OAuth 2.0: Theory and Practice

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whoami

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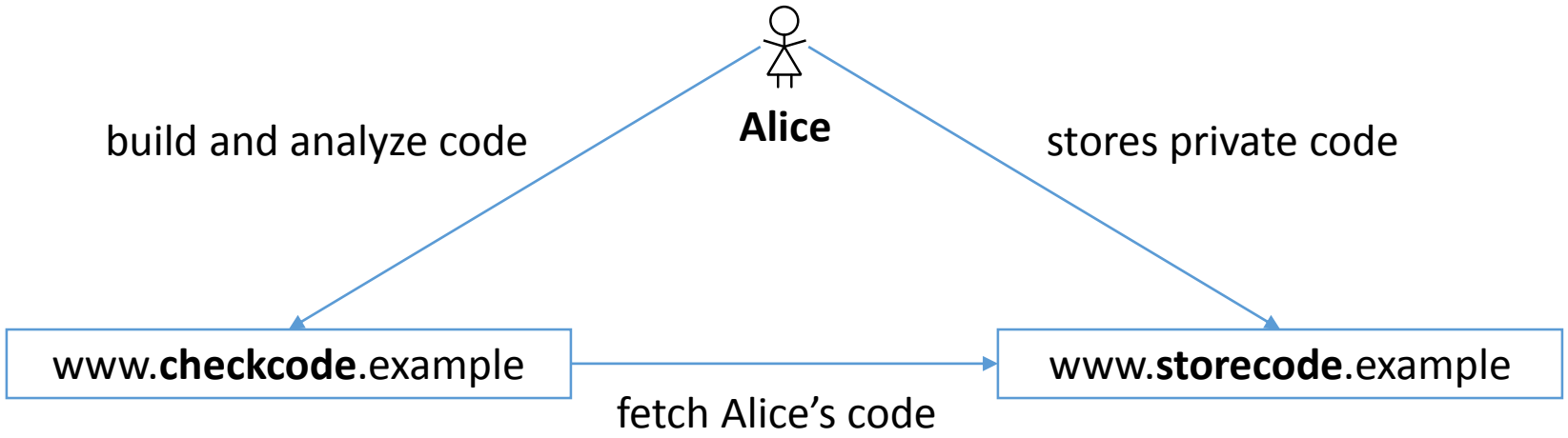
OAuth History

- OAuth started circa 2007
- 2008 - IETF normalization started in 2008
- 2010 - RFC 5849 defines OAuth 1.0
- 2010 - WRAP (Web Resource Authorization Profiles) proposed by Microsoft, Yahoo! And Google
- 2010 - OAuth 2.0 work begins in IETF
- 2012
  - RFC 6749 - The OAuth 2.0 Authorization Framework
  - RFC 6750 - The OAuth 2.0 Authorization Framework: Bearer Token Usage

An use case

- The cast of characters
  - www.**storecode**.example – code repository service (e.g. github.com)
  - www.**checkcode**.example – code analysis service (e.g. travis-ci.org)
  - **Alice** – a fictional developer
- The problem
  - How can **Alice** allow **checkcode** to access her private code stored at **storecode**?

