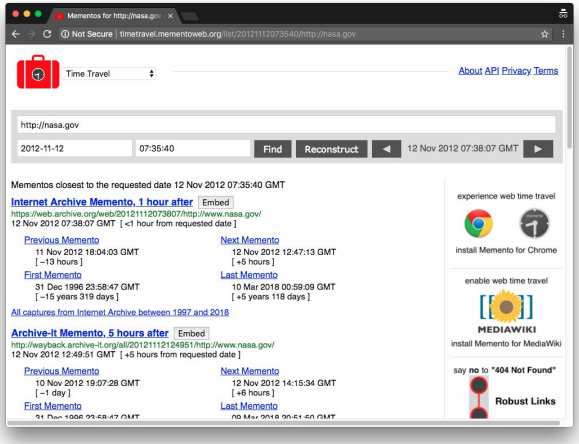
Memento Aggregation State of the Art

Memento Aggregation - MementoWeb



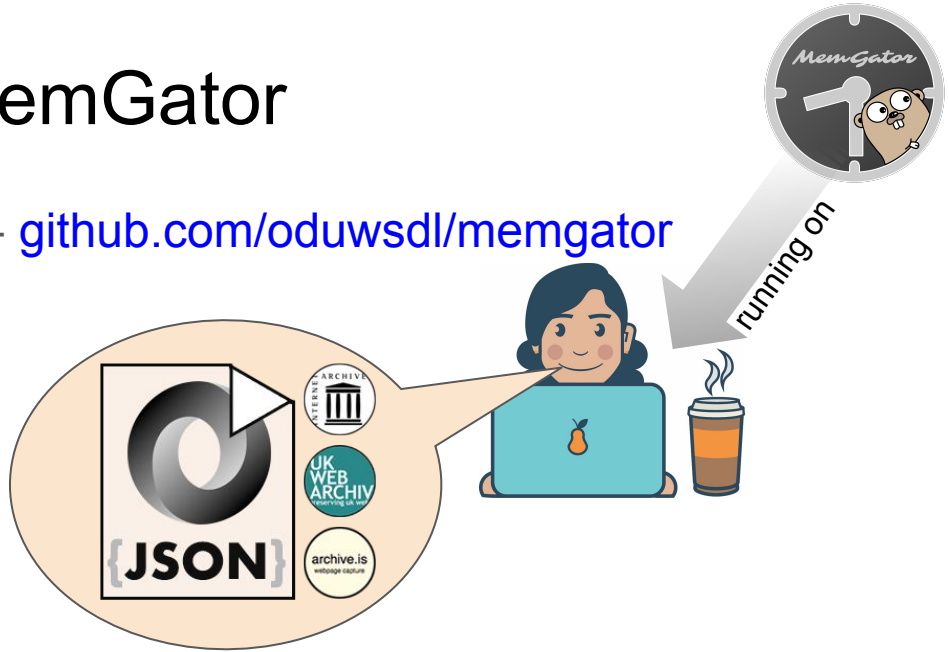


Also available via CLI:

```
$ curl http://timetravel.mementoweb.org/timemap/link/http://nasa.gov
```

Memento Aggregation - MemGator

- Open Source Memento Aggregator - github.com/oduwsdl/memgator
- Easy personal/local deployment
- Specify archive list on launch
  - Easily configurable **JSON** →
  - Use default collection if not specified
- TimeMap Formats:
  - Link
  - **JSON**
  - **CDXJ**



* Alam and Nelson, “MemGator - A Portable Concurrent Memento Aggregator: Cross-Platform CLI and Server Binaries in Go”, JCDL 2016

CDXJ: An Alternative TimeMap Format

```
<http://matkelly.com>; rel="original",
<http://localhost:1208/timemap/link/http://matkelly.com>;
rel="self"; type="application/link-format",
<http://web.archive.org/web/20060514123511/http://www.mat
kelly.com:80/>; rel="first memento"; datetime="Sun, 14
May 2006 12:35:11 GMT",
<http://web.archive.org/web/20060516213852/http://www.mat
kelly.com/>; rel="memento"; datetime="Tue, 16 May 2006
21:38:52 GMT",
...
<http://web.archive.org/web/20180128152125/http://matkell
y.com>; rel="memento"; datetime="Sun, 28 Jan 2018
15:21:25 GMT",
<http://web.archive.org/web/20180319141920/http://matkell
y.com/>; rel="last memento"; datetime="Mon, 19 Mar 2018
14:19:20 GMT",
<http://localhost:1208/timemap/link/http://matkelly.com>;
rel="timemap"; type="application/link-format",
<http://localhost:1208/timemap/json/http://matkelly.com>;
rel="timemap"; type="application/json",
<http://localhost:1208/timemap/cdxj/http://matkelly.com>;
rel="timemap"; type="application/cdxj+ors",
<http://localhost:1208/timegate/http://matkelly.com>;
rel="timegate"
```

```
!context ["http://tools.ietf.org/html/rfc7089"]
!id {"uri": "http://localhost:1208/timemap/cdxj/http://matkelly.com"}
!keys ["memento_datetime_YYYYMMDDhhmmss"]
!meta {"original_uri": "http://matkelly.com"}
!meta {"timegate_uri":
"http://localhost:1208/timegate/http://matkelly.com"}
!meta {"timemap_uri": {"link_format":
"http://localhost:1208/timemap/link/http://matkelly.com", "json_format":
"http://localhost:1208/timemap/json/http://matkelly.com", "cdxj_format":
"http://localhost:1208/timemap/cdxj/http://matkelly.com"}}
20060514123511 {"uri":
"http://web.archive.org/web/20060514123511/http://www.matkelly.com:80/",
"rel": "first memento", "datetime": "Sun, 14 May 2006 12:35:11 GMT"}
20060516213852 {"uri":
"http://web.archive.org/web/20060516213852/http://www.matkelly.com/",
"rel": "memento", "datetime": "Tue, 16 May 2006 21:38:52 GMT"}
...
20180128152125 {"uri":
"http://web.archive.org/web/20180128152125/http://matkelly.com", "rel":
"memento", "datetime": "Sun, 28 Jan 2018 15:21:25 GMT"}
20180319141920 {"uri":
"http://web.archive.org/web/20180319141920/http://matkelly.com/", "rel":
"last memento", "datetime": "Mon, 19 Mar 2018 14:19:20 GMT"}
```

Link (RFC 7089) TimeMap

CDXJ TimeMap

Original URI (URI-R)

Other TimeMaps (URI-Ts)

TimeGate (URI-G)

Relative Relations

See Alam, "CDXJ: An Object Resource Stream Serialization Format", 2015

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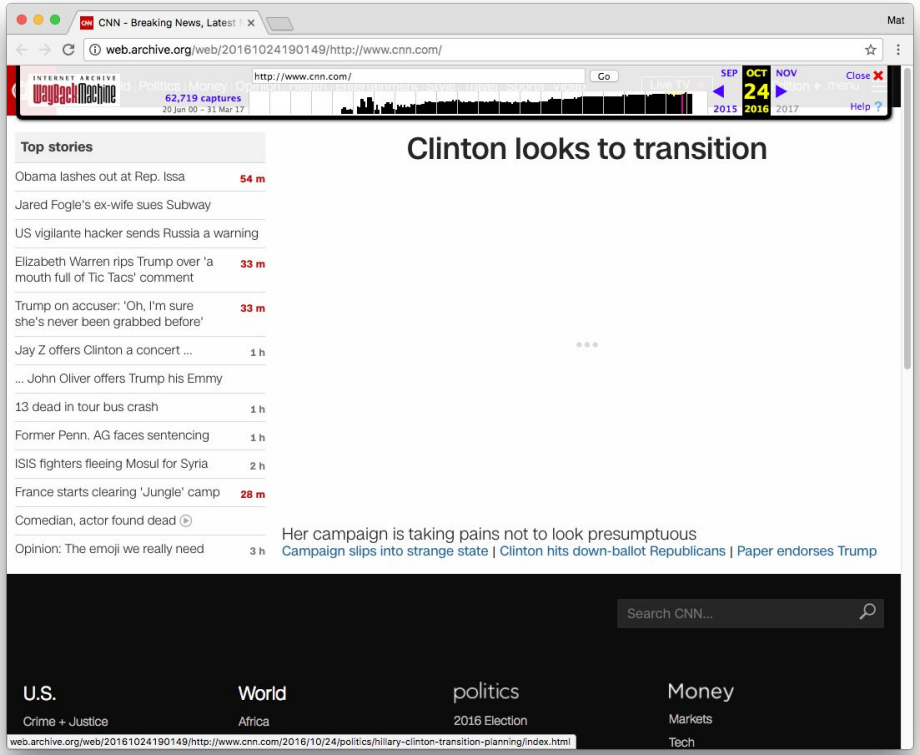
More Expressive TimeMaps

- Memento Quality (e.g., Damage)[1]
- How Many Captures?[2]
- How Many Are Identical?[2,3]
- Other Attributes of Mementos...



[1] Brunelle *et al.*, JCDL 2014, IJDL 2015
[2] Kelly *et al.*, JCDL 2017
[3] AlSum and Nelson, ECIR 2014

Additional TimeMap Attributes

Content-based Attributes

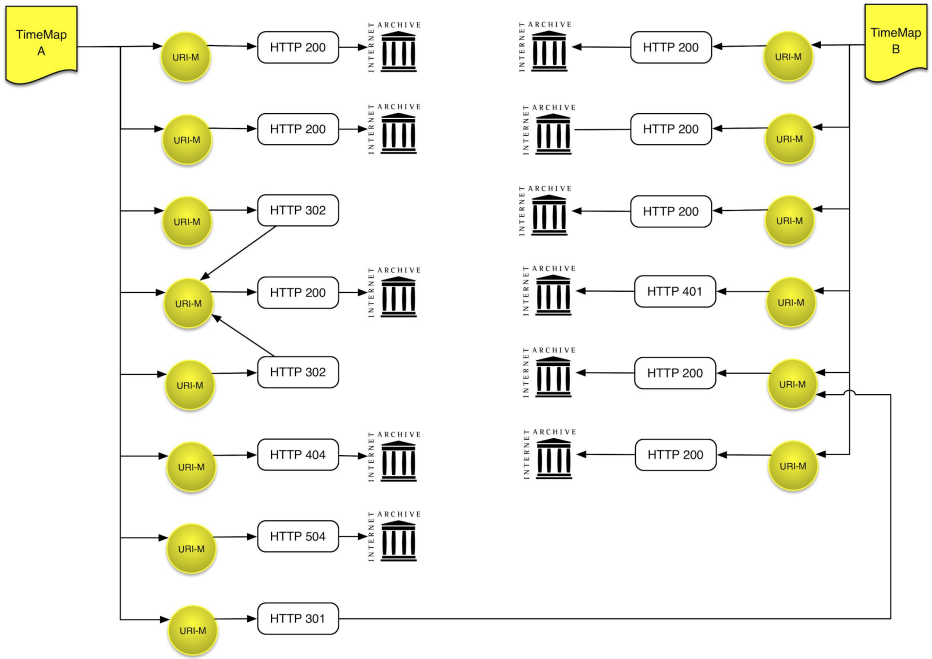
Derived Attributes

Access Attributes

TimeMap Enrichment: Content-Based Attributes

- Status Code[1]
- Content-Digest
  - In WARC & CDX
  - Not all archives expose CDX

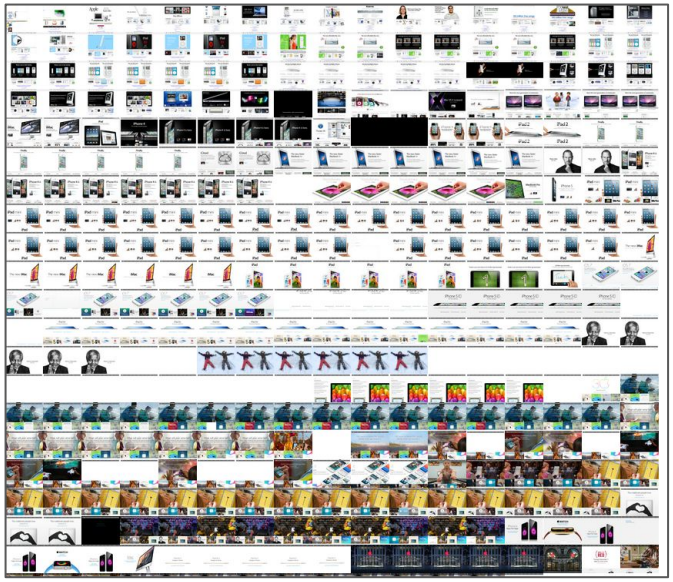
- Would allow more info about mementos without requiring comprehensive dereferencing



Kelly *et al.,* "Impact of URI Canonicalization on Memento Count", JCDL 2017, arXiv 1703.03302

TimeMap Enrichment: Derived Attributes

- Thumbnails (e.g, via SimHash)[1]
  - Calculation based on root memento's HTML
- Memento Damage (JCDL 2014, IJDL)[2]
  - Requires dereferencing embedded resources

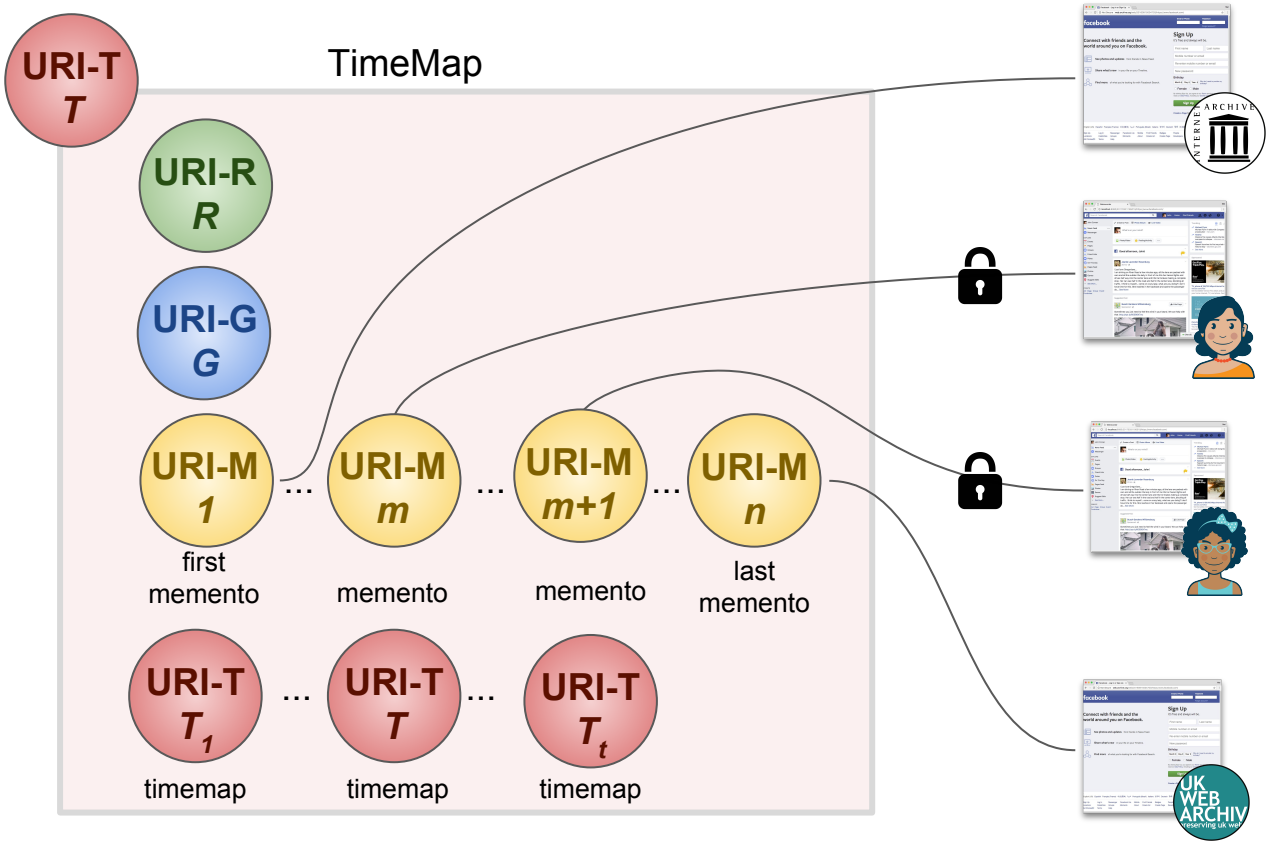


apple.com, many duplicate mementos!

