RTCWEB Architecture Open Issues

Interim Meeting; February 2012

Eric Rescorla

ekr@rtfm.com

Overview

- Security architecture document adopted after Taipei
  - `draft-ietf-rtcweb-security-arch-00`
- General agreement on a lot of issues
- Purpose of the next 30 min
  - Survey the open issues
  - Resolve any that are easy

Issue: Mixed Content

- Consent is granted by origin
- What about active mixed content?
  - `https://www.example.com/` loads script from `http://www.example.com`
  - What are the PeerConnection permissions
- Current draft says: treat page as the HTTP origin
  - Browser security experts: **“NOOOOO!!!!!!!!”**

How Browsers Handle Active Mixed Content Now

Browser	Action
Chrome	Allow with warning – (soon to be block)
Firefox	Big warning dialog
IE	Block
Safari	Accept

Proposed Resolution

- MUST treat HTTP and HTTPS origins as separate [uncontroversial]
- SHOULD * either:
  - Forbid all active mixed content [better, but out of scope]
  - Remove RTCWEB permissions for origins with mixed content
- Comments?

*Should this be a MUST?

Issue: Consent Freshness/Keepalives

- Problem: How to verify continuing consent?
  - Need some sort of keepalive
  - ICE keepalives are STUN Binding Indications (one-way)
- Proposal: use STUN Binding Requests instead
  - MUST check no less often than every 30s
- Comments?

Issue: Media Security Requirements

- DTLS/DTLS-SRTP provides the best security
  - Can detect MITM with fingerprint checks (though inconvenient)
  - Strong authentication when used with third-party IdP
- Demand for SDES, RTP, or both
  - Mostly in terms of interop with legacy systems w/o media gatewaying
  - Concerns about bid-down attacks, UI confusion, etc.

Interaction with Server-based features

- End-to-end security requires denying the server direct media access
  - Via MediaStream APIs [See Randell ~~JSEP~~Jesup's slides]
  - This precludes many fancy video applications
- Need for two security models

  Browser-to-browser secure. Limited effects but JS can't access media at all

  Javascript-visible. Powerful effects but need to trust JS

  - This should be under control of the JavaScript but with a UI indicator
- End-to-end crypto still adds value in server-visible model
  - Protection against programmer error (excess logging, XSS, etc.)
  - Malicious activity more readily detectable

Interop Deployment Questions

- Everyone supports RTP
  - But obviously security is... bad
- Most *current* implementations support SDES
  - Unclear (at least to me) how many deployments support it
- Decision proposal:
  - Need RTP if not much SDES deployment
  - If a lot of SDES deployment, not much need for RTP

Communications Security: Implementation Requirements (Proposed)

- MUST implement DTLS-SRTP (for media) and DTLS (for data)
- MAY implement RTP(?) and SDES(?)
- Security MUST be default state
  - Implementations MUST offer DTLS and/or DTLS-SRTP for every channel
  - MUST accept DTLS and/or DTLS-SRTP whenever offered
  - MUST not do unencrypted data channel

RTCWEB Generic Identity Service

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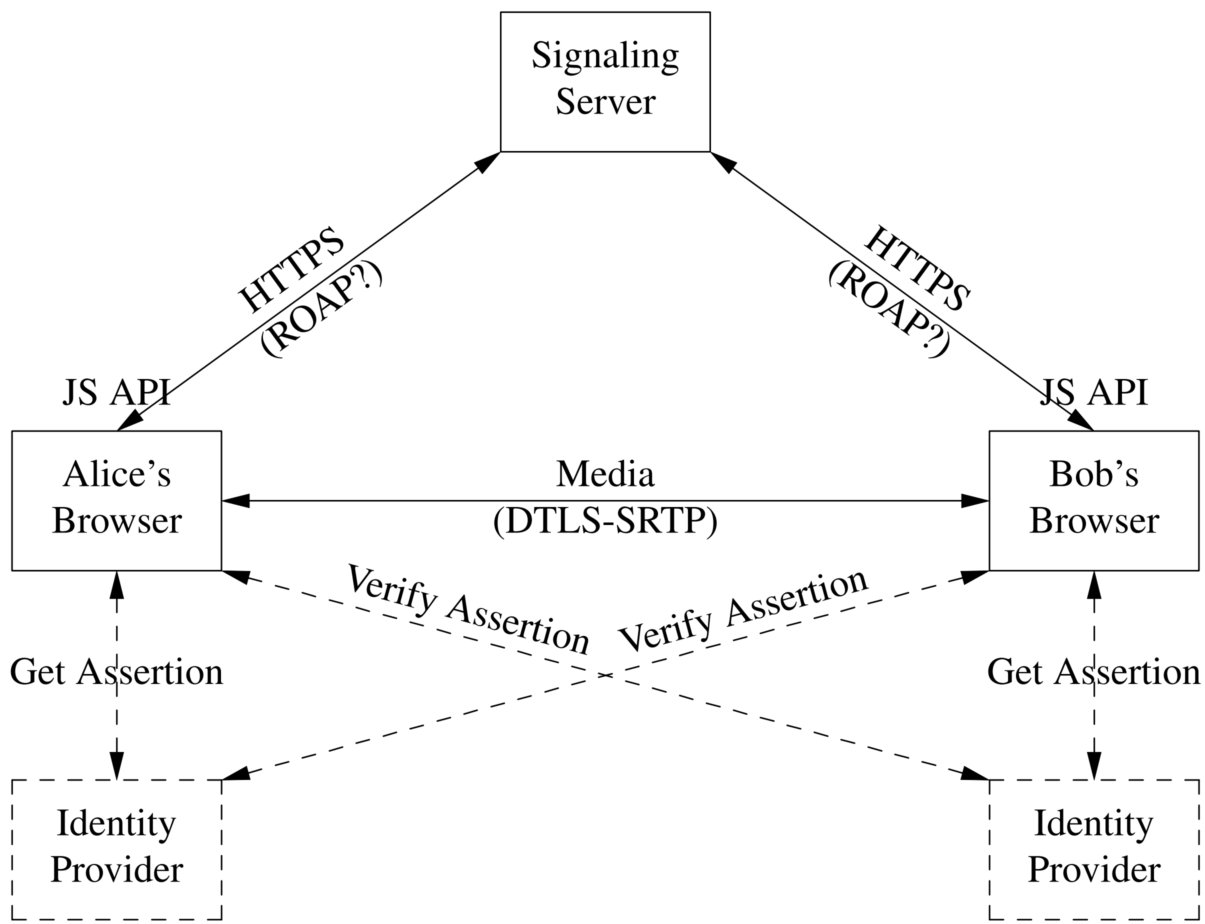
ekr@rtfm.com

What are we trying to accomplish?

- Allow Alice and Bob to have a secure call
  - Authenticated with their identity providers
  - On any site
    - Even untrusted/partially trusted ones
- Advantages
  - Use one identity on any calling site
  - Security against active attack by calling site
  - Support for federated cases

Topology


Signaling Server
HTTPS (ROAP?)
HTTPS (ROAP?)
JS API
JS API
Alice's Browser
Media (DTLS-SRTP)
Bob's Browser
Verify Assertion
Verify Assertion
Get Assertion
Get Assertion
Identity Provider
Identity Provider

Terminology

Authenticating Party (AP): The entity which is trying to establish its identity.

Identity Provider (IdP): The entity which is vouching for the AP's identity.

Relying Party (RP): The entity which is trying to verify the AP's identity.

Types of IdP

Authoritative: Attests for identities within their own namespace

- Often multiple Authoritatives IdPs exist with different scopes
- Examples: DNSSEC, RFC 4474, Facebook Connect (for the Facebook ID)

Third-party: Attests for identities in a name-space they don't control

- Often multiple Third-Party IdPs share the same space
- Can attest to real-world identities
- Examples: SSL/TLS certificates, the State of California (driver's licenses)

Authoritative vs. Third-Party IdPs: Trust Relationship

- No need to explicitly trust authoritative IdPs
  - `ekr@example.com` is whoever `example.com` says it is
  - The problem is authenticating `example.com`
- Third-party IdPs need to be explicitly trusted
  - Example: how do I know GoDaddy is a legitimate CA?
  - Answer: the browser manufacturer vetted them
  - They are allowed to attest to *any* domain name

User Relationships with IdPs

- Authenticating Party
  - Has some account with the IdP
  - May have established their identity
    - Especially for third-party IdPs
  - Can authenticate to the IdP in the future (e.g., with a password)
- Relying party
  - Doesn't have any account relationship with the IdP*
  - Must be able to verify the IdP's identity
  - Needs to trust third-party IdPs

*Note: privacy issues.

