# Add Synchronization to HTTP: Braid-HTTP

Michael Toomim Invisible College and Braid.org IETF 118, Prague

## HTTP was designed for Static Pages

## HTTP

ŀ



1993

HTML





2



VoridWideWeb		The World Wide Web project			
NCS & Mospie for MS Mindows		7:43 -			
File Edit Options Navigate Hotlist Annotate		World Wide Web			
	The WorldWideWeb (W3) is a wide-area <u>hypermedia</u> information retrieval initiative aiming to give universal access to a large universe of documents.				
Document URL: http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/NCSAMosaicHome.html		Everything there is online about W3 is linked directly or indirectly to this document, including an <u>executive</u> summary of the project, Mailing lists, Policy, November's W3 news, Frequently Asked Questions.			
		What's out there? Pointers to the world's online information, subjects, W3 servers, etc.			
N C		Help on the browser you are using			
MOSAIC XWindow System • Microsoft Windows • Macintosh		Software Products A list of W3 project components and their current state. (e.g. Line Mode ,X11 Viola , NeXTStep , Servers , Tools , Mail robot ,Library )			
		Technical Details of protocols, formats, program internals etc			
		Bibliography Paper documentation on W3 and references.			
		People A list of some people involved in the project.			
		History A summary of the history of the project.			
		How can I help ? If you would like to support the web			
		Getting tode by anonymous PTP, etc.			
Welcome to NCSA Mosaic, an Internet information browser and					
University of Illinois in> Urbana-Champaign. NCSA Mosaic	1	<header></header>			
The Board of Trustees of the University of Illinois (UI), an UI. Jan '97 The Software Development Group at NCSA has worked on NCSA Mo and we've learned a lot in the process. We are honored that this technology to the masses and appreciated all the suppor received in return. However, the time has come for us to con resources in other areas of interest and development on Mose		<pre>2 <title>The World Wide Web project</title></pre>			
		READER</td			
		<boda></boda>			
		6 <h1>World Wide Web</h1> The WorldWideWeb			
		NAME=0 HREF="WhatIs.html">			
		All information about the Mosaic project is available from :	8	hypermedia information retrieval	
NCSA Mosaic Platforms:	9	initiative aiming to give universal			
<ul> <li>NCSA Mosaic for the X Window System</li> <li>NCSA Mosaic for the Apple Macintosh</li> <li>NCSA Mosaic for Microsoft Windows</li> </ul>	10	access to a large universe of documents.			
	11	Everything there is online about			
	12	W3 is linked directly or indirectly			
World Wide Web Resources The following resources are available		to this document, including an $$			
• A glocosmy of World Wide Web terms and acronyme	14	NAME=24 HREE="Summary.html">executive			



Copyright © 1998 Google Inc.



- Arts - Humanities, Photography, Architecture, ...
- Business and Economy [Xtra!] - Directory, Investments, Classifieds, ...
- Computers and Internet [Xtra!] - Internet, WWW, Software, Multimedia, ...
- Education - Universities, K-12, Courses, ...
- Entertainment [Xtra!] - TV, Movies, Music, Magazines, ...
- Government - Politics [Xtra!], Agencies, Law, Military, ...
- Health [Xtra!] - Medicine, Drugs, Diseases, Fitness, ...
- News [Xtra!] - World [Xtra!], Daily, Current Events, ...

## 1998



Download free demo versions of AltaVista Technology software



[Creative][Search][Humor][Email]







oomim@gmail.c				
🕁 🔿 🗆 🗄				
ayla				
F Widget library, Invisible	olleg ×			05 toomim
Secure https://ww	.figma.com/file/lgEcb11kGzWi9gXd9	qugKlt0/Widget-library%2C-Invisible	-College-Projects?node	-id=6%3A2 🟠
<b>#</b> - □- Ø	Criteeseburger merapy	: S 🚸 🔍 🍡 🖽		Share @ 71
Air / Mini Elipse	Tawk.space		"Statebus where you	= + =  <del>  </del> ++
Ellipse of	Considerit		subgroup forked gro	X Mixed Y Mb
Intersect	News		Maybe the are just su of the invi	- 0* 0 p
Intersect	Say something Donald Trump plays poker; to	umps opponents	college, th filter the p	CONSTRAINTS
Intersect	<ul> <li>Michelangelo found on moo</li> <li>Alphabet soup linked to cand</li> </ul>	r; Mars denies.	top.	Left Top
Intersect	<ul> <li>Supercaliflour – a fragilistic</li> <li>Never would I ever float a</li> </ul>	a boogie oogie bever	#2.	
Intersect	Five men eat six thin Something ugly happened to	someone funny.	206 206	Dasa Through
Say something	<ul> <li>Buzzfeed linked to cancer. S</li> <li>Inations have convened today</li> <li>samples of a bureaucracy th</li> </ul>	cientists from 80 analyze ev call "cancer."	-A-	(raas moog)
Rectangle 3	429.26 x 353.82	ey ean eaneen		TEXT
Group	Bitcoin reaches parity with US To	vinkie Sfre entre	······	Mixed
Group	Reddit found on mars. Facebook	found envious.	6	Mixed ~
Group	Sometimes it's better just not to Bitcoin reaches parity with US To	vinkie Sojust don't.		A] 100%
Group	Reddit found on mars. Facebook	found envious.		1 0 mr +=







### MVC Framework

Database





### jQuery

## Javascript Javascript ( XMLHttpRequest

MVC Framework

Database



### React MVC Framework jQuery Javascript <sup>Cli</sup> XMLHttpRequest <sup>HI</sup> Websocket

MVC Framewdrk

Database



# MVC Framework jQuery Javascri babel

- XMLHttp
- Websocl
- MVC Fra
- Databas



CSS

## Time for Web Standards to Evolve

### from: REpresentational State Transfer REpresentational State Synchronization to:

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 13

## 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

Proven with multiple implementations: braid.org

Program remote state as local variable





## 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