[1] AlSum and Nelson, Thumbnail Summarization Techniques for Web Archives, ECIR 2014, pp. 299-310.
[2] Brunelle *et al.,* "The Impact of JavaScript on Archivability," IJDL, 17(2), pp. 95-117. January 2016.

TimeMap Enrichment: Access Attributes

- How to distinguish Private captures In a TimeMap?



TimeMap Enrichment - in a CDXJ TimeMap

Line breaks added for clarity, CDXJ records occupy a single line

```
19981212013921 {
  "uri": "http://localhost:8080/20101116060516/http://facebook.com/",
  "rel": "memento",
  "datetime": "Tue, 16 Nov 2010 06:05:16 GMT",
  "status_code": 200,
  "digest": "sha1:LK26DRRQJ4WATC6LBVF3B3Z4P2CP5ZZ7",
  "damage": 0.24,
  "simhash": "65511106224221534 88",
  "content-language": "en-US",
  "access": {
     "type": "Blake2b",
     "token": "c6ed419e74907d220c69858614d86...ef0a3a88a41"
  }
}
```

Content-based attributes **Derived Attributes** **Access Attributes**

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Query Precedence

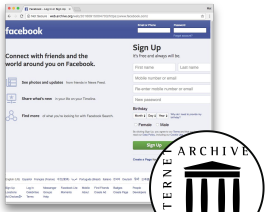
- More control of querying in series and parallel

1

2

3

3



"Check my archive first, then Carol's, then all public archives."

See Atkins', "Paywalls in the Internet Archive", March 2018

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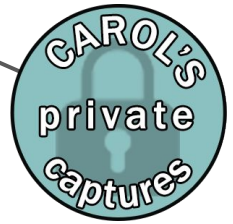

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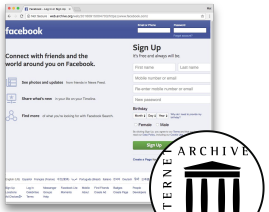

"Check my archive first, then Carol's, then all public archives."

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Query Short-Circuiting

- **May give priority to archive relevancy.**
- Series halt when threshold met.

1

1

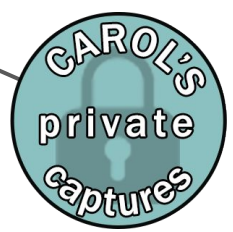
2

2

"Check private archives first. **Iff** you find no captures, only *then* check the public archives.

Query Short-Circuiting

- May give priority to archive relevancy.
- **Series halt when threshold met.**



1

1

2

2

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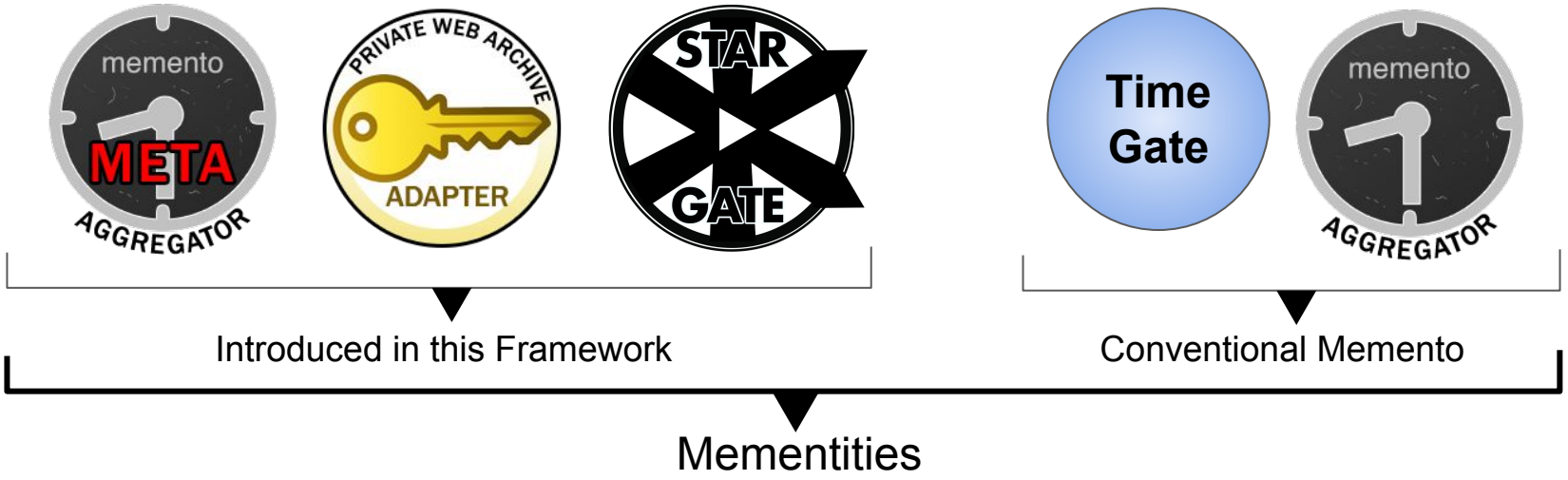
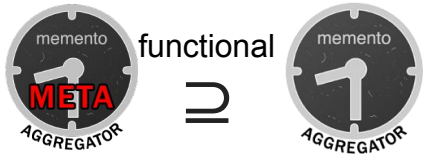
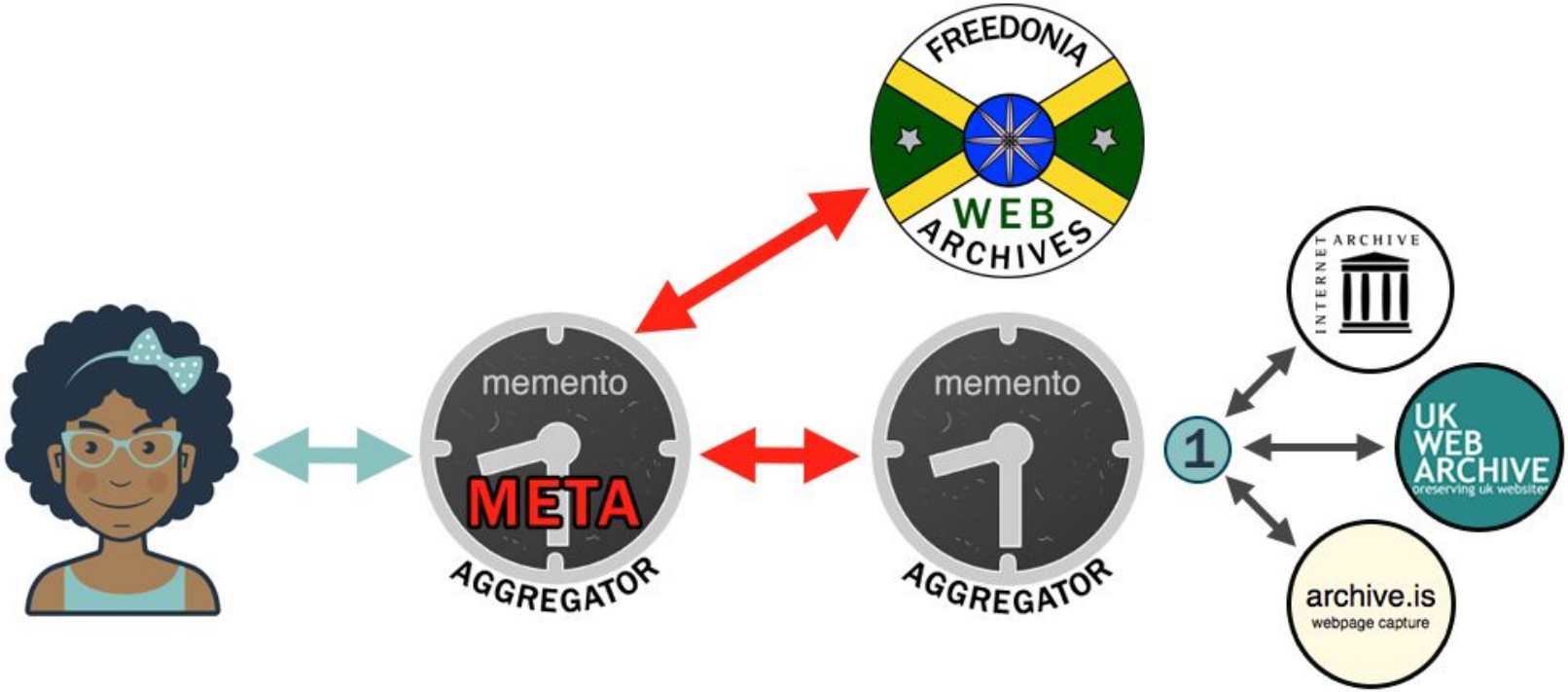
Mementities

- Memento + Entity (*entity* term already overused)



Memento Meta-Aggregator (MMA)





MMA: Archive Selection

MMA: User-Driven Archival Specification

MMA Aggregation sources

MMA_{α}:

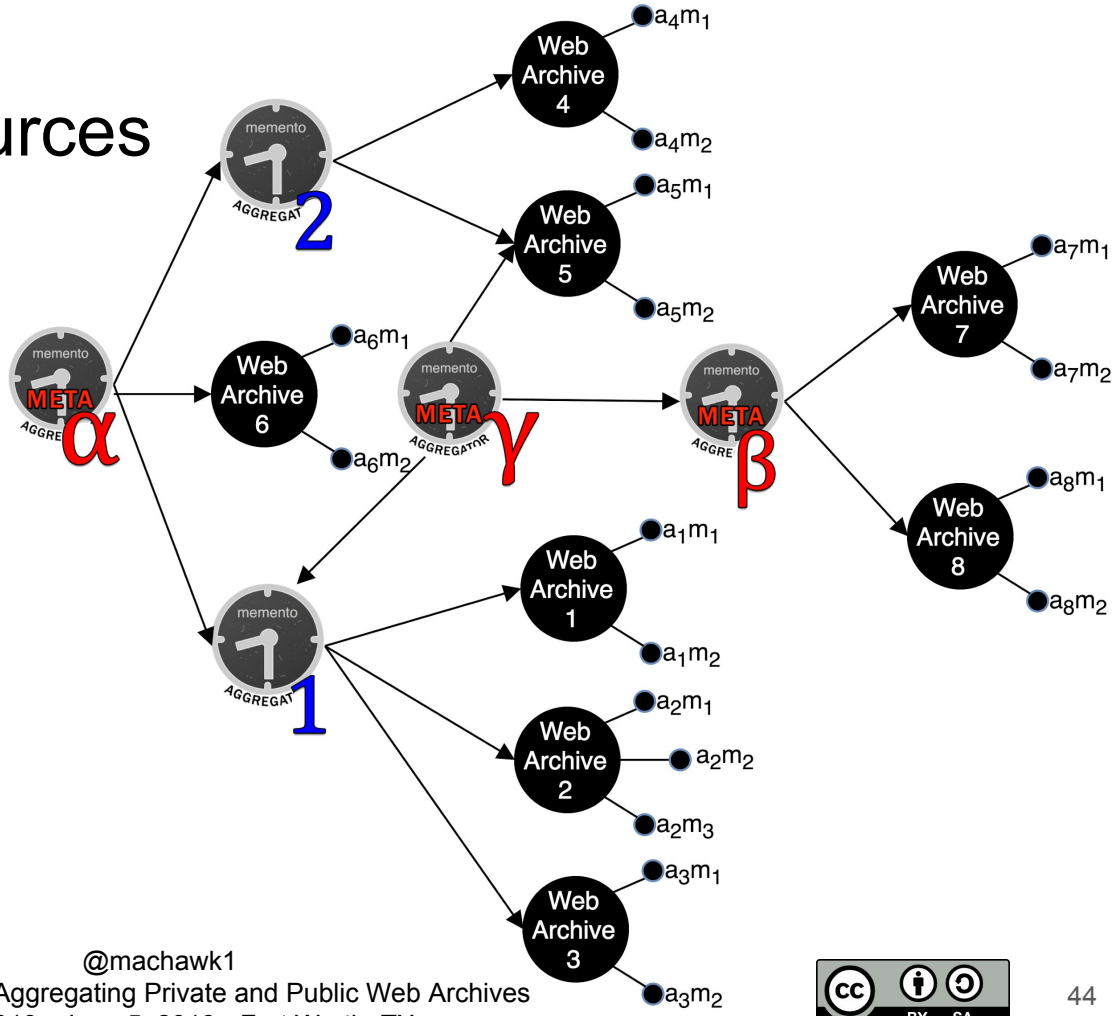
from MA_2, MA_1 and $\mathbf{WA_6}$

MMA_{β}:

from $\mathbf{WA_7}$ and $\mathbf{WA_8}$

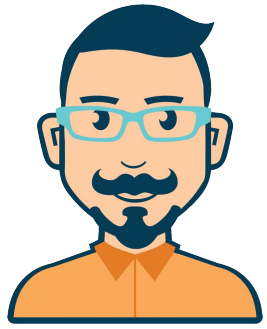
MMA_{γ}:

from MMA_{β}, MA_5, and $\mathbf{WA_1}$



MMA Dynamics By-Example

- Personal Archive Aggregation
- MMA Chaining
- Client-Side Aggregation Preference