Web-based IdP Systems

- Facebook Connect
- Google login
- OAuth
- OpenID
- BrowserID

Web-based IdP Objectives: User Perspective

- Single-sign on
  - No need to make a new account for each service
  - Don't need to remember lots of passwords
- Privacy
  - Avoid creating a super-cookie
    - Only authenticate to sites I have approved
    - Control exposure of my personal information

Web-based IdP Objectives: Site Perspective

- Low friction
  - Avoid the need for account creation
  - ... the source of a lot of user rolloff
- Leverage existing user information
  - E.g., information you've stored in your FB account

Example: Facebook Connect (sorta OAuth)

- AP is a user with a Facebook account
  - They may or may not be logged in at the moment
  - (Where *logged in* == cookies)
- RP is a Web server
  - Idea is to bootstrap Facebook authentication
  - ... rather than have your own account system
  - RP registers with Facebook and gets an application key
    - Facebook wants to control authentication experience

Facebook Connect Call Flow (not logged in) 1

Alice | RP `www.example.com` | Facebook

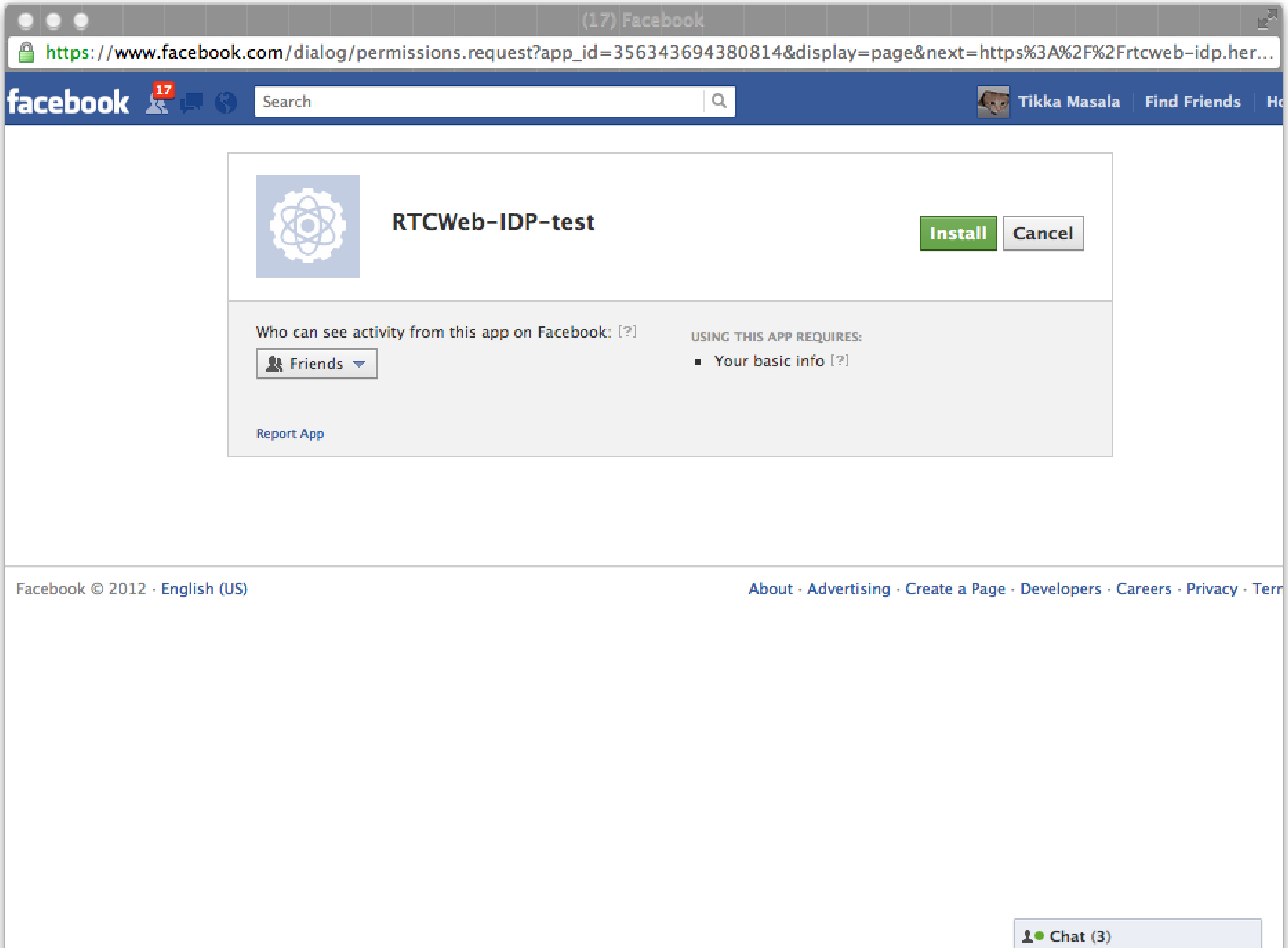
`GET /...`

Redirect to

`www.facebook.com/dialog/oauth?client_id=1234&redirect_uri=www.example.com/auth`

`GET /dialog/oauth?client_id=1234&redirect_uri=www.example.com/auth`