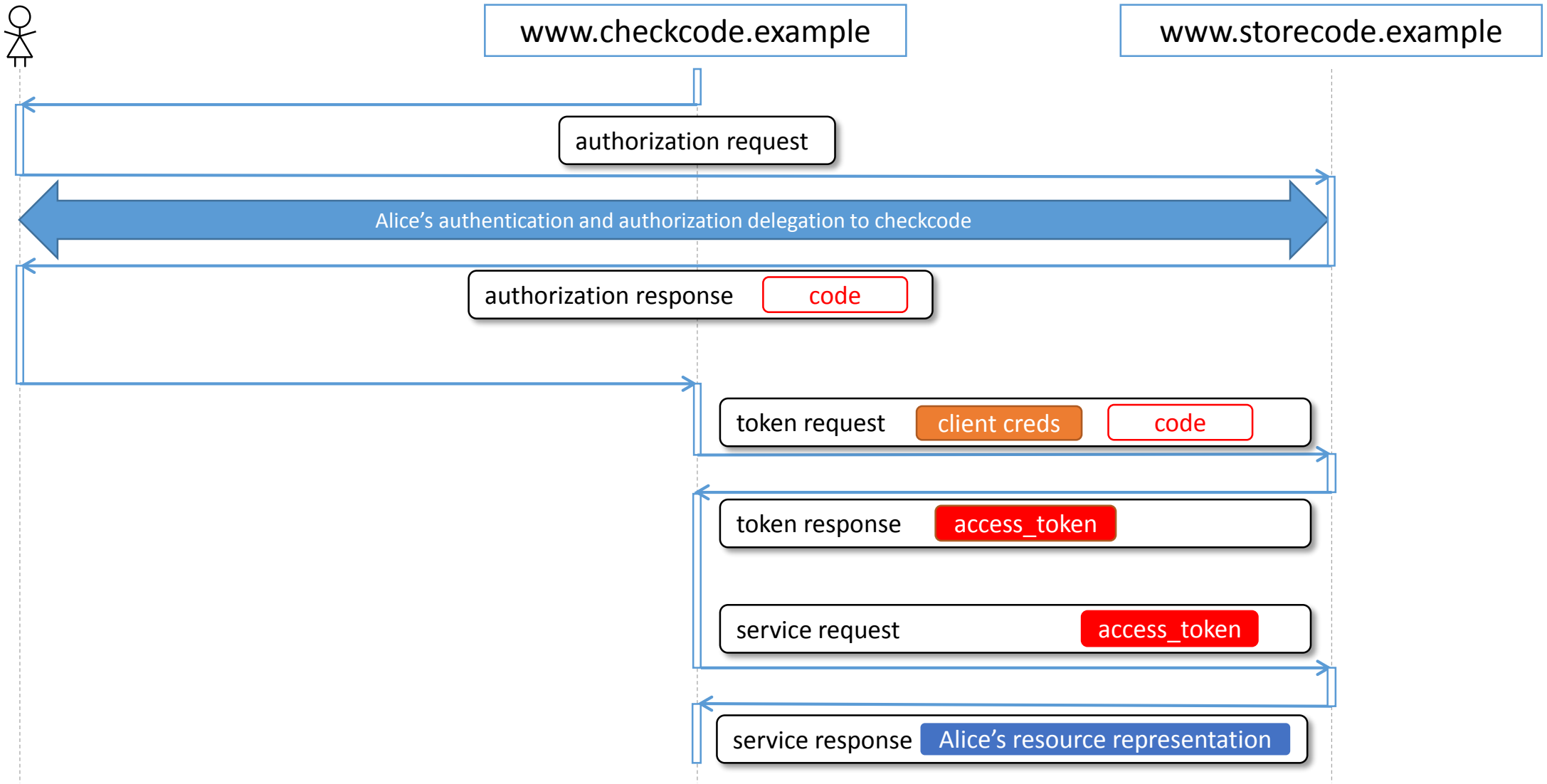


The password anti-pattern

- A solution: Alice shares her password with checkcode

- Problems:
  - Unrestricted access – checkcode has all of Alice's permissions
    - read and write on all code repositories, issues, wiki, ...
  - No easy revocation
    - Changing password implies revoking all other client applications
  - Password management
    - Changing password implies updating all the delegated applications