MMA Dynamics - Personal Archive Aggregation

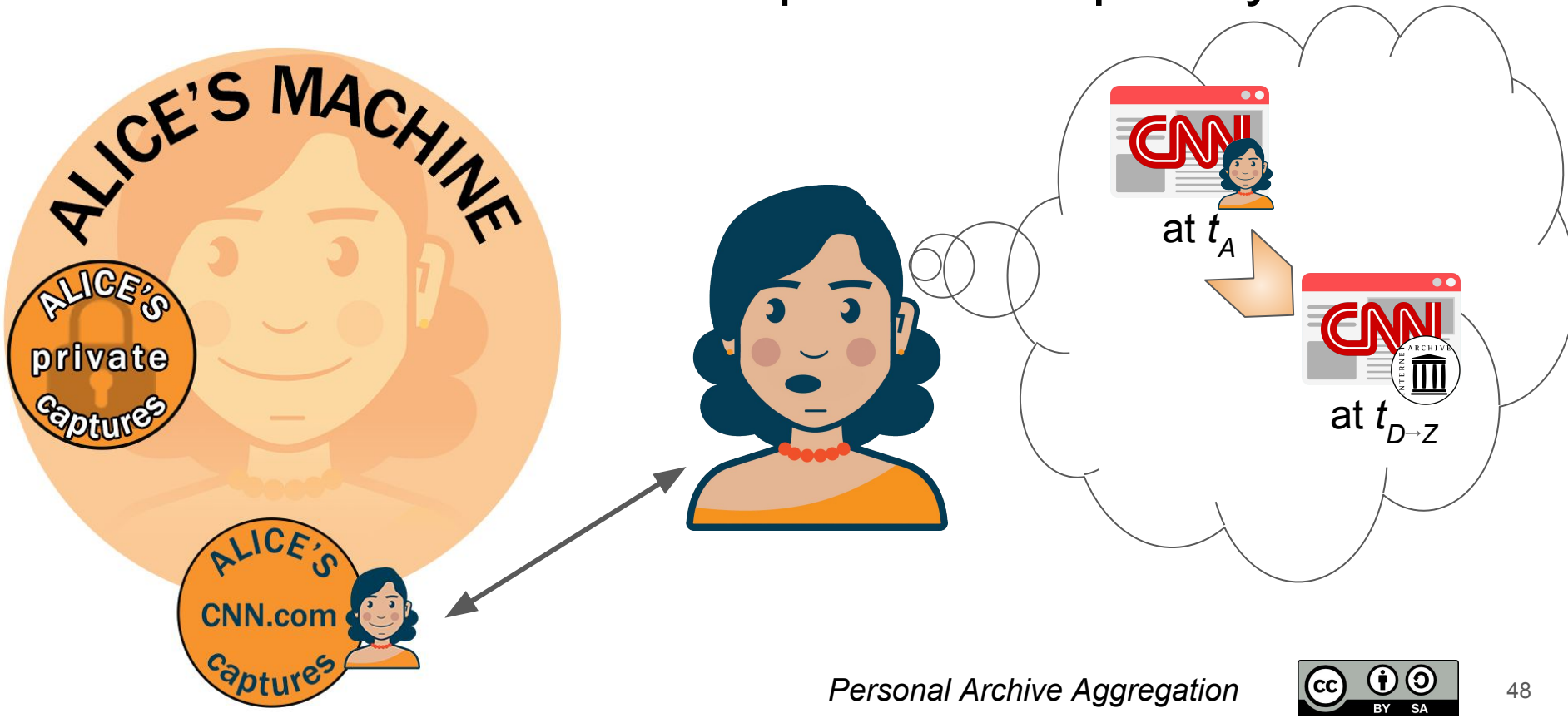
bbc | homepage

Public videos

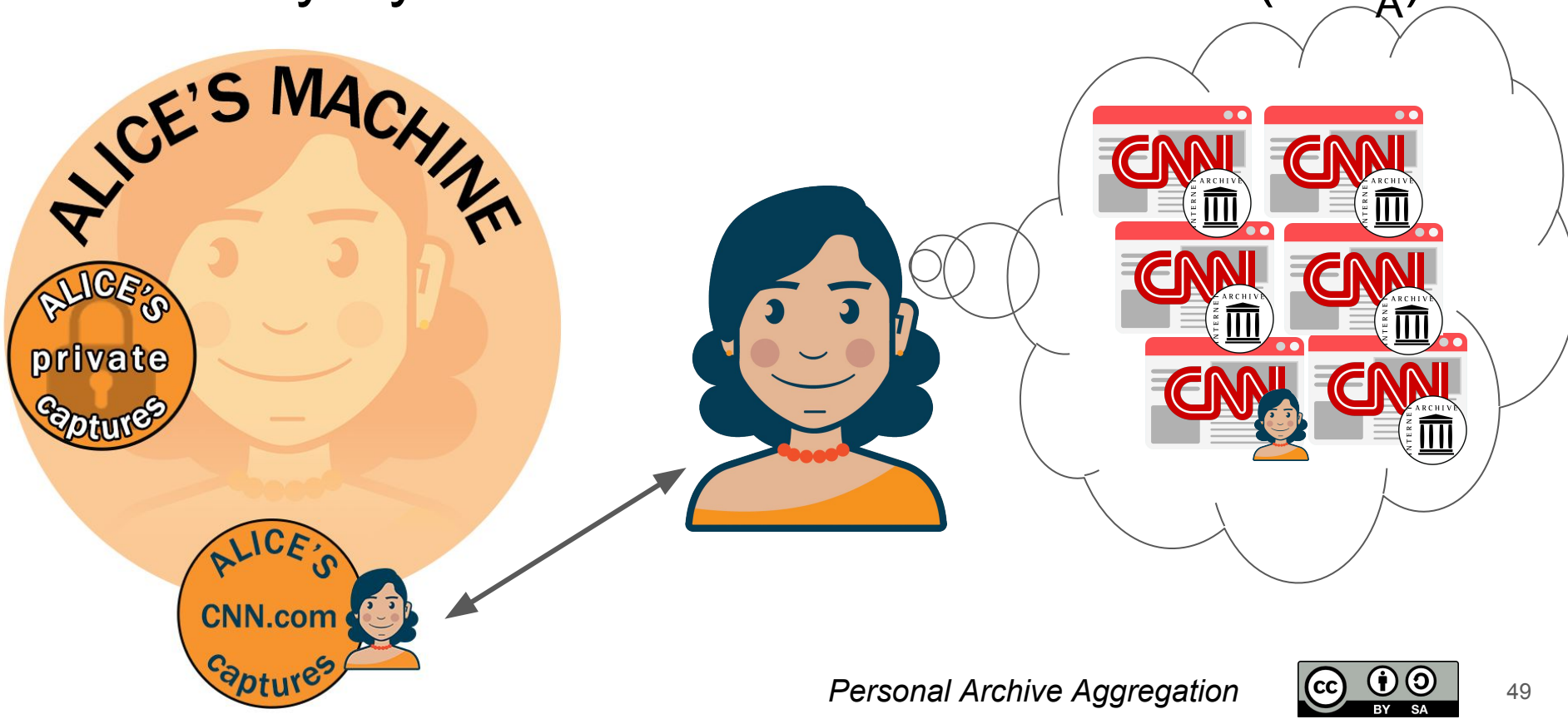
FB | bank | flickr

Alice Saves the Web

Alice Wants to See Her Captures Temporally Inline

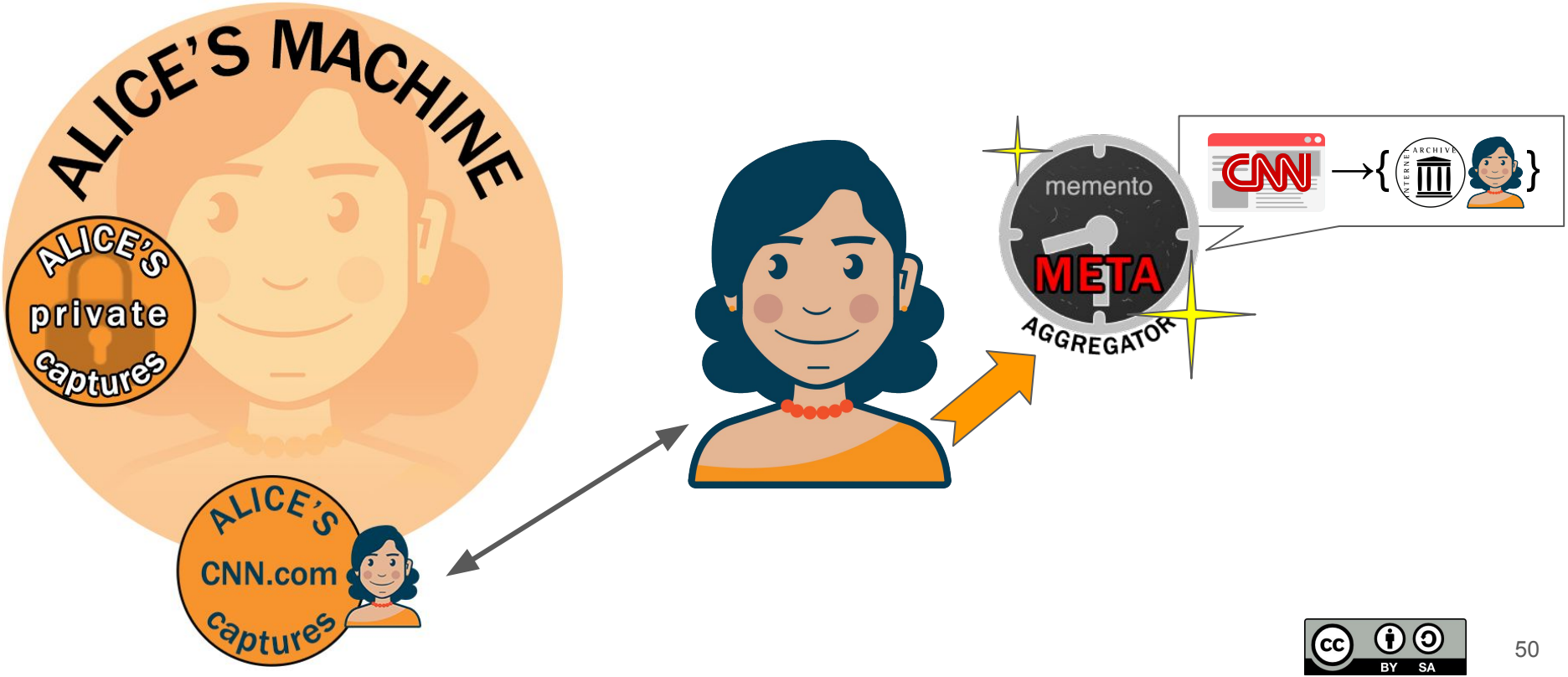


Mementity Dynamics - Alice & Her Archives (WA_A)