Login and permissions dialog


(17) Facebook
https://www.facebook.com/dialog/permissions.request?app_id=356343694380814&display=page&next=https%3A%2F%2Frtcweb-idp.her...
facebook
17
Search
Tikka Masala
Find Friends
RTCWeb-IDP-test
Install
Cancel
Who can see activity from this app on Facebook: [?]
Friends
USING THIS APP REQUIRES:
Your basic info [?]
Report App
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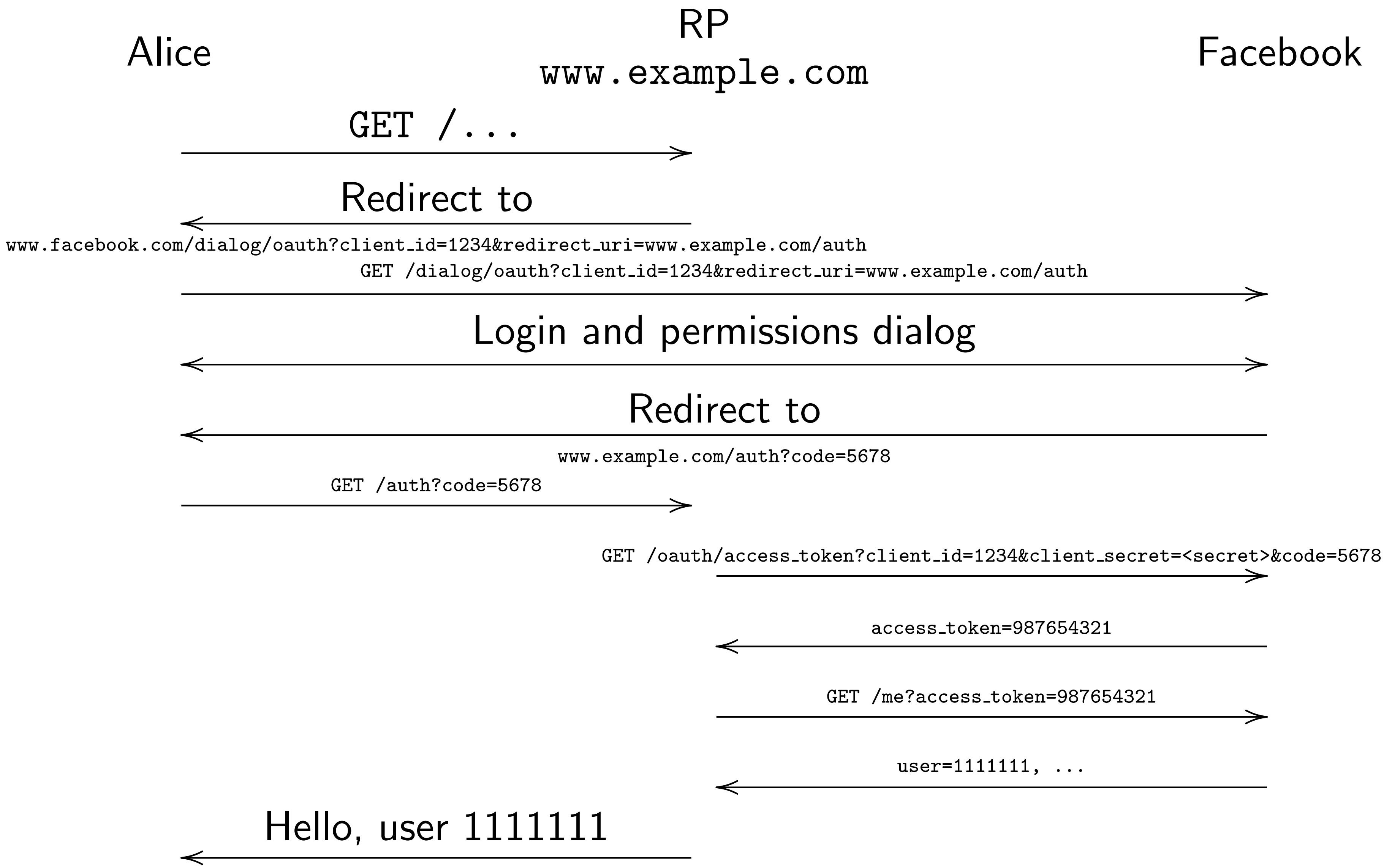
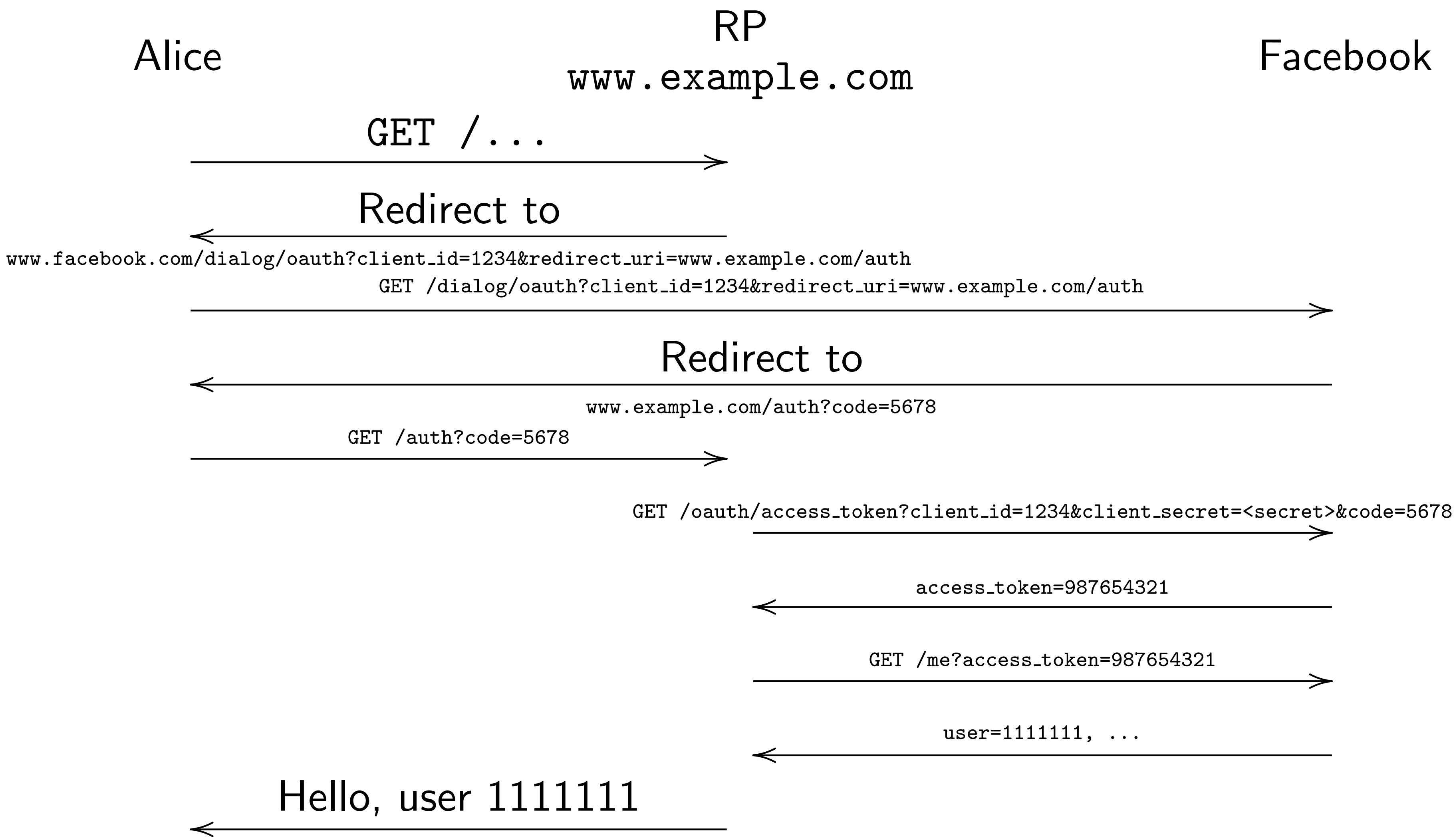
About · Advertising · Create a Page · Developers · Careers · Privacy
Chat (3)

Facebook Connect Call Flow (not logged in) 2



Facebook Connect Call Flow (logged in)



Facebook Connect Privacy Features

- RP needs to register with Facebook
- User approves policy separately for each RP
  - Including which user information to share
- Facebook learns about every authentication transaction
  - Including user/RP pair

Example: BrowserID

- Effectively client-side certificates
  - But user not exposed to certificates
- Why this example?
  - Easy to understand
  - Familiar-looking technology
  - Less need to wrap your head around redirects, etc.

BrowserID (no key pair)

Alice

RP
`www.example.com`

BrowserID.org

`GET /...`

`<script src="https://browserid.org/include.js"/>`

`navigator.id.get(function(assertion){...});`

[Generate Keys]