The protocol

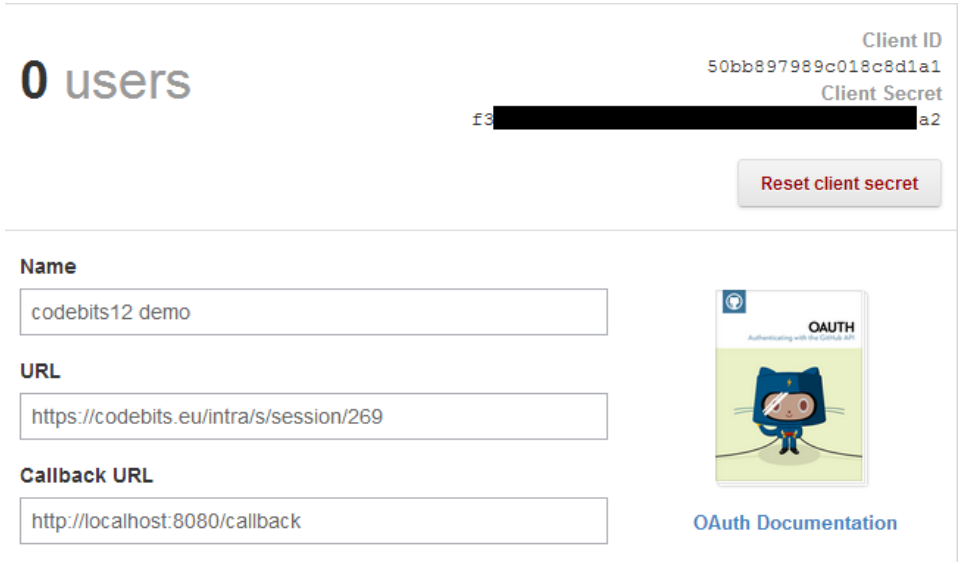


A demo would be nice

Accessing GitHub

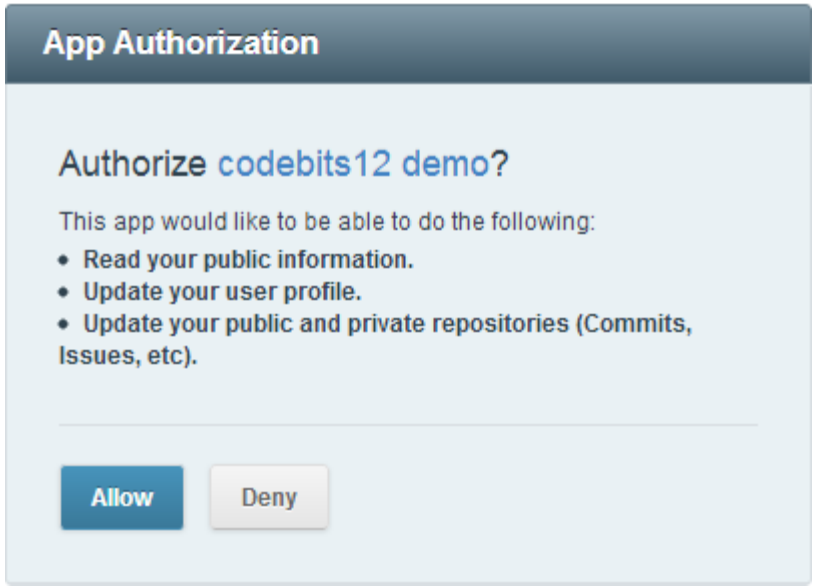
Developer experience

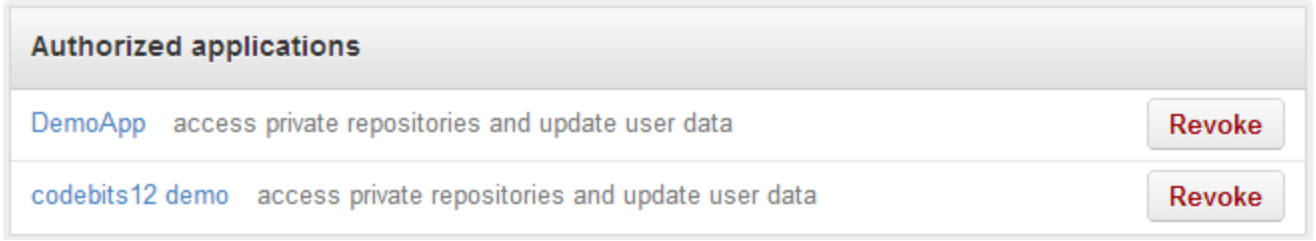
- Manage Clients (Applications)
  - client_id
  - client_secret
  - redirect_uri