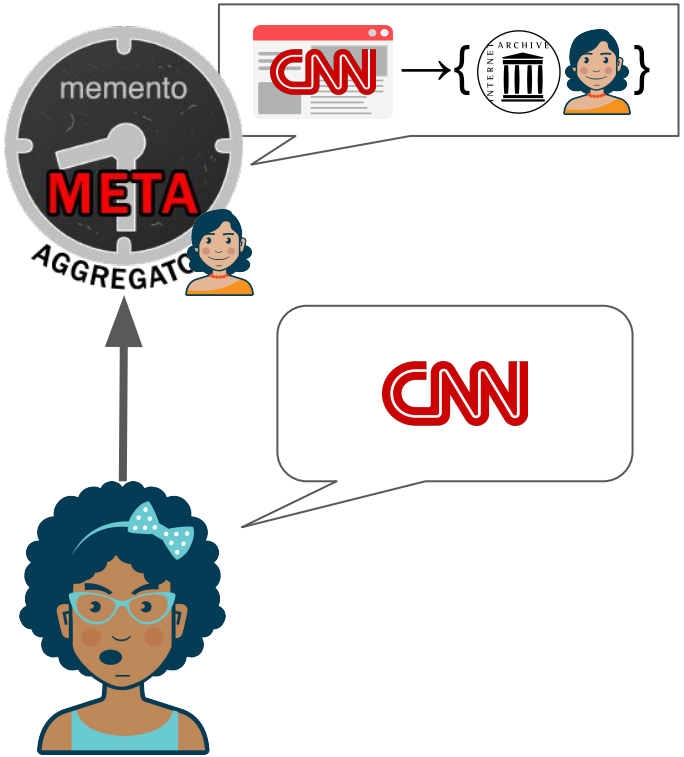


Personal Archive Aggregation

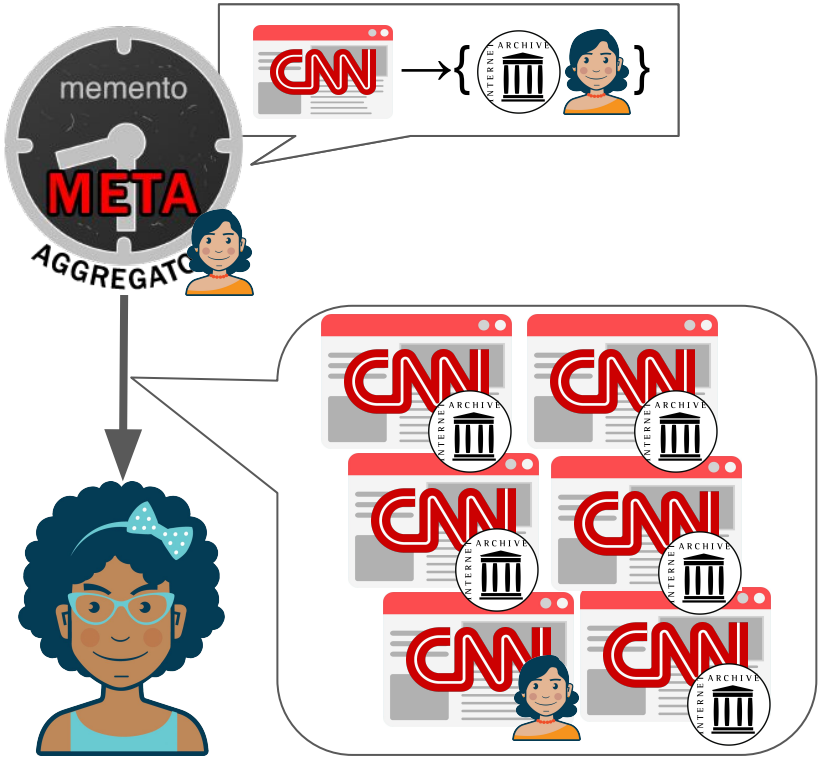
Alice Deploys MMA_A



Carol Asks MMA_A for CNN

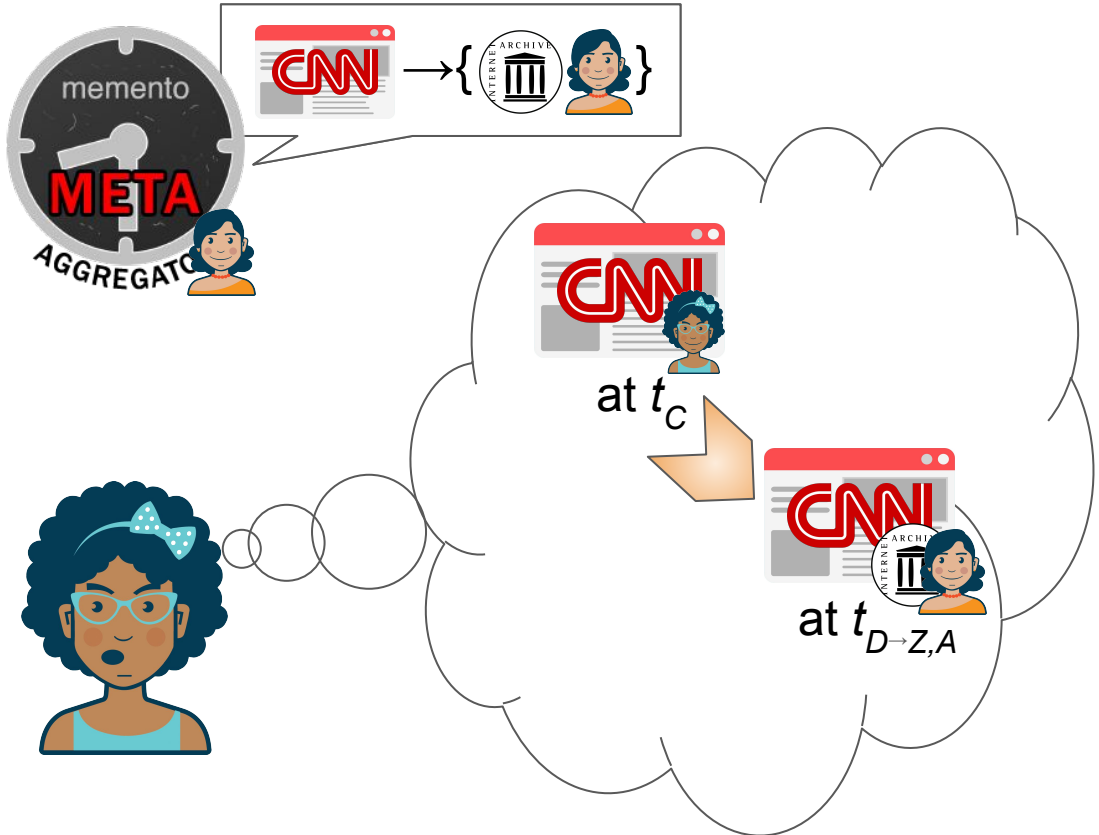


MMA_A returns CNN Memento $\{M_A, M_{IA}\}$

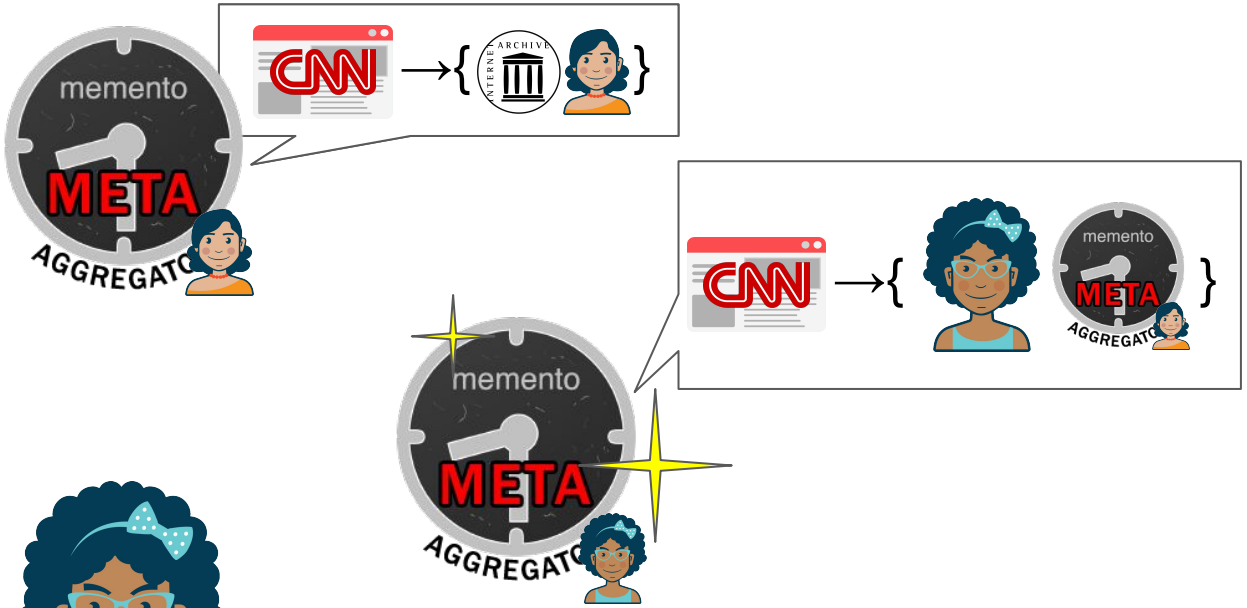


Carol Wants to Aggregate Her Own Captures

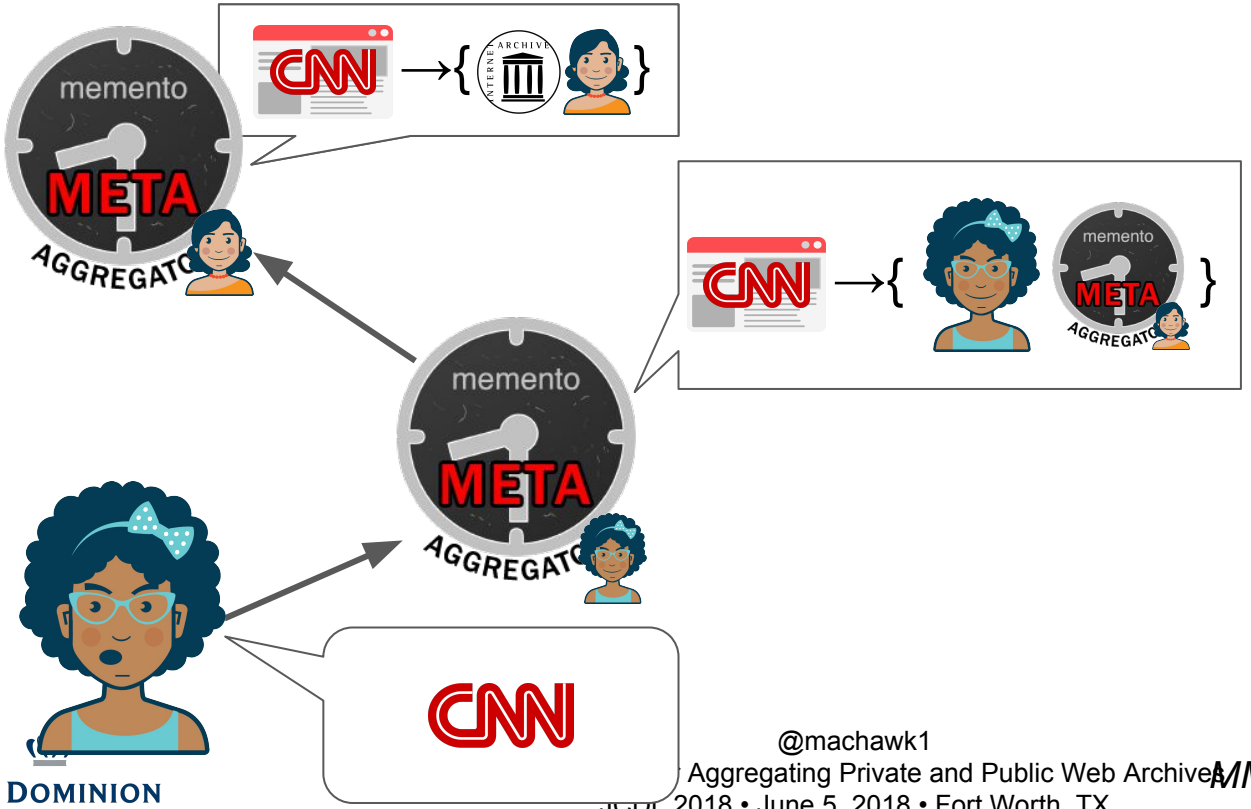
CNN(M(WA$_C$))



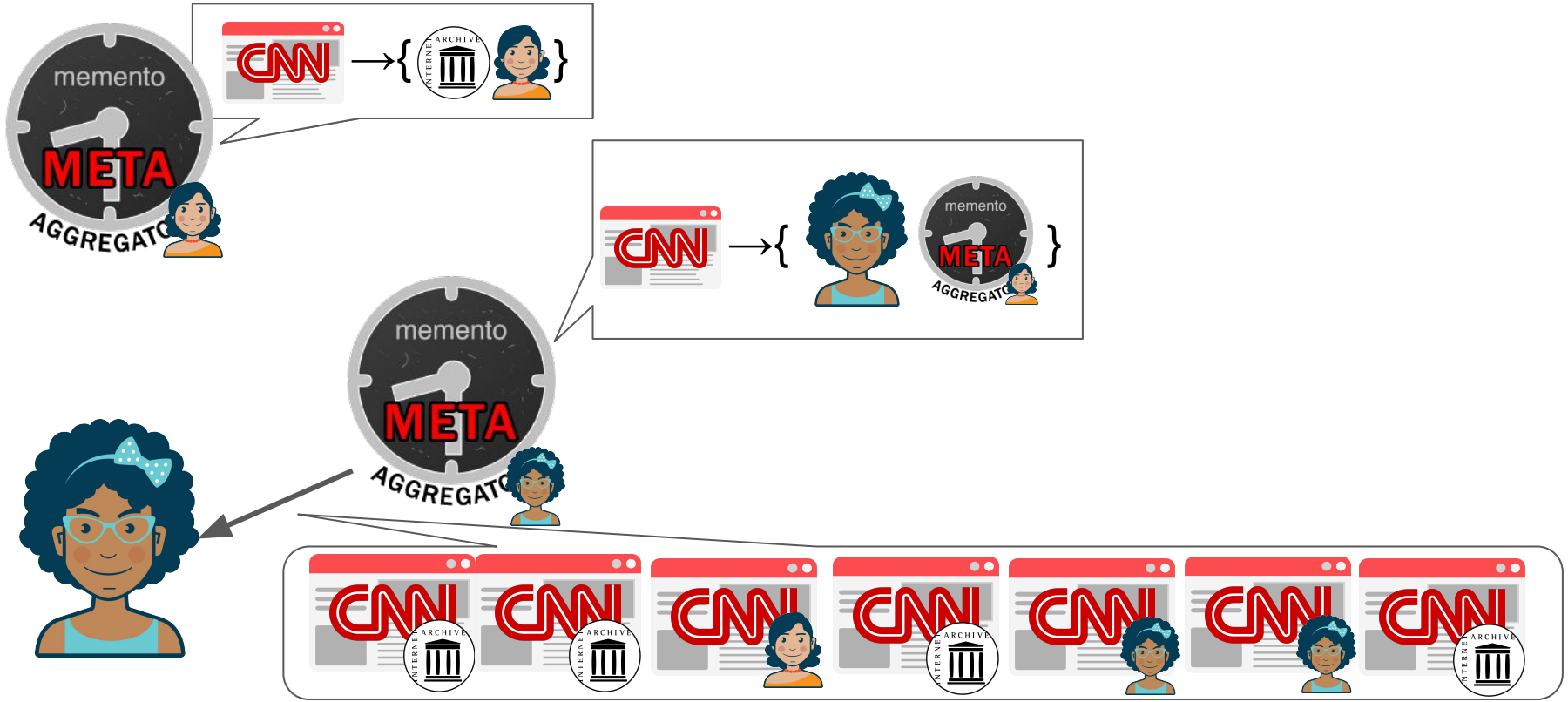
Carol Creates MMA_C to Access WA_C and MMA_A