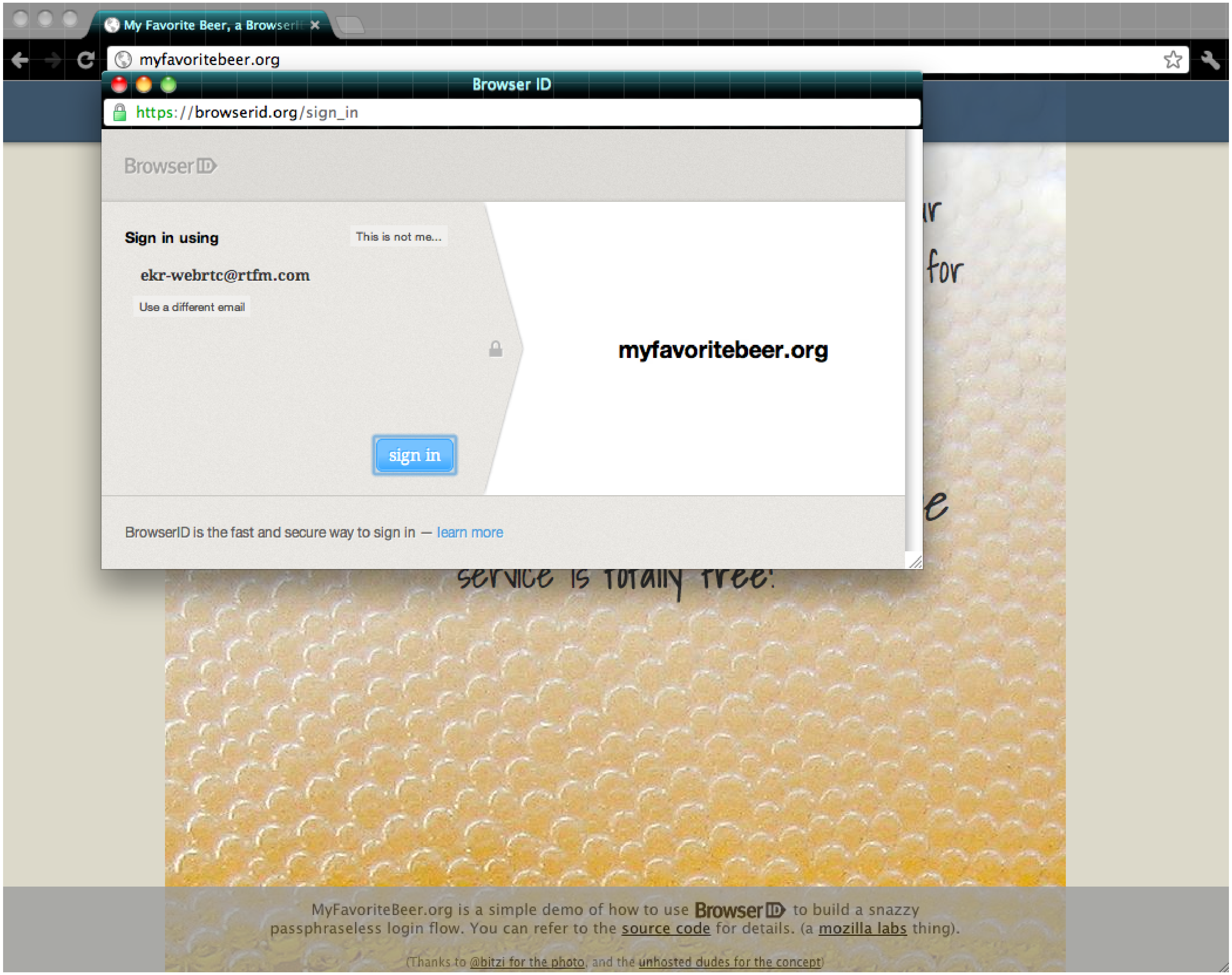
Get certificate + Cookie

Certificate

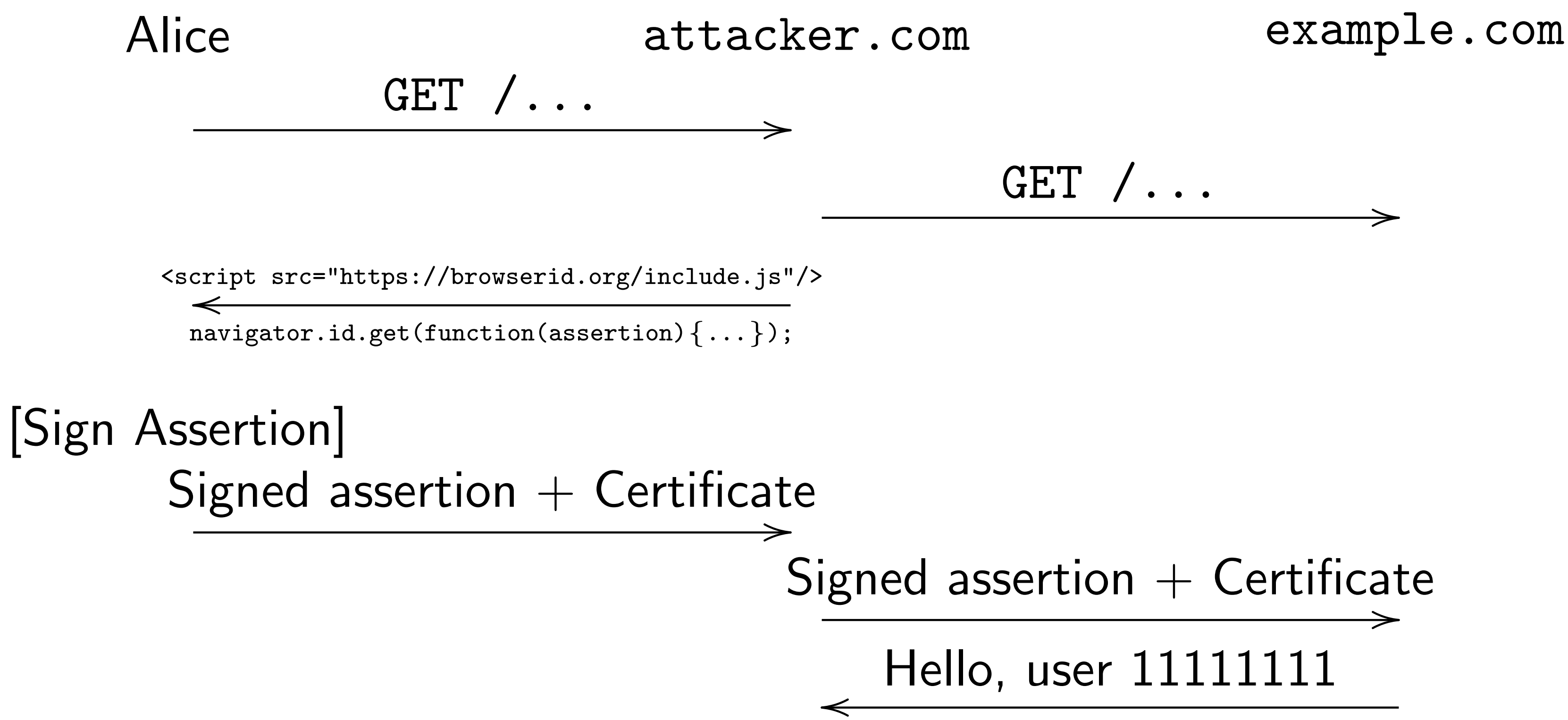
[Sign Assertion]

Signed assertion + Certificate

Hello, user 11111111


My Favorite Beer, a BrowserI
myfavoritebeer.org
Browser ID
https://browserid.org/sign_in
BrowserID
Sign in using
This is not me...
ekr-webrtc@rtfm.com
Use a different email
myfavoritebeer.org
sign in
BrowserID is the fast and secure way to sign in — learn more
service is totally free!
MyFavoriteBeer.org is a simple demo of how to use BrowserID to build a snazzy passphraseless login flow. You can refer to the source code for details. (a mozilla labs thing).
(Thanks to @bitzi for the photo, and the unhosted dudes for the concept)

BrowserID: Why no MITM Attacks?



BrowserID: Audience Parameter

Preventing assertion forwarding

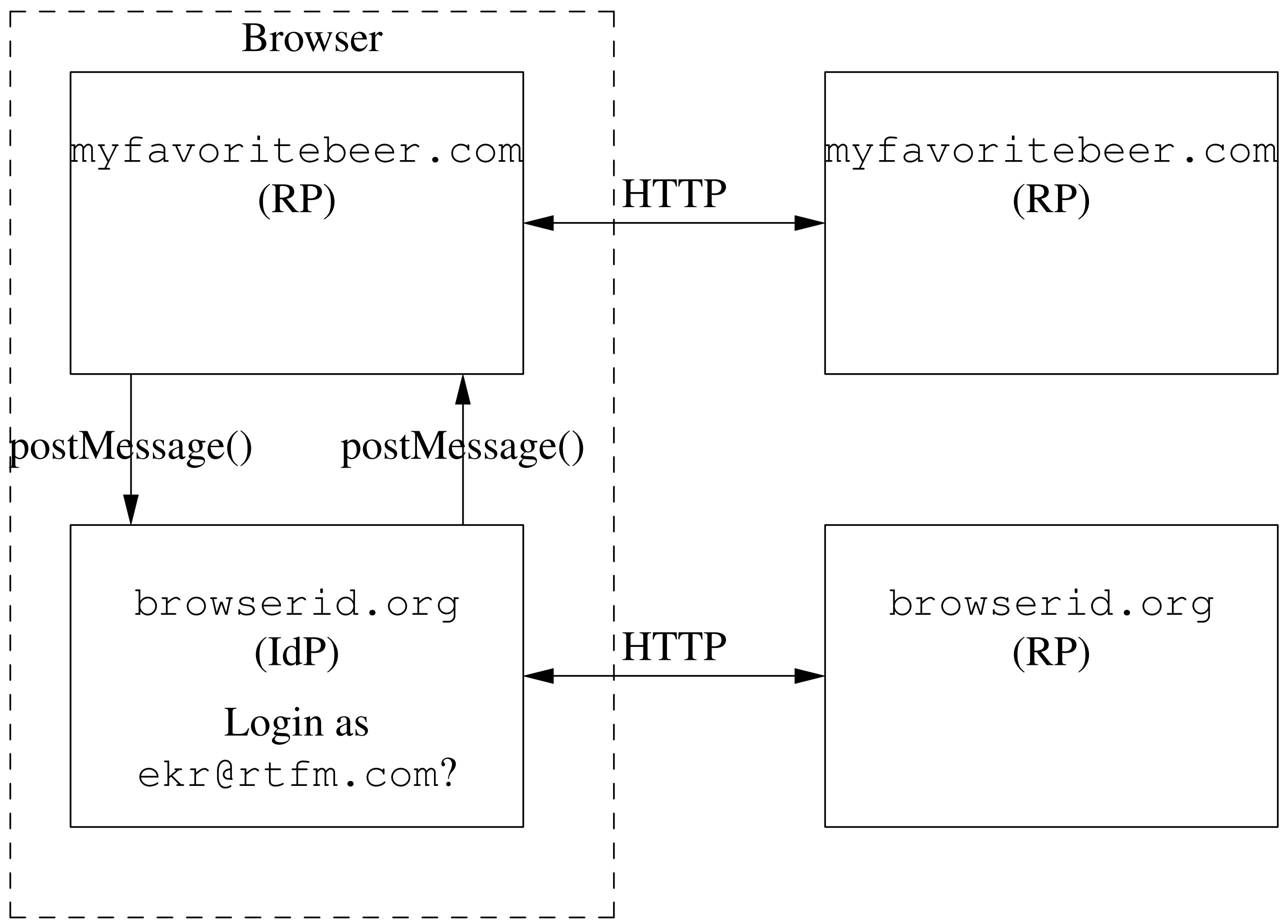
- BrowserID assertions are scoped to origin (audience parameter)
  - RPs check that the origin in the assertion matches their domain
  - This prevents assertion forwarding
- Why does this work?
  - BrowserID JS is part of the TCB
  - Browser enforces origin of requests from the calling site
  - RP transitively trusts origin/audience because it trusts BrowserID.org