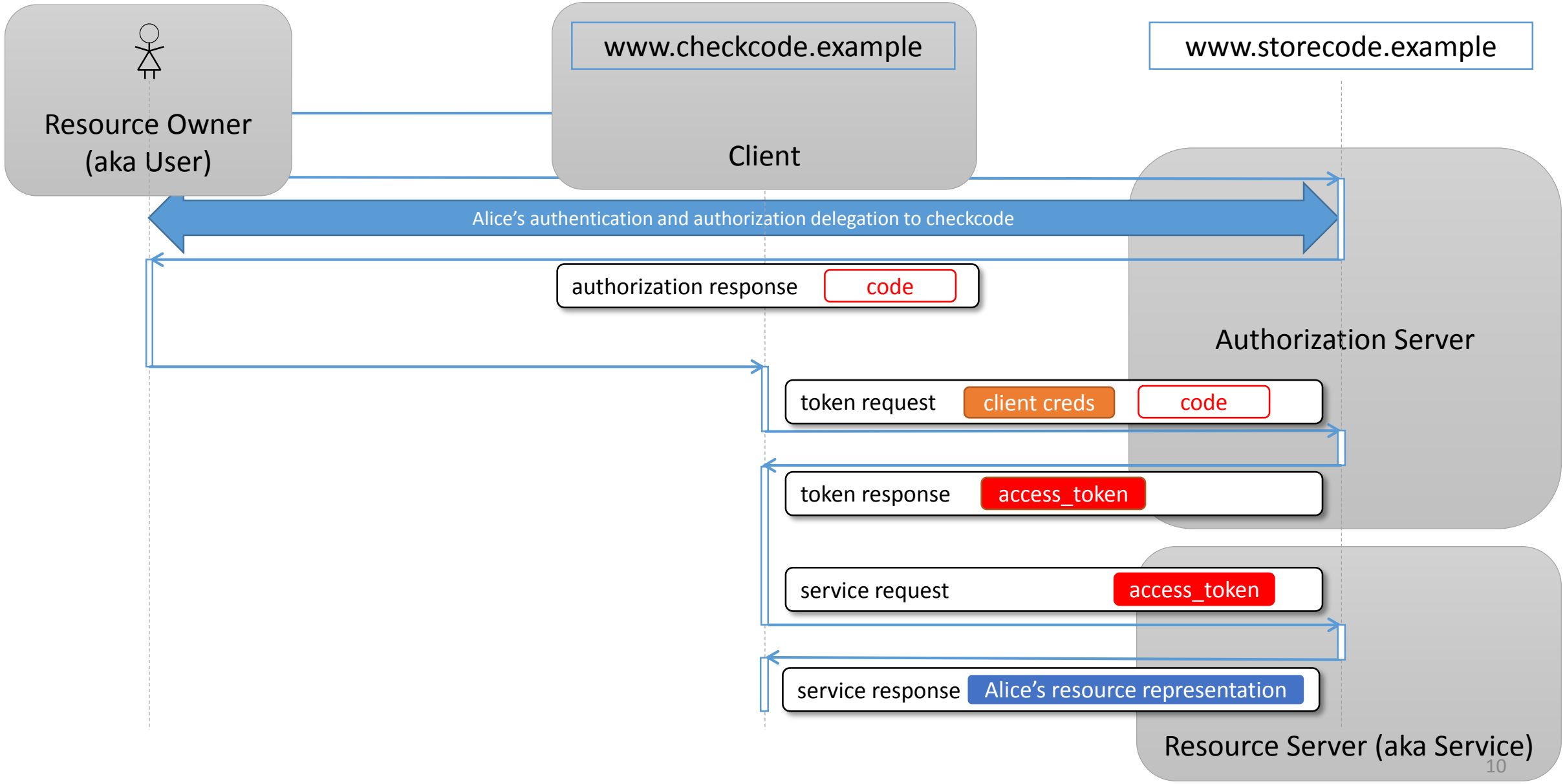
User experience

- Grant authorizations
- Manage authorization

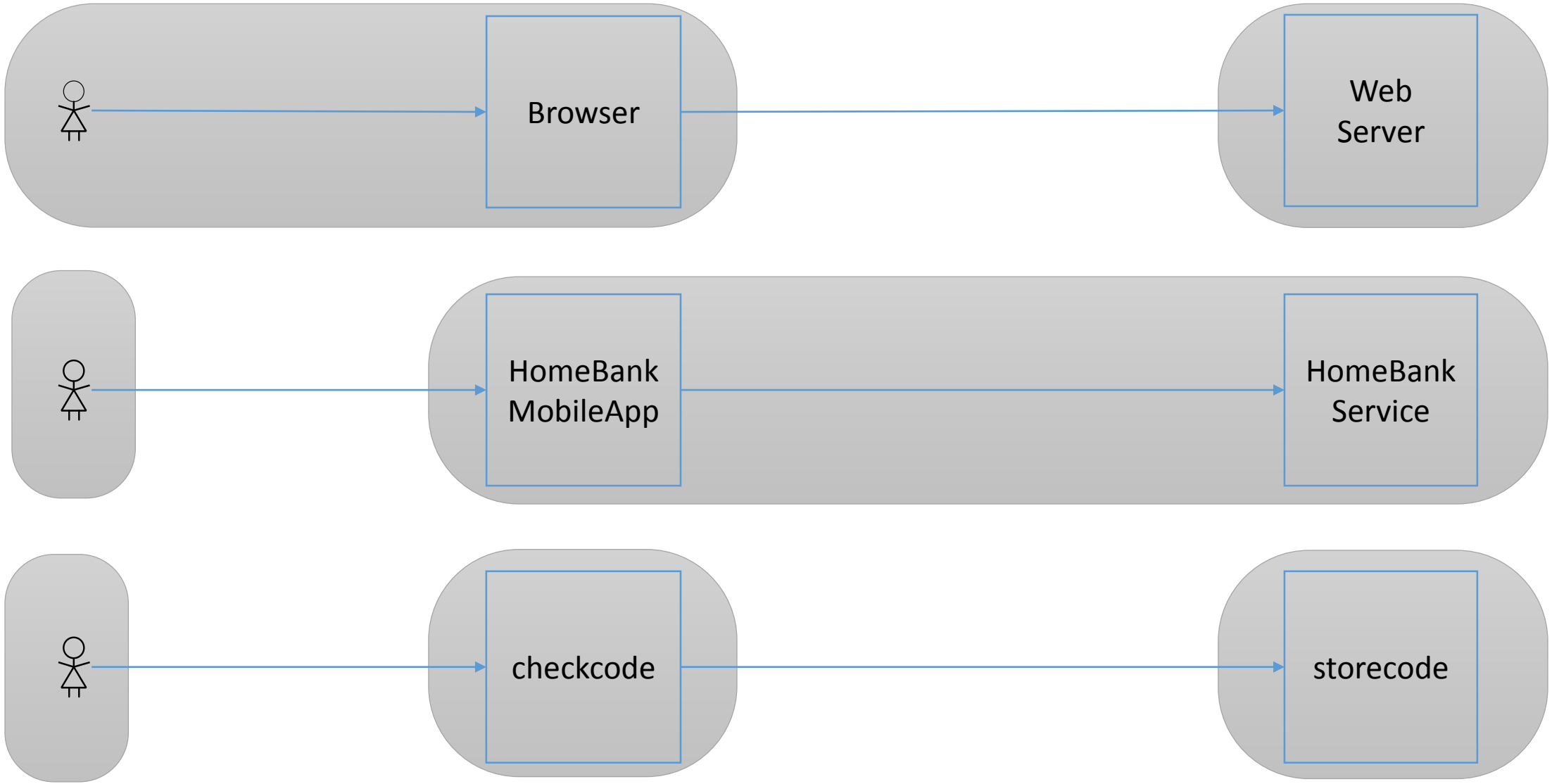




The OAuth 2.0 roles



A matter of trust



Client Types

- **Confidential**
  “Clients capable of maintaining the confidentiality of their credentials”
  (e.g. client implemented on a secure server)