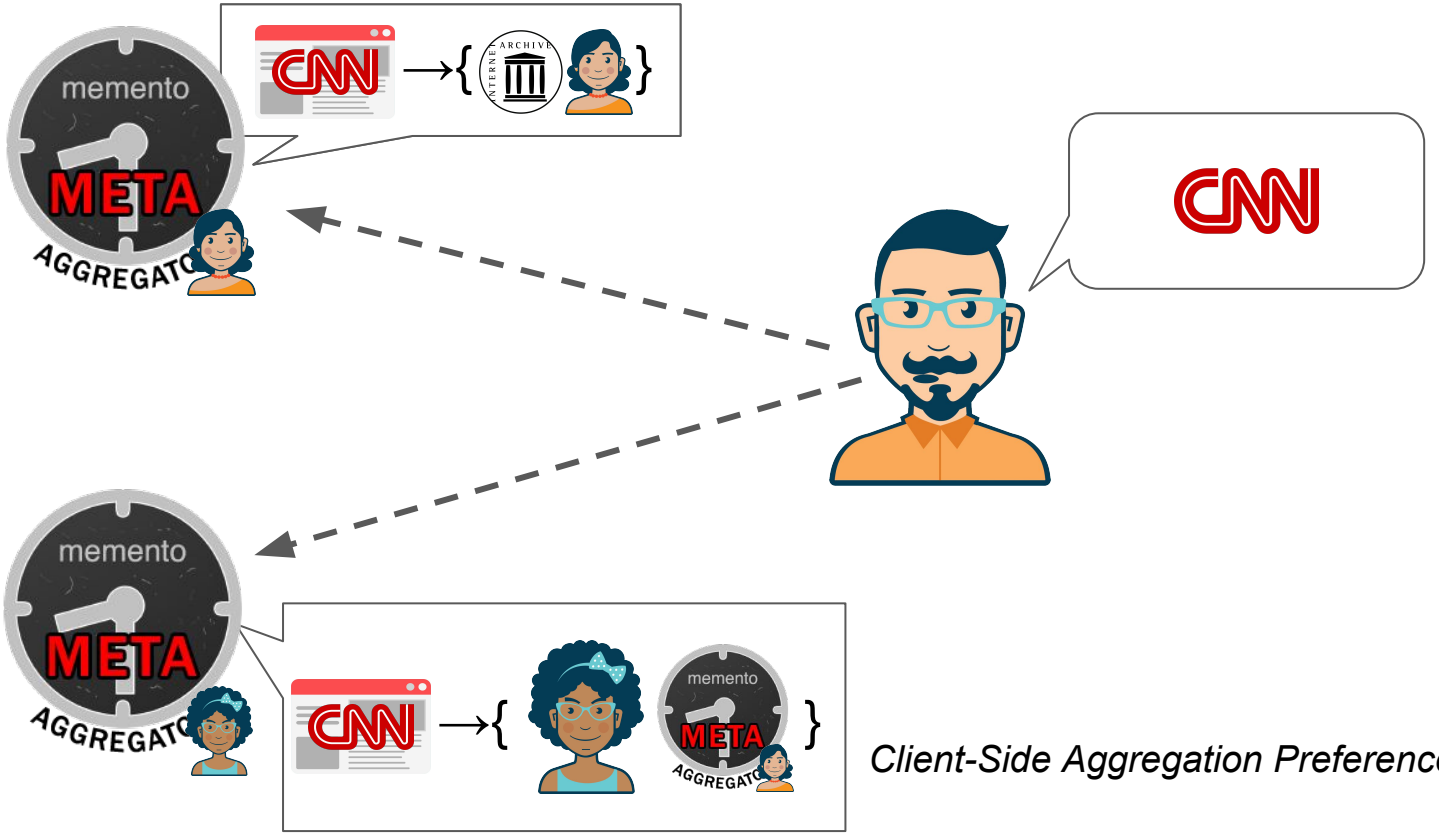
Carol Asks MMA_C For CNN



MMA_A returns CNN Memento $\{M_A, M_{IA}, M_C\}$



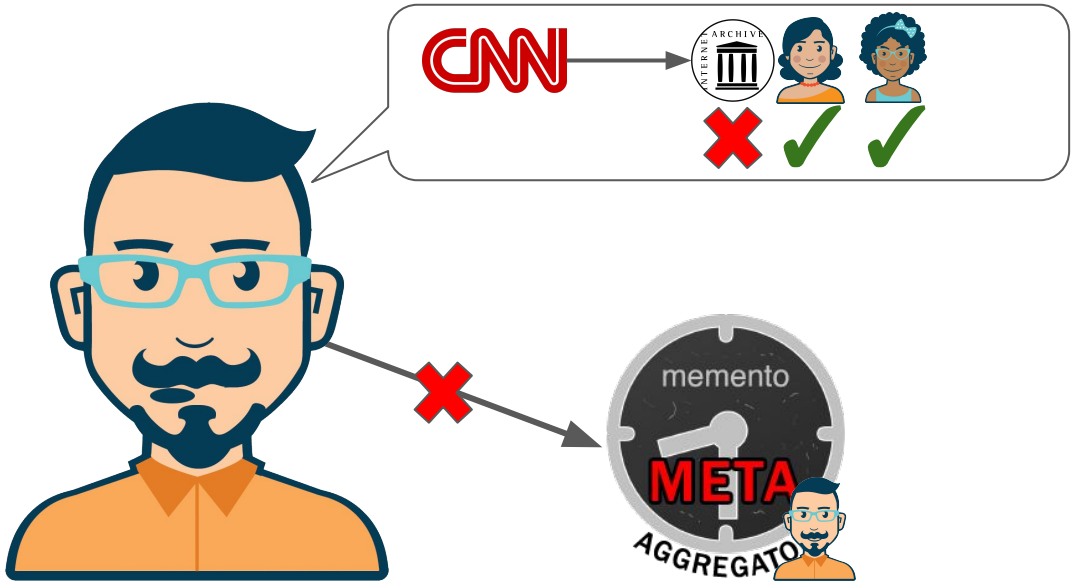
Bob May Request M(CNN) From MMA_A or MMA_C