Browser-ID Privacy Features

- Client generates a key pair
  - Idp signs a binding between key pair and user ID
- Client generates assertions based on key pair
  - Sends along certificate
- RP fetches IdP public key
  - This need only happen once
- IdP never learns where you are visiting
  - No relationship between RP and IdP

Example: BrowserID (existing key pair)

BrowserID Security Architecture



One browser, multiple security contexts

- Browser security data scoped by *origin*
  - `browserid.org` window and `myfavoritebeer.org` window are isolated
  - Each runs their own JS independently
- Security guarantees
  - Origin A can't touch origin B's data
  - Origin A can't see what origin B is displaying
  - Communication is by `postMessage()` (or navigation hack)

PostMessage: Sender

```
otherWindow.postMessage(message, targetOrigin);
```

`otherWindow`: the window to send the message to

`message`: the message to send

`targetOrigin`: the expected origin of the other window

Why do we need `targetOrigin`?

- Malicious pages can navigate other windows
  - This creates a race condition
- RP creates the new window to IdP with `w = createWindow()`
- Attacker navigates `w` to his own site
- RP does `w.postMessage(secret,...)`
- Attacker gets the secret
- `targetOrigin` stops this

PostMessage: receiver

```
window.addEventListener('message',
                        function(event) {
                          ...
                        });
```

- Event properties:

  `data`: the message passed by the sender

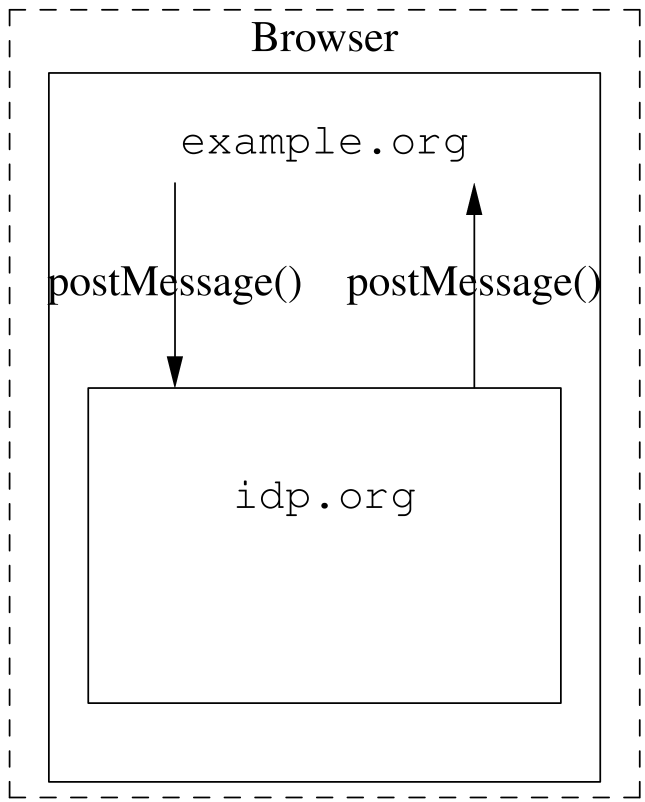
  `origin`: the sender's origin

  `source`: the sender's window

- Important: `origin` value can be trusted
  - Enforced by the browser
  - May not be the current origin of `source`, however

IFRAMEs

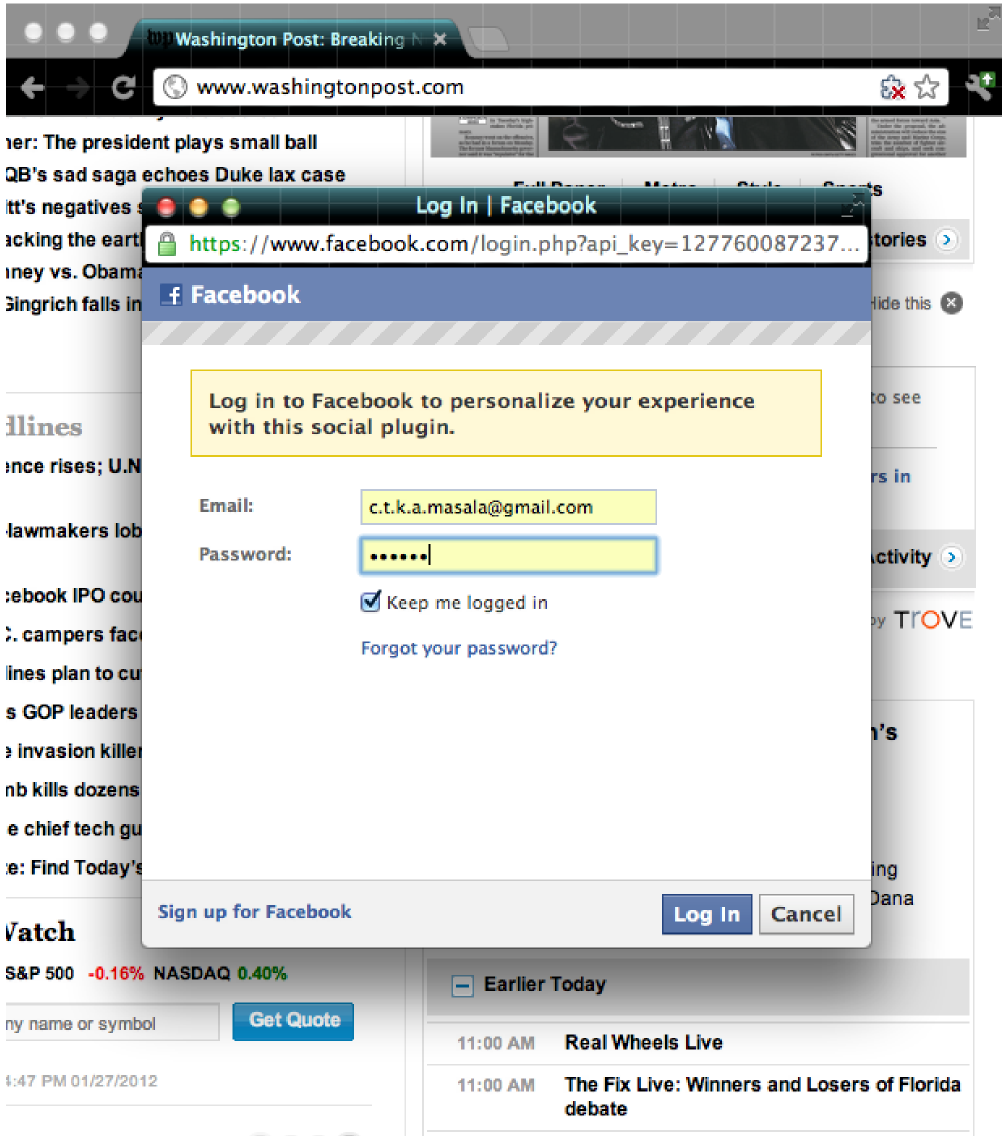
- What if I don't want another window to open?
  - Solution: IFRAMEs



IFRAME Security Properties

- Isolated from the main page
  - More or less the same rules as a separate window
- Can be easily navigated by the main page
- Can be invisible (both good and bad)

Logins generally done in separate windows



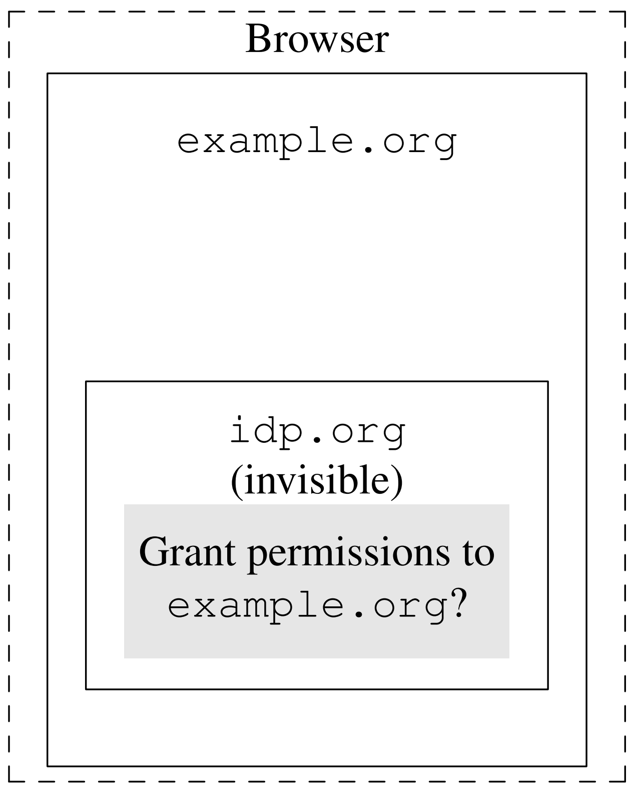
Why aren't logins done in IFRAMEs?