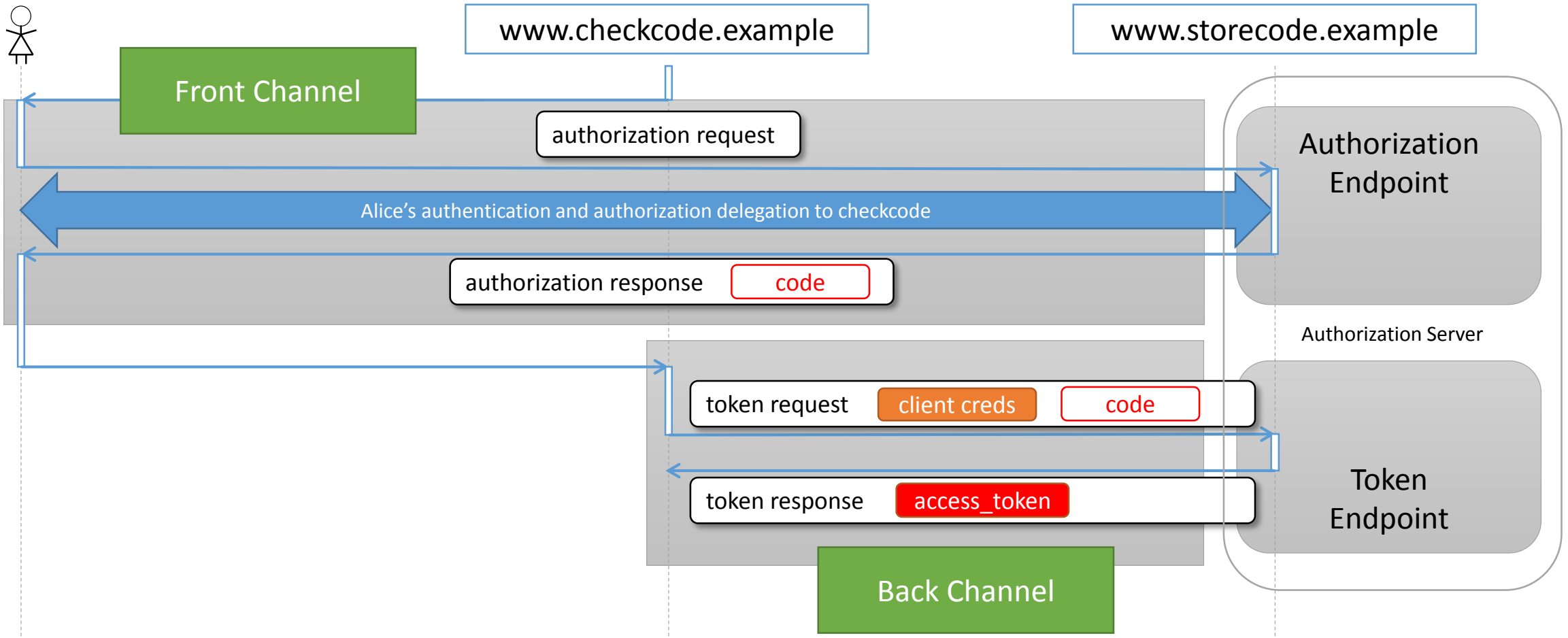
- **Public**
  “Clients incapable of maintaining the confidentiality of their credentials”
  (e.g. clients executing on the device used by the resource owner)

Client Types

- 3 implementation scenarios
  - Single client – all the users (web app)
  - One client per user (native mobile app)
  - One client per multiple users (family shared tablet, IPTV Box)

- Dynamic Client Registration
  - Client Registration Endpoint – still in draft
  - Turning public clients into private client instances
  - Not a closed problem

Authorization and Token Endpoints



Front and back channels

- Front channel
  - Authorization Endpoint (AE)
  - Authorization request – redirect from Client to AE via the User-agent
  - Human interface – User authentication and authorization delegation
  - Authorization response – redirect from AE to Client via the User-agent

- Back channel
  - Token Endpoint (TE)
  - Direct request-response between Client and TE
  - No User interaction
  - No human interface

Scopes

- `scope`
  - “scope of the access request”
  - Parameter on the authorization request or token request
    - Set of space-delimited strings
  - E.g `https://www.googleapis.com/auth/calendar.readonly`
- Usages
  - Client – Must find the required scopes for each service interaction – docs
  - User – AS translates the scopes into friendly User messages
  - Service – Maps a scope into (URIs, methods) or (service, operation)
- Granted scope may differ from requested scopes
  - No provision for mandatory and optional scopes

The *grant* concept

- Represents the logical outcome of the User's authorization
  - User identity
  - Client identity
  - Scope
- Core domain concept
- Bound to all the tokens
  - Code
  - Access token
  - Refresh token

Not (Keep It Simple)

Internet Engineering Task Force (IETF) D. Hardt, Ed.
Request for Comments: 6749 Microsoft
Obsoletes: 5849 October 2012
Category: Standards Track
ISSN: 2070-1721