Client-Side Aggregation Preference

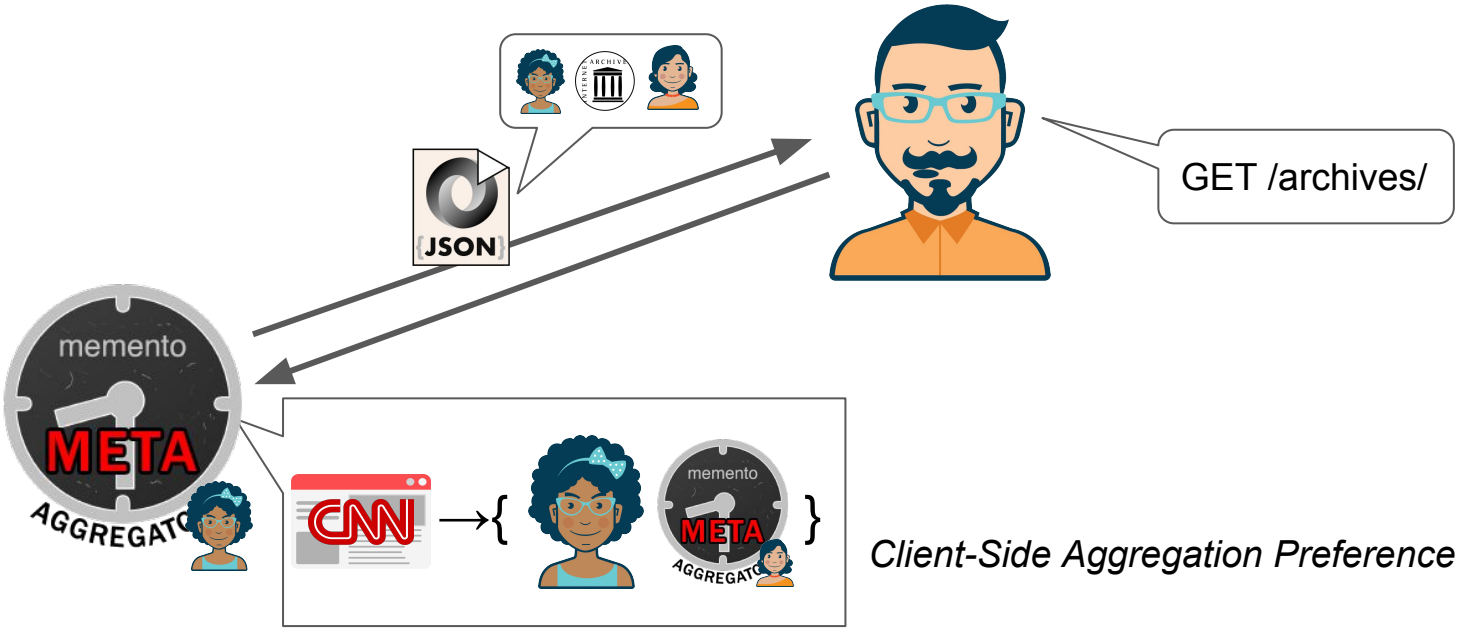
Bob Prefers to Exclude IA Captures

...and does not want to setup his own MMA



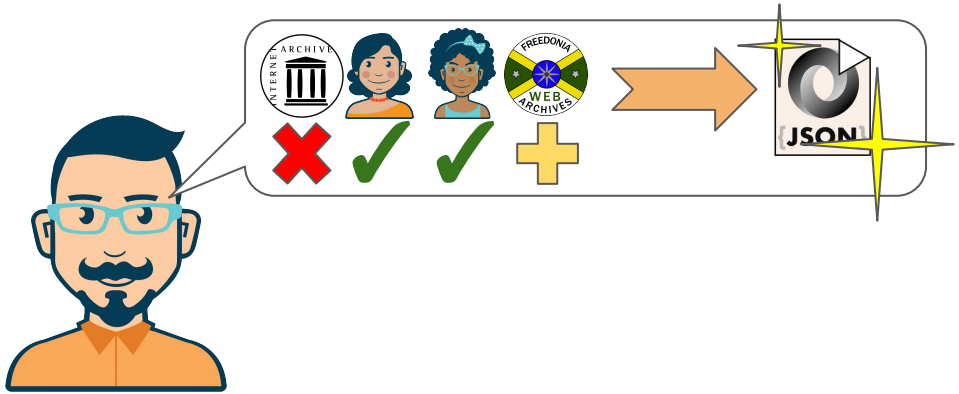
Client-Side Aggregation Preference

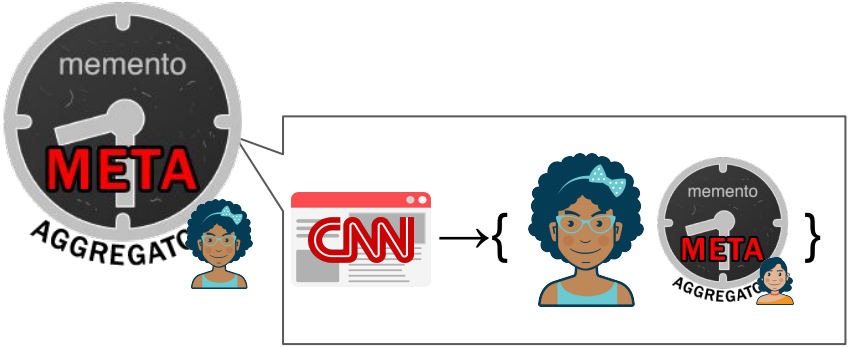
Bob Requests Supported Archives



Client-Side Aggregation Preference

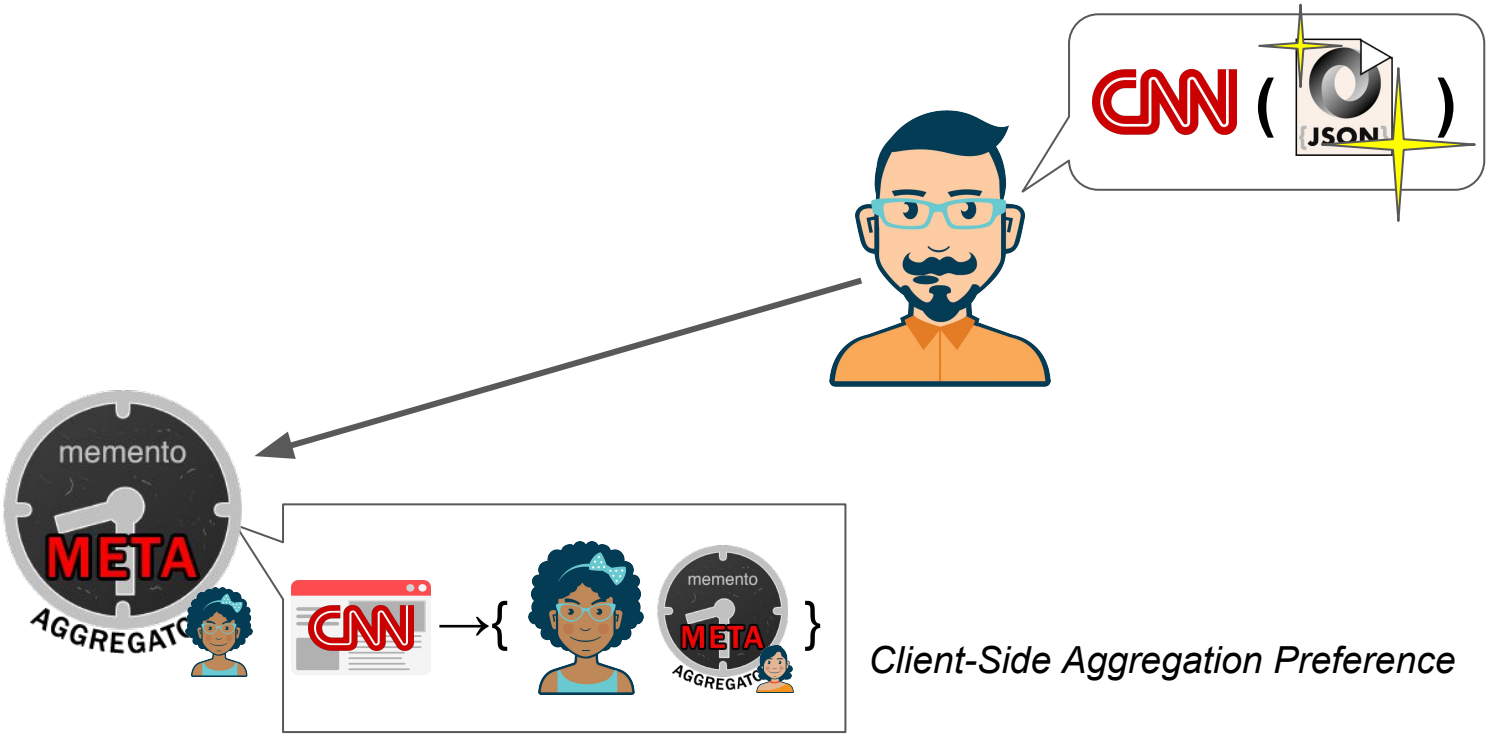
Bob Customizes the Set in the JSON





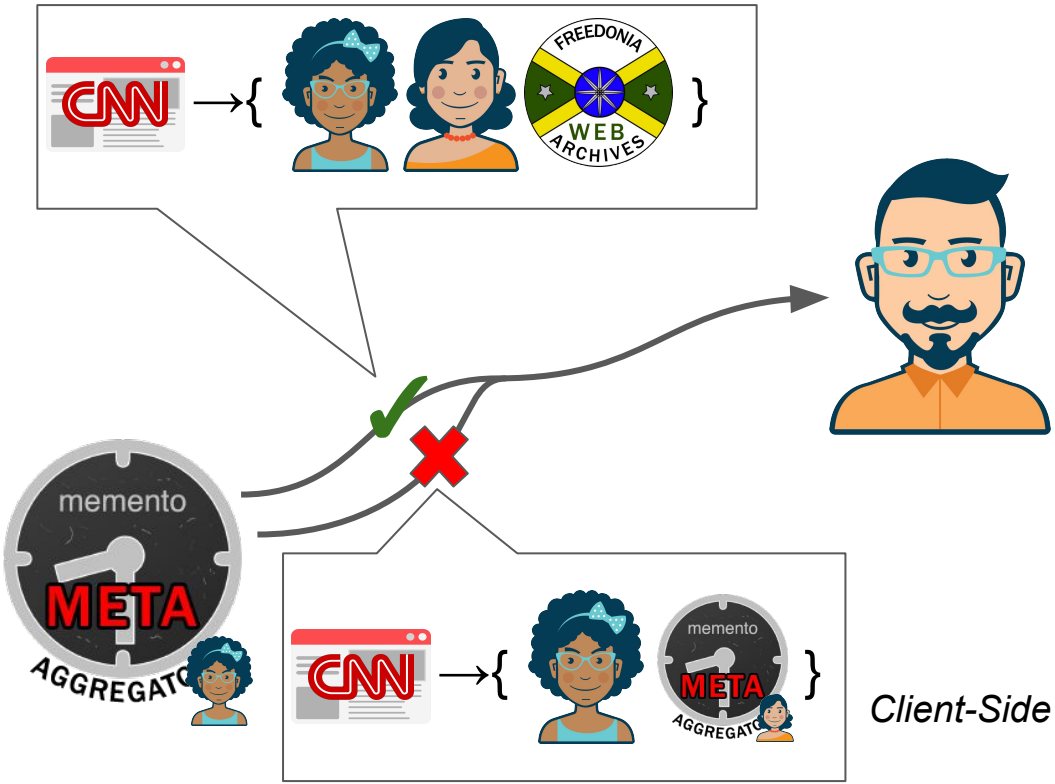
Client-Side Aggregation Preference

Bob Requests CNN for His Custom Set



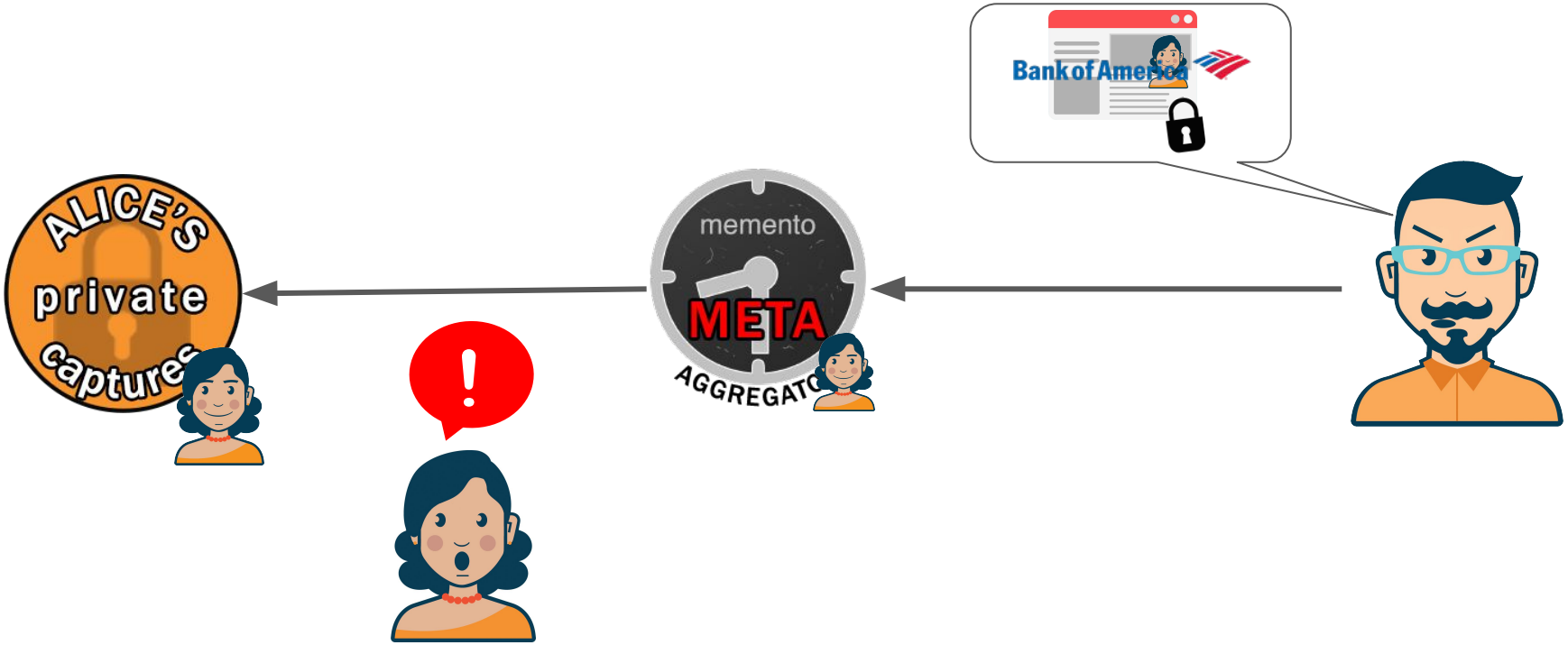
Client-Side Aggregation Preference

MMA Complies or Ignores Preference

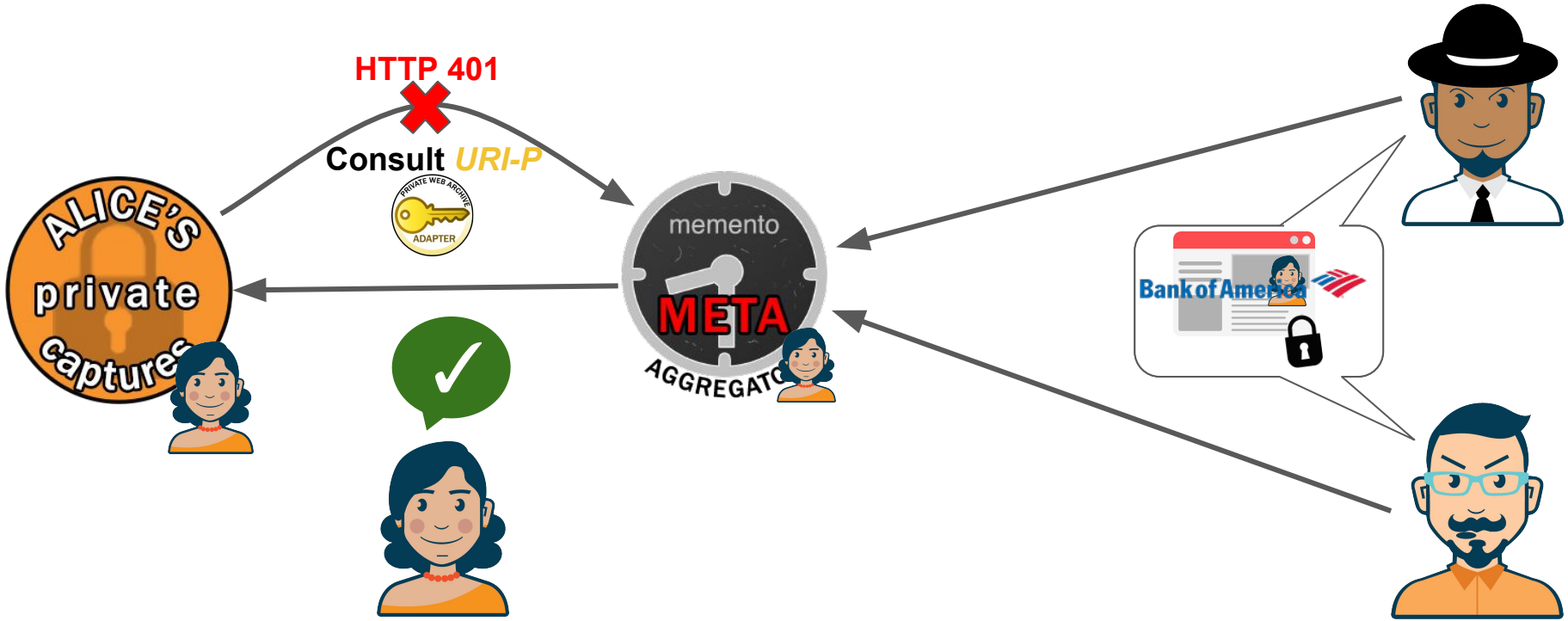


Client-Side Aggregation Preference

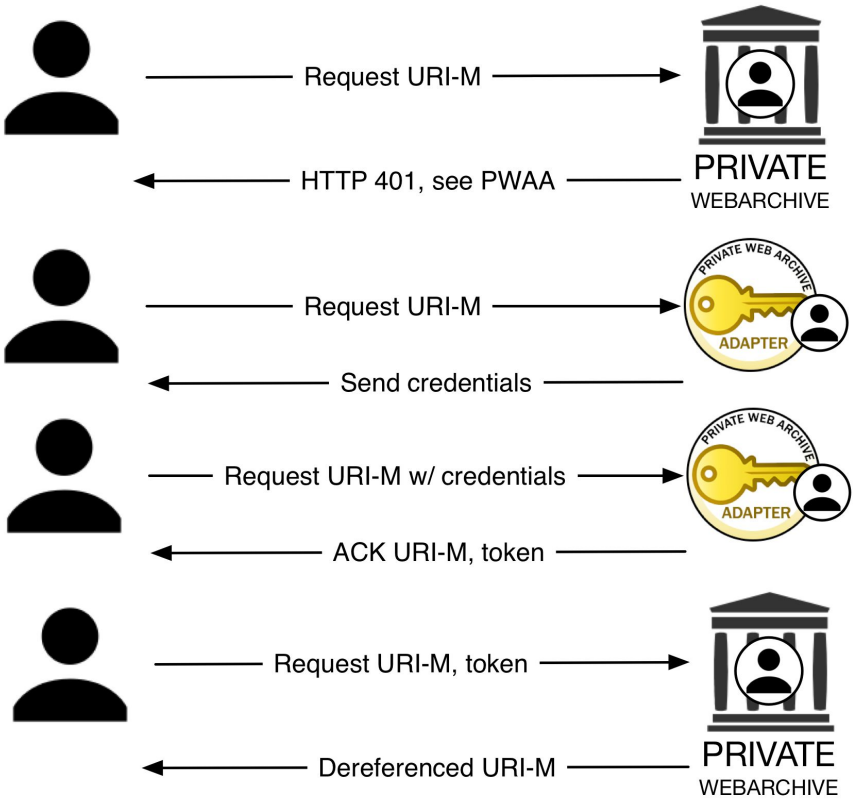
Hooray, Aggregation!



Hooray, Aggregation!

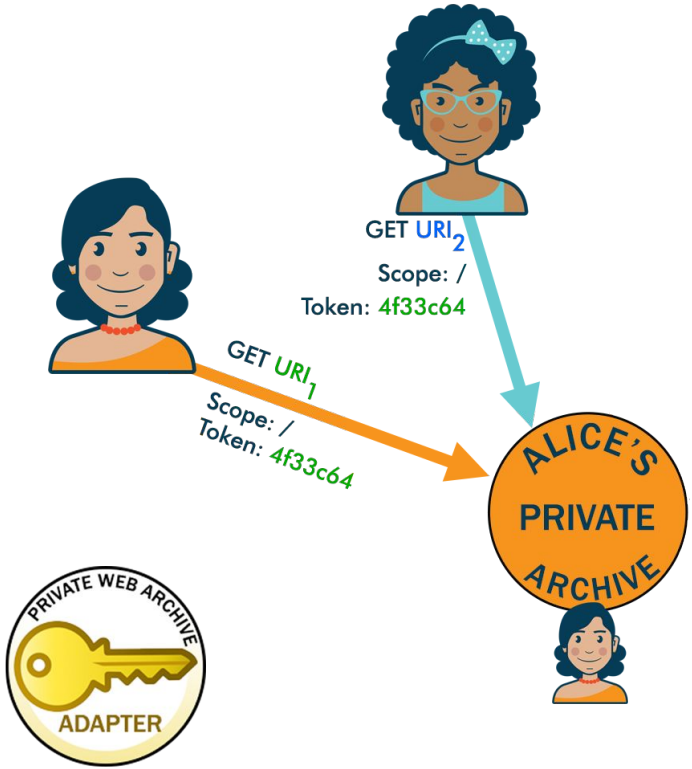


Private Web Archive Adapter (PWAA)

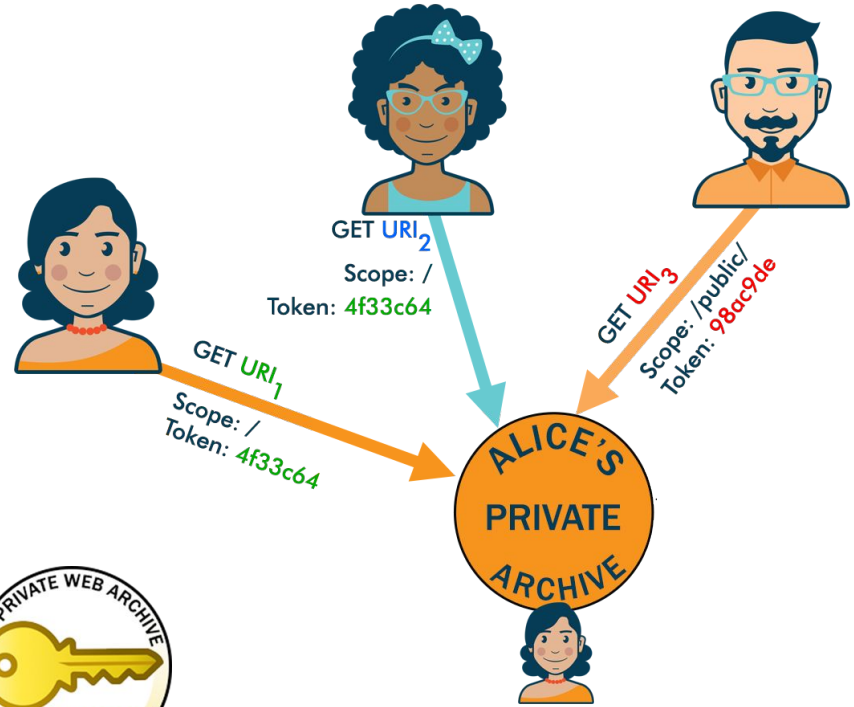


- Auth Layer for to encourage Private Web archive aggregation
- Typical OAuth 2.0 flow
- Auth role cohesive to PWAA
- Persistent access through tokenization