- Scenario: you are on `example.org`
  - `example.org` wants to log you in with `idp.org`
- Both Facebook Connect and BrowserID use a separate window
- Why?
  - IdP is soliciting the user's password
  - User needs to know they are using the right IdP
  - A separate window means they can examine the URL bar
  - Also concerns about clickjacking/redressing
- Other option is to navigate the entire page to an interstitial page

How Clickjacking Works

- Attacker embeds the victim site's page in an IFRAME
  - IFRAME is in front but marked transparent
  - The attacker's page shows through
- Attacker gets the victim to click on "his" page
  - Really the victim site's page
- Victim has just taken action on the victim site

IFRAMEs, Clickjacking, and Permissions Grants



Real frame hierarchy

What the user sees

Preventing Framing

- IdP policy is to have the login page be top-level
  - Good RPs comply with this policy
  - But we're concerned about malicious RPs
- IdPs use "framebusting" JavaScript to prevent being framed
  - This is harder than it sounds
  - ... but standard procedure

IFRAMEs don't have to be visible

```
idp = document.createElement('IFRAME');
$(idp).hide();
```

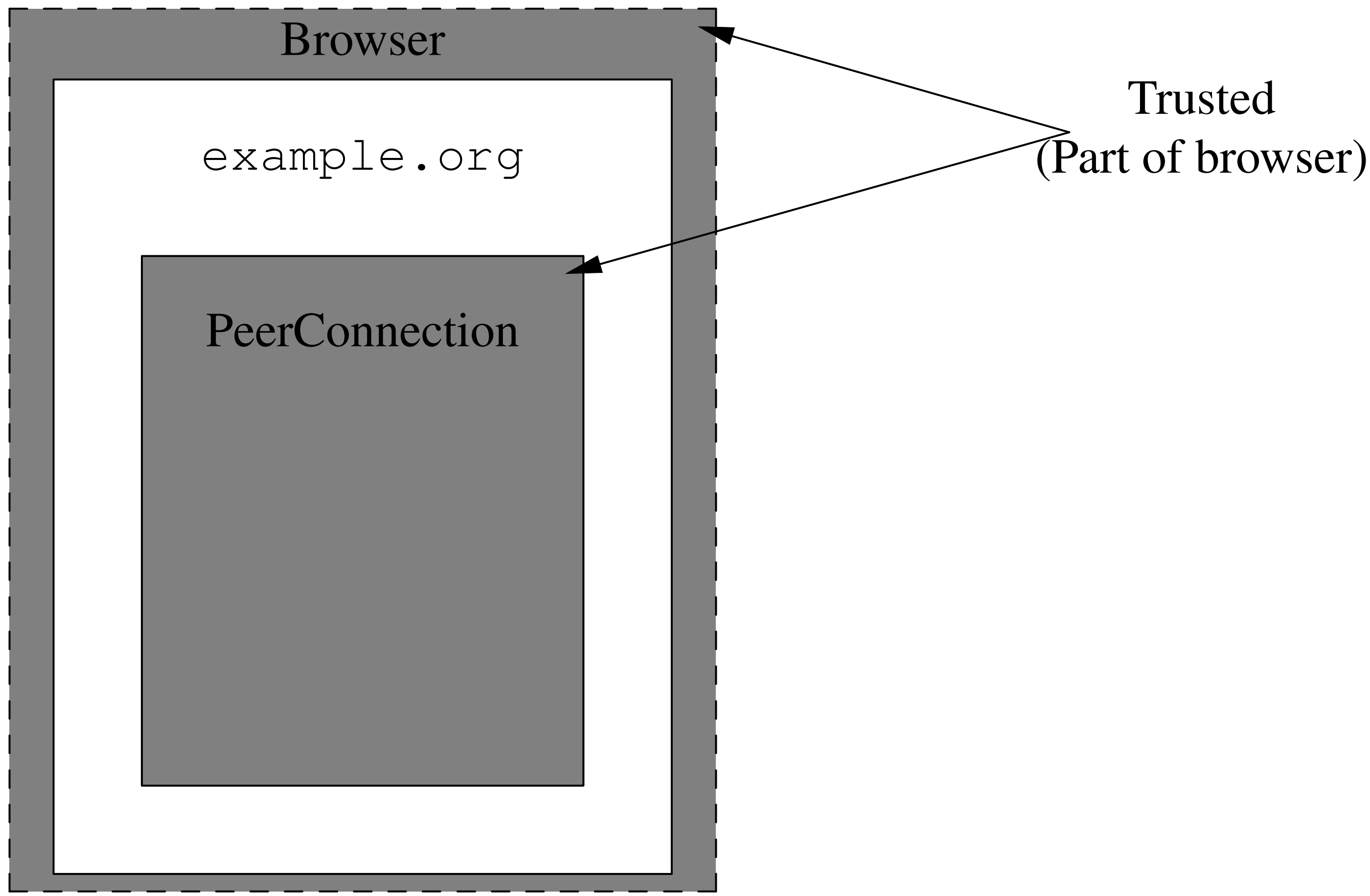
- This takes up no space on the screen
  - It's just JS from the IFRAME source running on the page
  - Can still `postMessage()` to and from it
- Invisible IFRAMEs are a very important tool

What are we trying to accomplish?

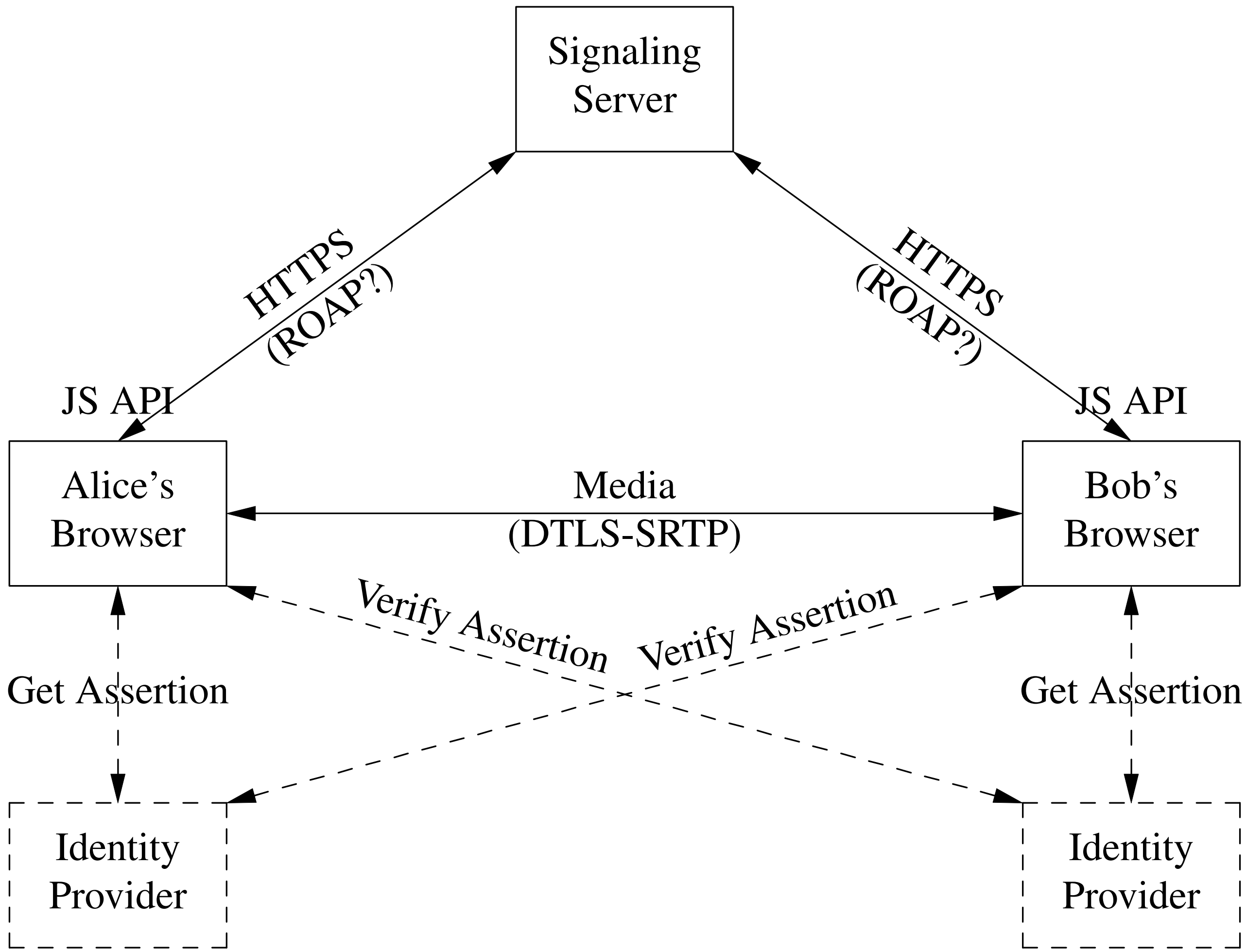
- Repurpose existing identity infrastructure for user-to-user authentication

