Add Synchronization to HTTP: Braid-HTTP

Michael Toomim
Invisible College and Braid.org
IETF 118, Prague
HTTP was designed for Static Pages

1993

HTTP

HTML

HTML

2
Welcome to NCSA Mosaic, an Internet information browser and MOSAIC was developed at the National Center for Supercomputer University of Illinois in Urbana-Champaign. NCSA Mosaic: The Board of Trustees of the University of Illinois (UI), at UI.

Jan '97

The Software Development Group at NCSA has worked on NCSA Mosaic, and we've learned a lot in the process. We are honored that this technology to the masses and appreciated all the support received in return. However, the time has come for us to cut resources in other areas of interest and development on Mosaic.

All information about the Mosaic project is available from:

NCSA Mosaic Platforms:
- NCSA Mosaic for the X Window System
- NCSA Mosaic for the Apple Macintosh
- NCSA Mosaic for Microsoft Windows

World Wide Web Resources: The following resources are available:
- A glossary of World Wide Web terms, and acronyms
- A directory of World Wide Web servers

The World Wide Web project

World Wide Web

World Wide Web

World Wide Web

World Wide Web

World Wide Web

World Wide Web

World Wide Web

World Wide Web

World Wide Web

World Wide Web
2017
Change happens
Change happens

HTTP Websites

Client

HTTP

Server

MVC Framework

Database

Views
Controllers
Models
Database
Change happens

HTTP Websites

Client

Server

jQuery

Javascript

XMLHttpRequest

MVC Framework

Database
Change happens

jQuery

React
MVC Framework
Javascript
XMLHttpRequest
Websocket
MVC Framework
Database

HTTP Websites

Webpage DOM
HTML Template Views
Javascript Models
Views
Controllers
Models
Database
This is why web programming sucks

jQuery
MVC Framework
Javascript
XMLHttpRequest
Webpack
babel
quick start
nodejs
css
postgres
mongo

HTTP Websites
Webpage DOM
HTML Template Views
Javascript Models
Views
Controllers
Models
Database
Time for Web Standards to Evolve

from: REpresentational State Transfer
to: REpresentational State Synchronization

from: HyperText Transfer Protocol
to: State Synchronization Protocol
State Synchronization starts simple

• "Send state X to Alice"

But evolves into more:

• **Collaboration:** Multiple editors over the network
• **Performance:** Realtime updates, pushed, delta-compressed, pub/sub
• **Reliability:** Consistent vs. race conditions & machine failures
• **Decentralization:** New network topologies, offline peers
• **Versioning:** History, archiving, rewinding & playback
We have a well-characterized solution

Multiple writers can make simultaneous edits arbitrarily, across any network delay or drop, on any network topology, to any content-type, while guaranteeing consistency across peers.

- CDNs can cache dynamic state
- Every site has offline mode
- All edits are delta-compressed
- Resumeable uploads for free
- Collaborative editing for free
- Program remote state as local variable

Proven with multiple implementations: braid.org
It works!

This is live updating over Braid-HTTP! These are what the messages look like.

YES! Nice. ^(-v-)^ =)
HTTP is almost there already:

- Subscriptions: PREP, Mercure
- Distributed State Sync: CRDT, OT
- Range Updates: Resumeable Uploads, Byte-Range-Patch

HTTP is almost there already.
Four improvements fit together

**Subscriptions to Updates**

- Stream multiple responses as snapshot or patch
- Resume from a version

**Versioning**

- GET/PUT/POST/PATCH of version(s)
- Causal time (not linear)
- Interoperate with strings (e.g. RLE, vector clocks, dates)

**Patches**

- Bidirectional (client<->server)
- Reusable on Content & Merge Types
- Improved Content-Range:
  - Indefinite content length
  - Non-integer range units
- Multiple patches per update

**Merge-Type**
Proposal for Discussion

Adopt **State Synchronization** as goal for HTTP

**Scope:** Combine work on *Ranged Updates* (Resumeable Uploads, Byte-Range-Patch, Content-Offset) with *Subscriptions*, *Versioning*, and *Merge-Type* to support Distributed State Sync

See Braid-HTTP as example, well-tested implementation