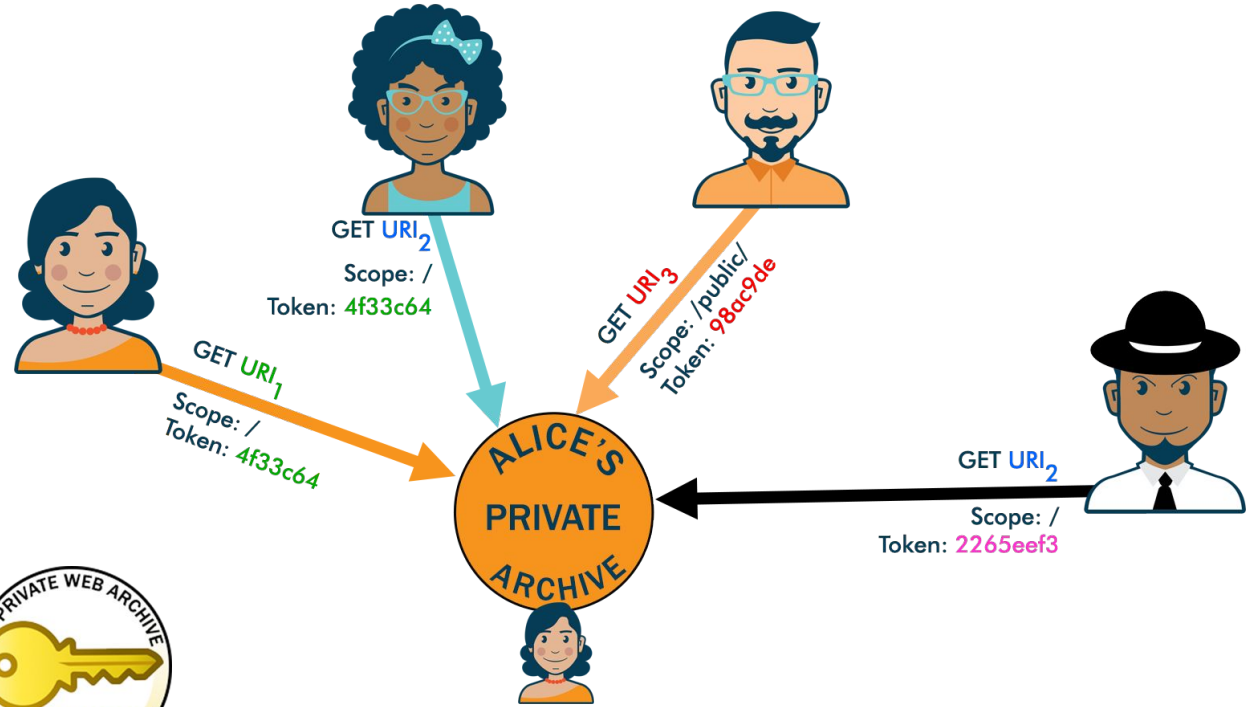
PWAA - Sharing Tokens



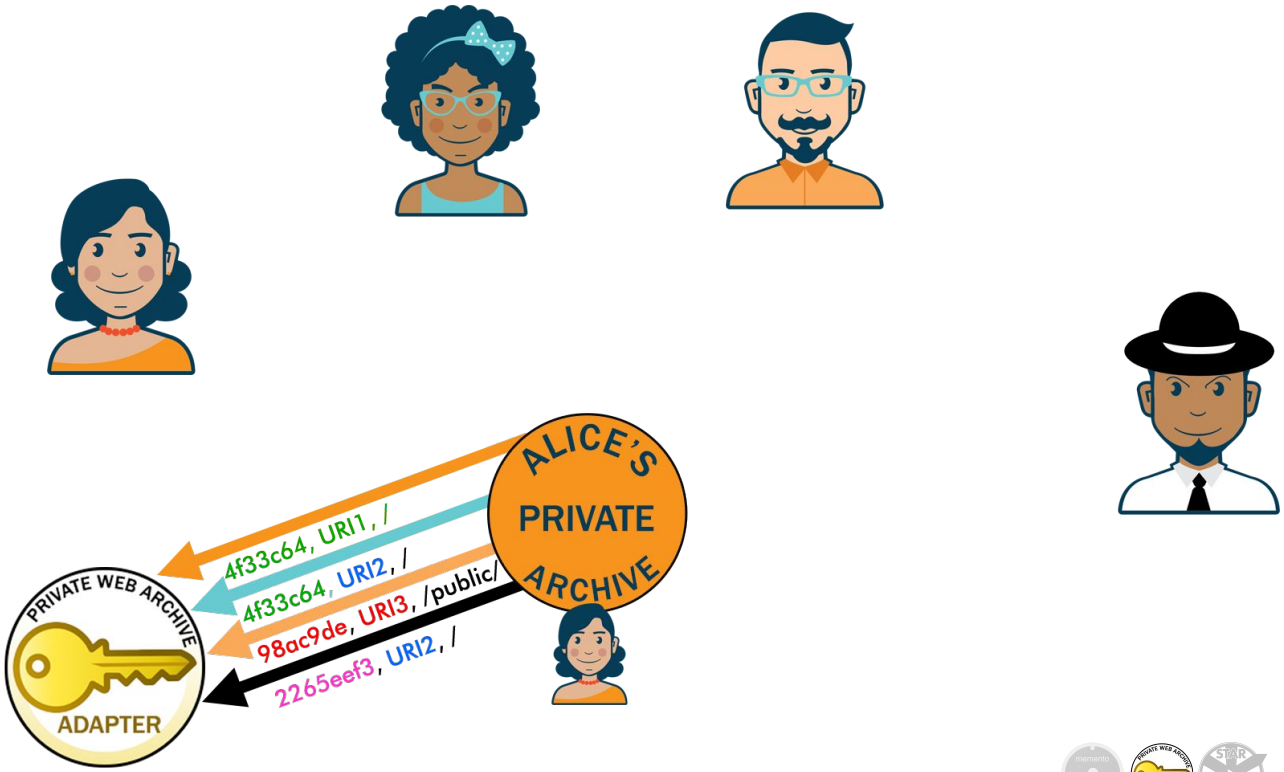
PWAA - Previously Authorized



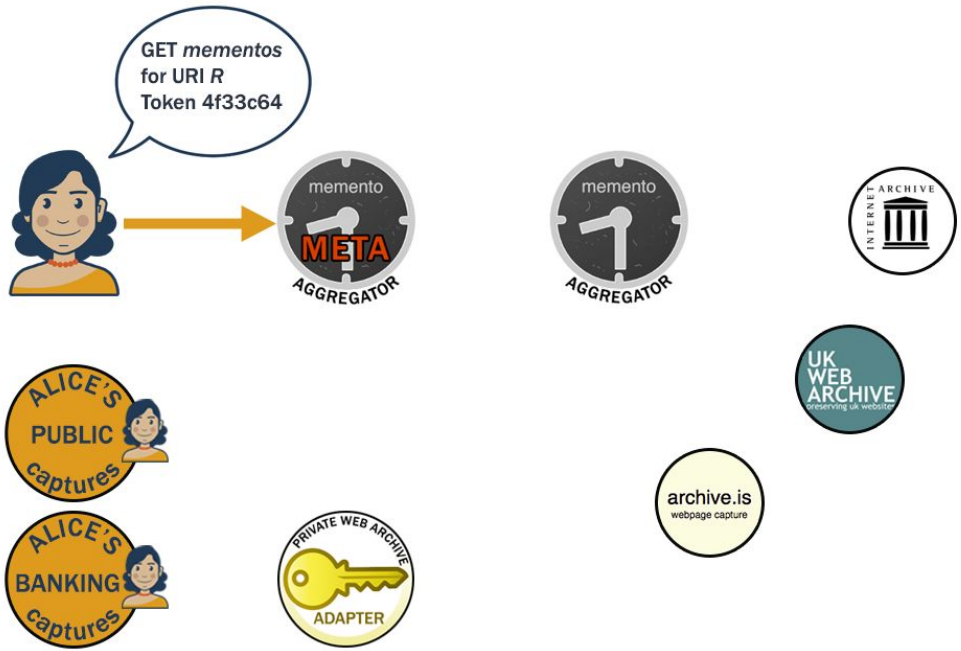
PWAA - Unauthorized Request



PWAA - Sharing Tokens

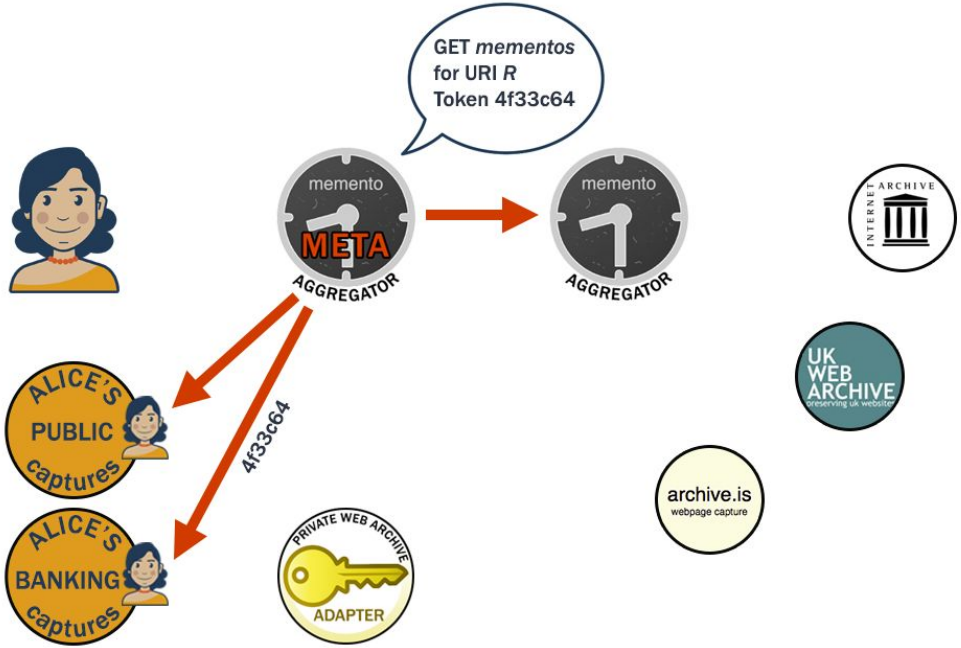


Alice Passes Associative Token to MMA

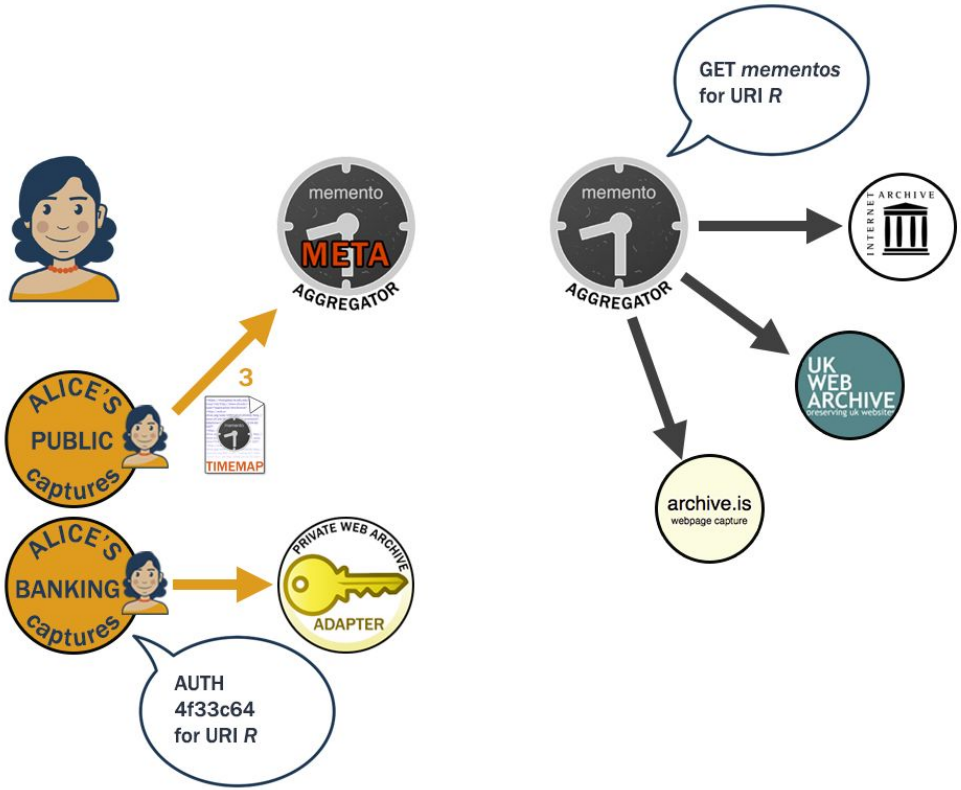


MMA requests URI-R...