- Requirements/objectives
  - Use existing accounts
  - Minimal (preferably no) changes to IdP
  - Easy to support at calling site
    * Better if no change
  - Generic support in browser
    * Single downward interface between PeerConnection object and IdP
    * Should be able to support new IdPs/protocols without changing browser

Reminder: Trust Architecture



Example IdP Interaction: BrowserID



Example ROAP Offer with BrowserID

```
{
  "messageType":"OFFER",
  "callerSessionId":"13456789ABCDEF",
  "seq": 1
  "sdp":"
  ...
a=fingerprint: SHA-1 \
4A:AD:B9:B1:3F:82:18:3B:54:02:12:DF:3E:5D:49:6B:19:E5:7C:AB\n",
 "identity":{
      "idp":{     // Standardized
         "domain":"browserid.org",
         "method":"default"
      },
      "assertion":   // Contents are browserid-specific
        "\"assertion\": {
          \"digest\":\"<hash of the contents from the browser>\",
          \"audience\": \"[TBD]\"
          \"valid-until\": 1308859352261,
         },
         \"certificate\": {
           \"email\": \"rescorla@example.org\",
           \"public-key\": \"<ekrs-public-key>\",
           \"valid-until\": 1308860561861,
         }" // certificate is signed by example.org
      }
}
```

Example JSEP TransportInfo with Facebook Connect (Or any private identity service)


```
{
       "pwd":"asd88fgpdd777uzjYhagZg",
       "ufrag":"8hhy",
       "fingerprint":{
          "algorithm":"sha-1",
          "value":"4AADB9B13F82183B540212DF3E5D496B19E57CAB",
       },
       "candidates:[
         ...
       ],
       "identity":{
         "idp":{
            "domain": "example.org"
            "protocol": "bogus"
          },
          "assertion":\"{\"identity\":\"bob@example.org\",
                        \"contents\":\"abcdefghijklmnopqrstuvwyz\",
                        \"signature\":\"010203040506\"}"
       }
}
```


* Assumption here is that we have changed JSEP to emit transport-infos

But we want it to be generic...

- This means defined interfaces
- ... that work for any IdP

What needs to be defined

- Information from the signaling message that is authenticated [IETF]
  - Minimally: DTLS-SRTP fingerprint
  - Generic carrier for identity assertion
  - Depends on signaling protocol
- Interface from PeerConnection to the IdP [IETF]
  - A specific set of messages to exchange
  - Sent via `postMessage()` or WebIntents
- JavaScript calling interfaces to PeerConnection [W3C]
  - Specify the IdP
  - Interrogate the connection identity information

What needs to be tied to user identity?

- Only data which is verifiably bound is trustworthy
  - Need to assume attacker has modified anything else
- Initial analysis (depends on protocol)
  - Fingerprint (MUST)
  - ICE candidates
  - Media parameters

Security Properties of ICE Candidates

- Effect of modifying ICE candidates
  - Advertise candidates to route media through attacker
    * Makes a MITM attack easier
    * Mostly irrelevant if DTLS keying used
  - Route to `/dev/null` (DoS)
    * Silly if you are in signaling path!
- Signaling service can affect ICE candidates anyway
  - Provide a malicious TURN server
  - Return blackhole server reflexive addresses
  - This drives data through signaling service

Security Properties of Media Parameters

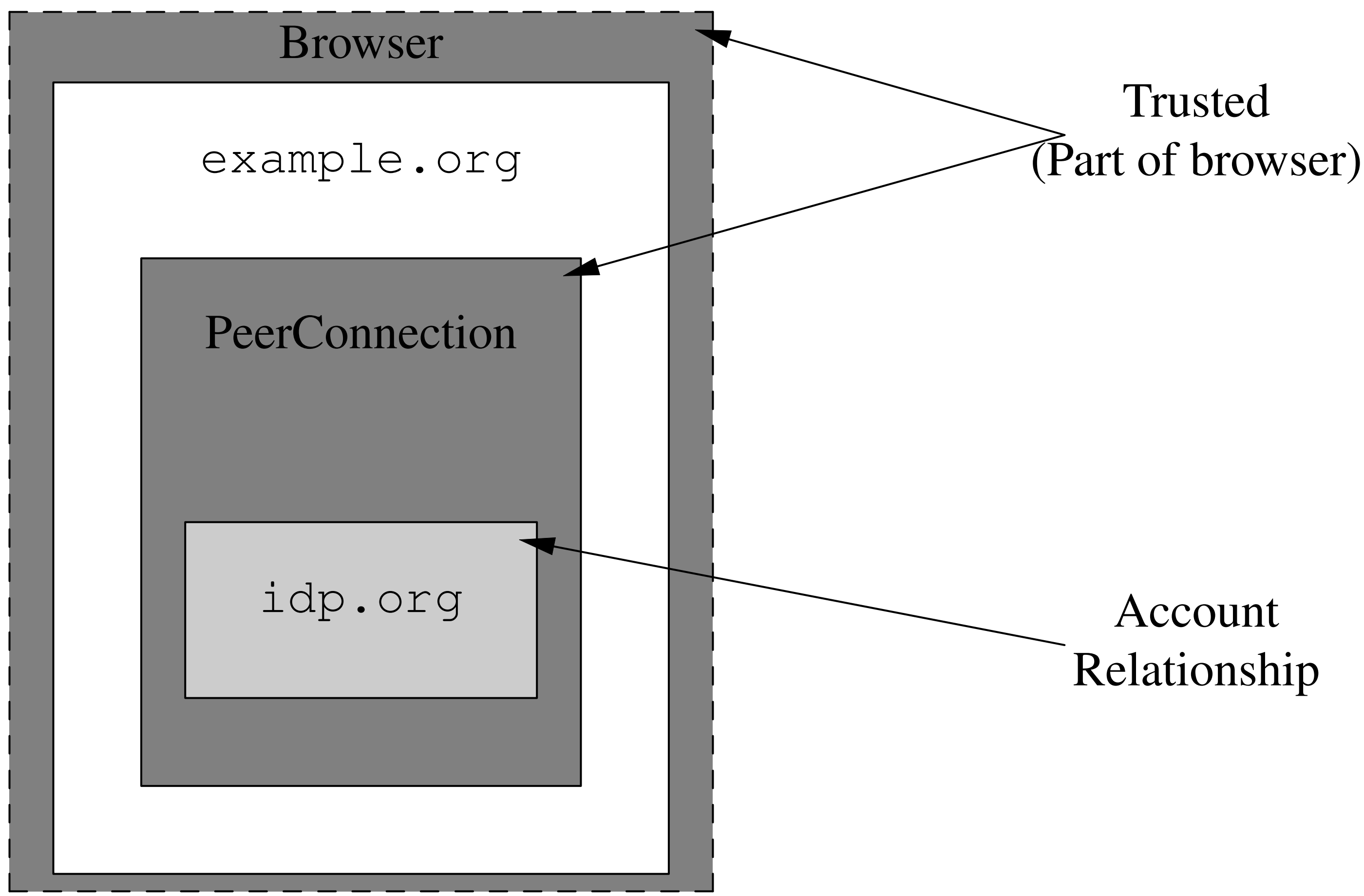
- Which media flows
  - Calling service has control of this anyway
  - But the UI needs to show what is being used
    * For consent reasons
- Which codecs
  - Calling service can influence these
  - Might be nice to secure them
  - But too limiting
  - SRTP should provide security regardless of codec selection