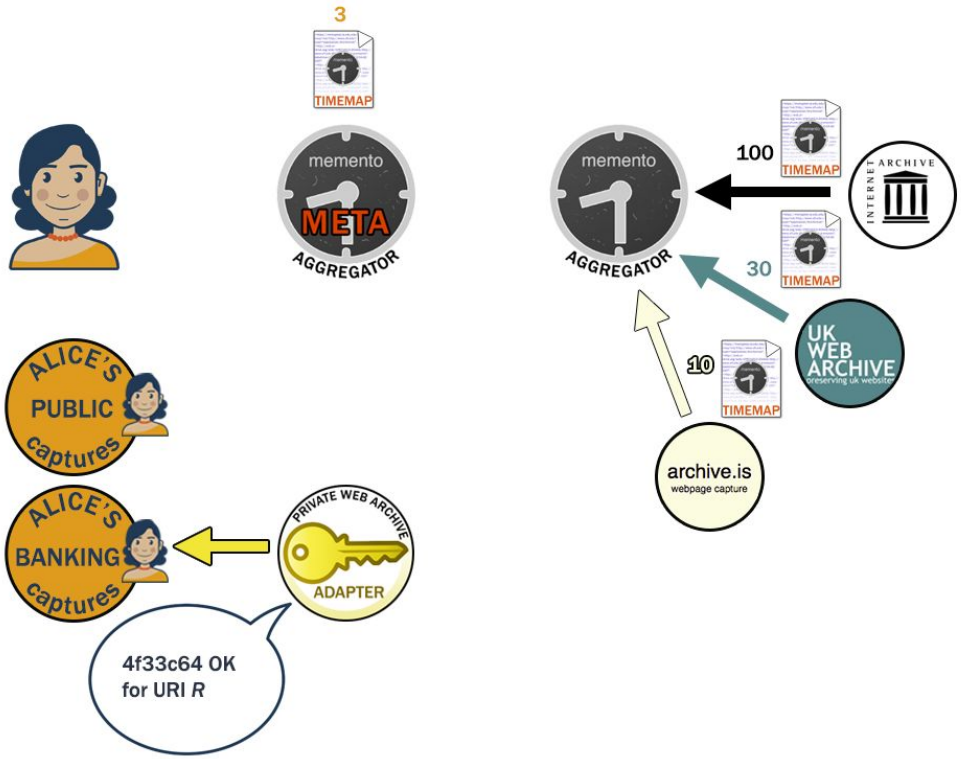
...relays token where applicable



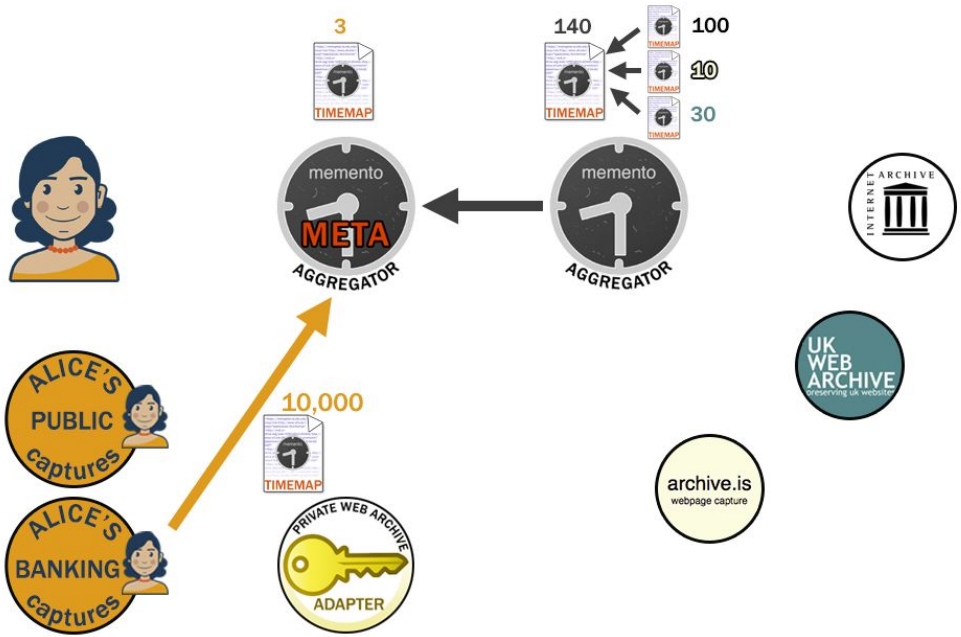
Private Archive Validates with PWAA



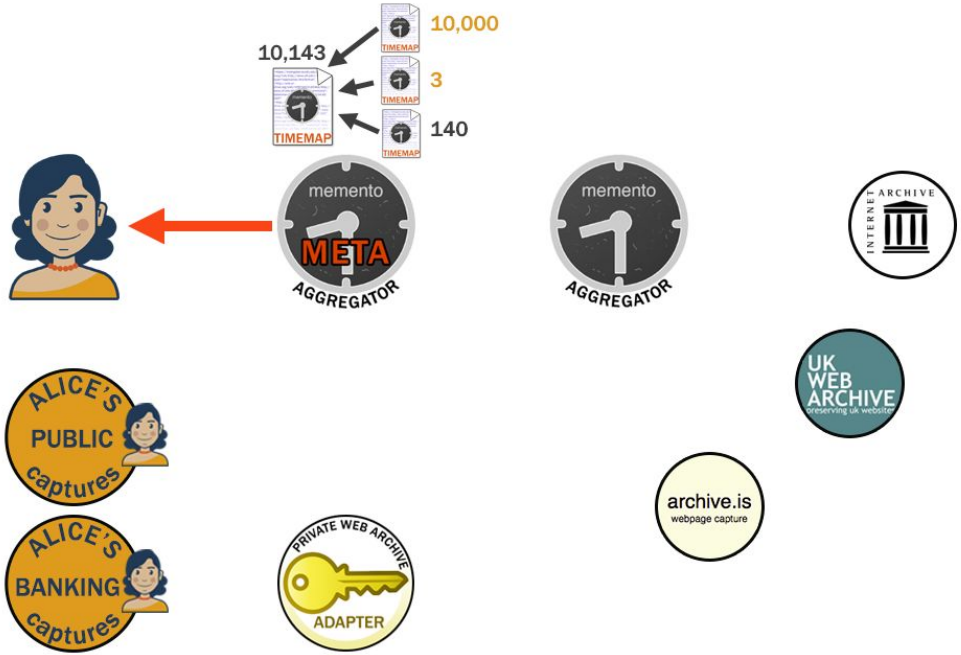
PWAA Confirms Token



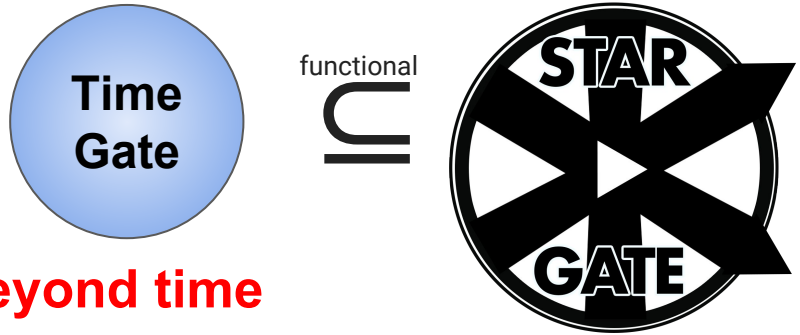
Private Archive Returns Captures



MMA Aggregates, Associates Token

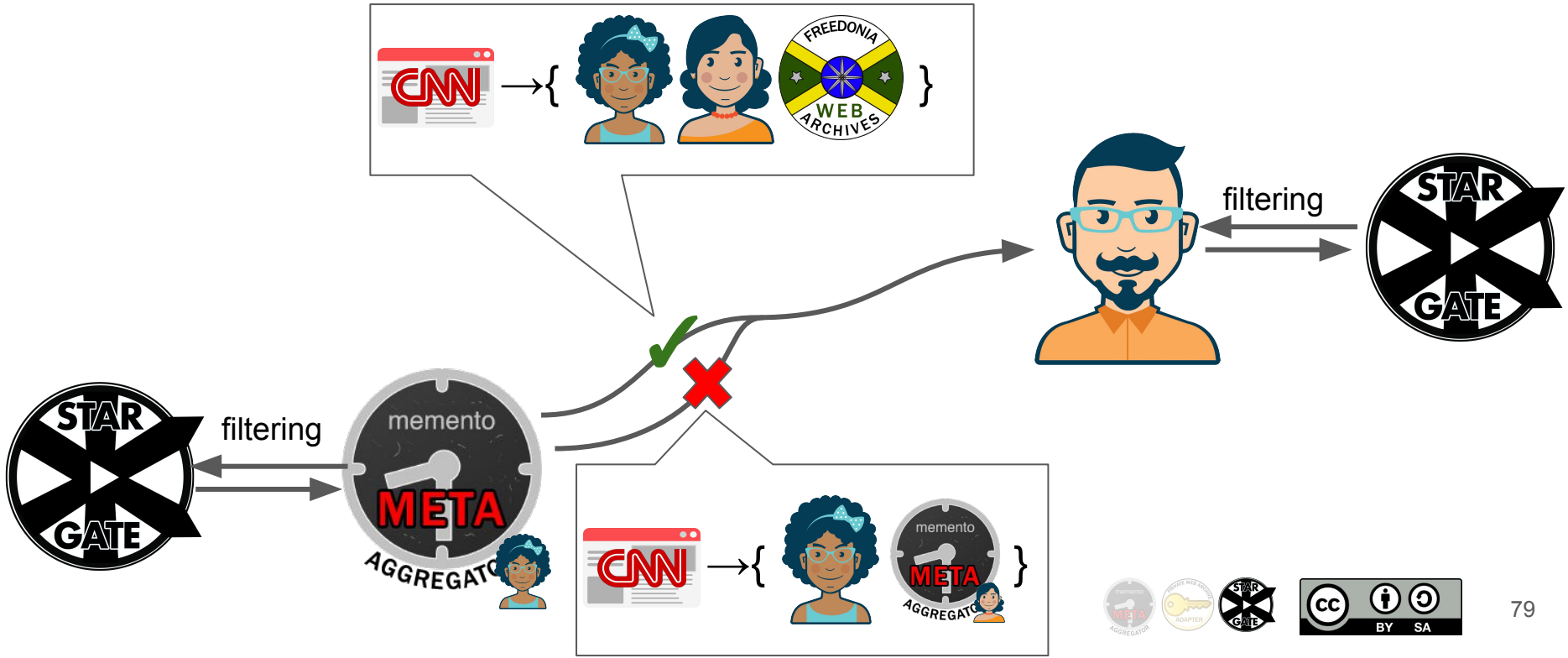


StarGate



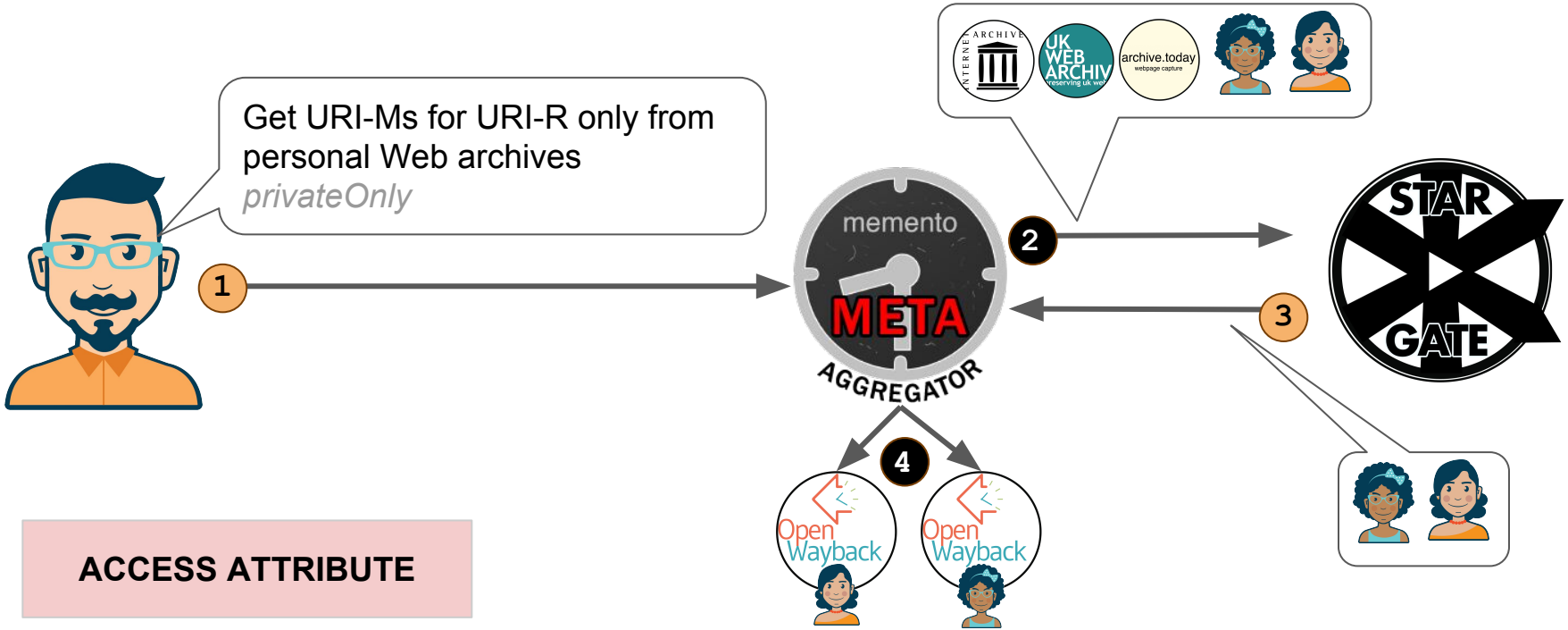
- Content negotiation in Web archives **beyond time**
- "Star" ~ wildcard (*) → **any** dimension of negotiation
- Allow for queries like: Only show me memento…
  - That are not redirects (*content-based attribute* HTTP Status ≠ 3XX)
  - Of a sufficient quality (*derived attribute* Memento Damage < 0.4)
  - Are from personal Web archives (*access attribute* indicate Facebook.com memento is not a login page)

Implicit Filtering via MMA or Directly (a la TG)



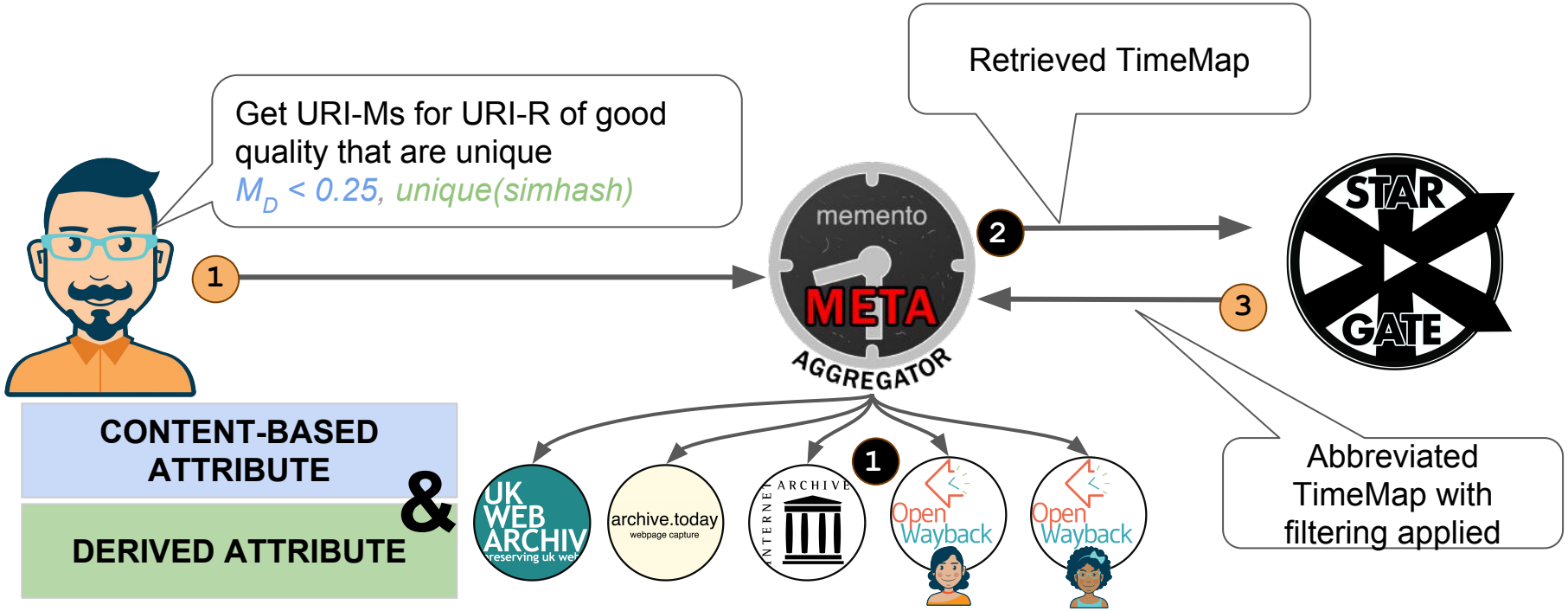
Negotiation in the Privacy Dimension

(via short circuiting)



Negotiation on Content-Based or Derived Attributes

(with response filtering)



Future Work and Conclusions

- **Aggregation with private web archives**
- **Client-side archive specification**
- ***TimeMap Caching Ramifications***

- **Authentication layer to systematically interface with private Web archives**
- ***Password-less approaches***

- **Archival negotiation in dimensions beyond time**
- ***Time/Space Complexity***
- ***Elegance of Expression***

Ongoing Research Supported By...

- NEH grant #HK-50181-14
- IMLS grant #RE-33-16-0107
- SIGIR Travel Grant

Some artwork based on Agata Krych
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A Framework for Aggregating Private and Public Web Archives

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Joint Conference on Digital Libraries (JCDL)
June 5, 2018, Fort Worth, TX

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JCDL 2018 Ft. Worth, Texas

SIGIR Special Interest Group on Information Retrieval