Generic Structure for Identity Assertions

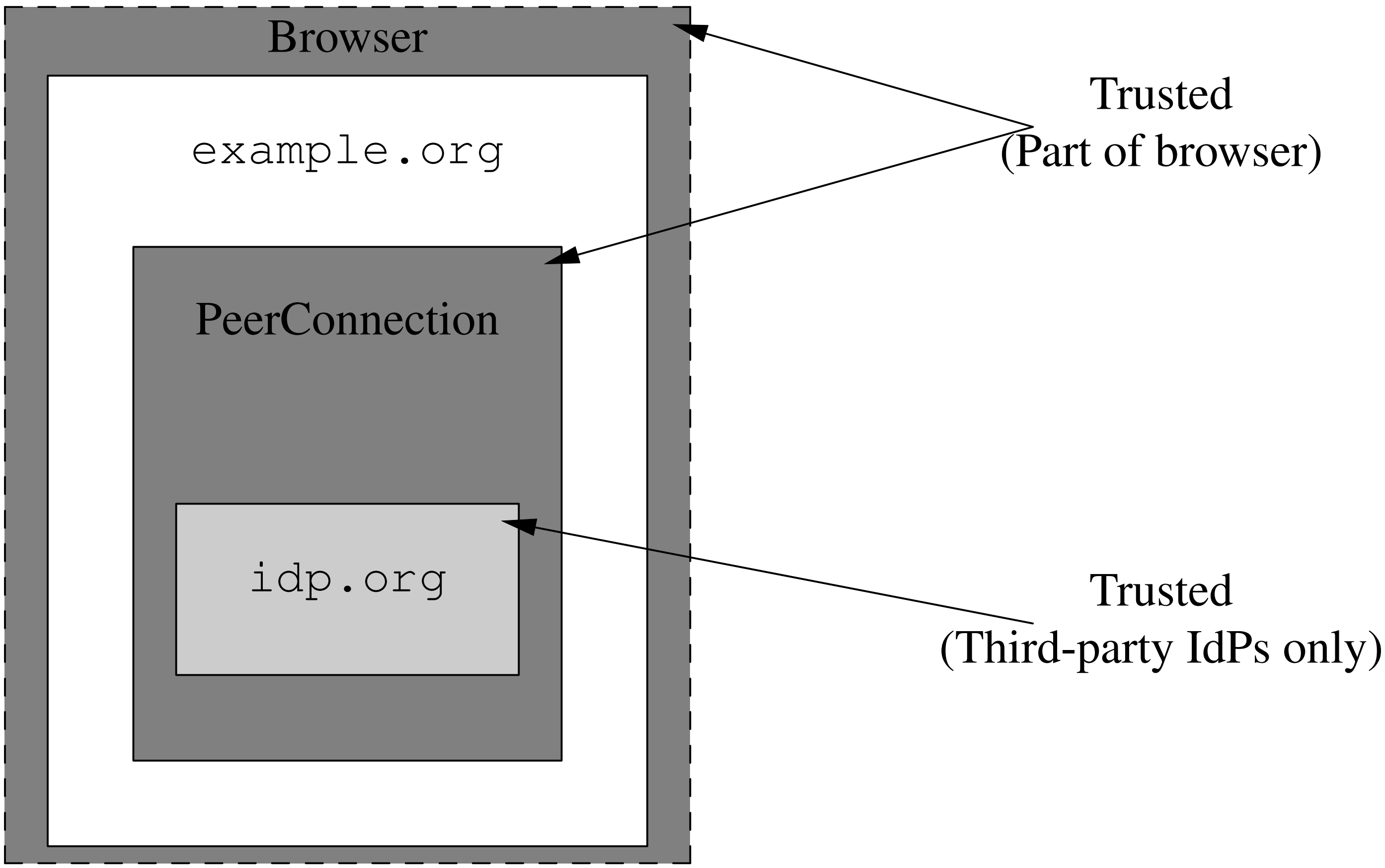
```
"identity":{
     "idp":{     // Standardized
        "domain":"idp.example.org", // Identity domain
        "method":"default"          // Domain-specific method
     },
     "assertion": "..."             // IdP-specific
}
```

Basic Architecture

IdP Trust Architecture: Authenticating Party



IdP Trust Architecture: Relying Party



Generic Downward Interface (Implemented by PeerConnection)

- Instantiate "IdP Proxy" with JS from IdP
  - Probably invisible IFRAME
  - Maybe a WebIntent (more later)
- Send (standardized) messages to IdP proxy via `postMessage()`
  - "`SIGN`" to get assertion
  - "`VERIFY`" to verify assertion
- IdP proxy responds
  - "`SUCCESS`" with answer
  - "`ERROR`" with error

Where is the IdP JS fetched from?

- Deterministically constructed from IdP domain name and method

  `https://<idp-domain>/.well-known/idp-proxy/<protocol>`

- Why in `/.well-known`?
  - Trust-relationship derives from control of the domain
  - Must not be possible for non-administrative users of domain to impersonate IdP

How does PeerConnection know IdP domain?

- Authenticating Party
  - IdP domain configured into browser
    - User "logs into" browser via UI
    - WebIntents again
  - Specified by the calling site
    - "Authenticate this call with Facebook connect"
    - Need a new API point for this
- Relying party
  - Carried in the generic part of the identity assertion

Generic Message Structure

```
{
  "type": "...",       // "SIGN","VERIFY","SUCCESS", ...
  "id": "1",           // used for correlation
}
```

Incoming Message Checks (IdP Proxy)

- Messages MUST come from `rtcweb://.../`
- This prevents ordinary JS from instantiating IdP proxy
  - Remember, it's just an IFRAME
  - But you can't set your origin to arbitrary values
- Messages MUST come from parent window
  - Prevents confusion about which proxy

Incoming Message Checks (PeerConnection)

- Messages MUST come from IdP origin domain
  - Prevents navigation by attackers in other windows
- Messages MUST come from IdP proxy window
  - Prevents confusion about which proxy

Signature process

```
PeerConnection -> IdP proxy:
  {
    "type":"SIGN",
     "id":1,
     "message":"abcdefghijklmnopqrstuvwyz"
  }

IdPProxy -> PeerConnection:
  {
    "type":"SUCCESS",
    "id":1,
    "message": {
      "idp":{
        "domain": "example.org"
        "protocol": "bogus"
      },
      "assertion":\"{\"identity\":\"bob@example.org\",
                     \"contents\":\"abcdefghijklmnopqrstuvwyz\",
                     \"signature\":\"010203040506\"}"
    }
  }
```

Verification Process

```
PeerConnection -> IdP Proxy:
  {
    "type":"VERIFY",
    "id":2,
    "message":\"{\"identity\":\"bob@example.org\",
                 \"contents\":\"abcdefghijklmnopqrstuvwyz\",
                 \"signature\":\"010203040506\"}"
  }

IdP Proxy -> PeerConnection:
  {
   "type":"SUCCESS",
   "id":2,
   "message": {
     "identity" : {
       "name" : "bob@example.org",
       "displayname" : "Bob"
     },
     "contents":"abcdefghijklmnopqrstuvwyz"
   }
  }
```

Meaning of Successful Verification

- IdP has verified assertion
  - Identity is given in “identity”
  - “name” is the actual identity (RFC822 format)
  - “displayname” is a human-readable string
- Contents is the original message the AP passed in

Processing Successful Verifications

- Authoritative IdPs
  - RHS of `identity.name` matches IdP domain
  - No more checks needed
- Third-party IdPs
  - RHS of `identity.name` does not match IdP domain
  - IdP MUST be trusted by policy
- These checks performed by PeerConnection

How do I stand up a new IdP?

1. Get some users (the hard part)
2. Implement handlers for `SIGN` and `VERIFY` messages
   - Probably < 100 lines of JS
3. Put the right JS at `/.well-known/idp-proxy`
4. Profit

Integrated IdP Support

- Things work fine with no browser-side IdP support
- But specialized support is nice too
  - "Sign-in to browser" in Chrome
  - BrowserID in Firefox
  - Better UI/performance properties
- Still specify IdP by URL
  - IdP JS detects that the browser has built-in support
  - Calls go directly to the browser code

Questions?