The OAuth 2.0 Authorization Framework

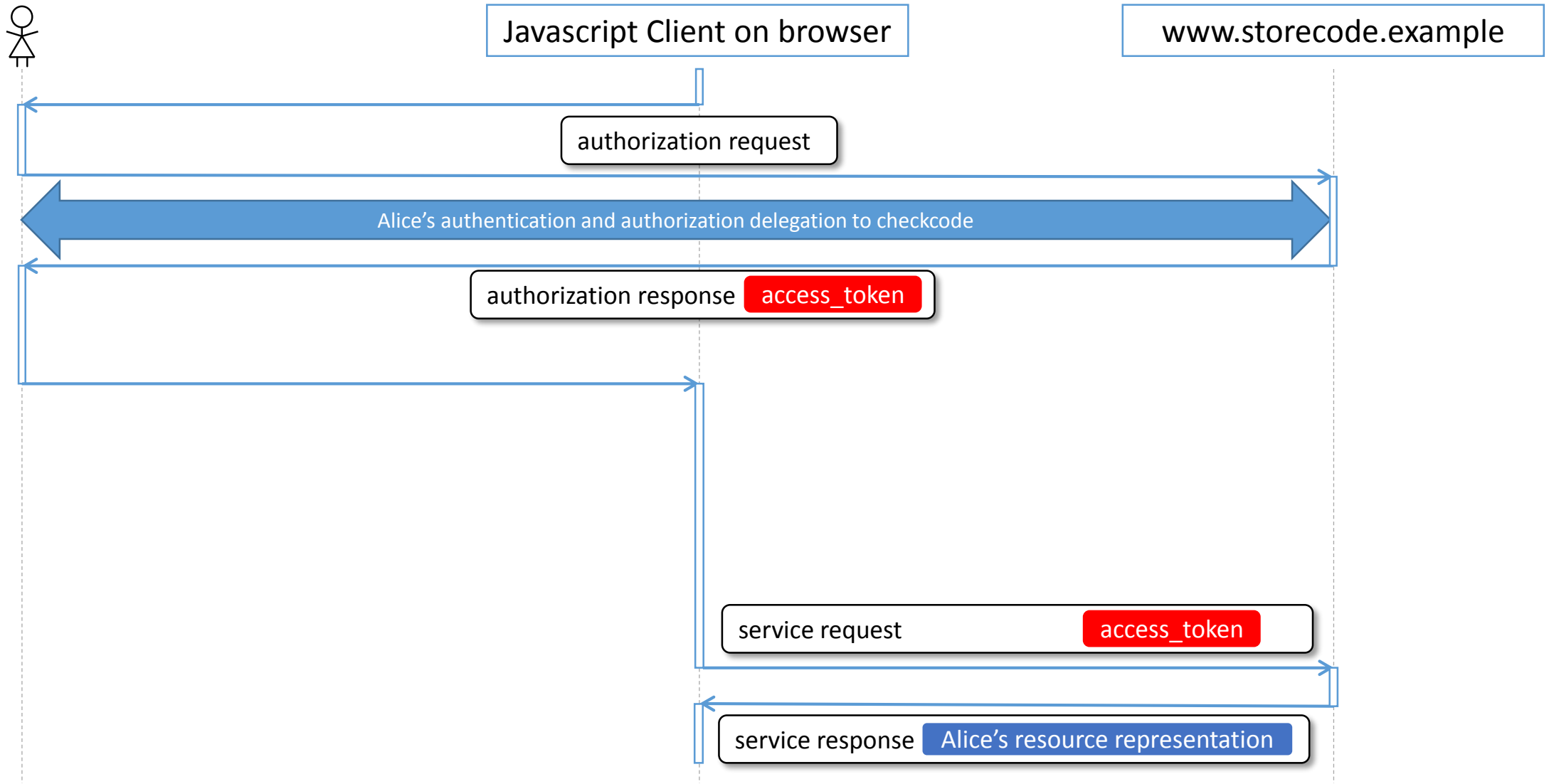
OAuth 2.0: a framework not a protocol

- The previous protocol is just a one of many options
- Three parts
  1. Obtaining user authorization
  2. Issuing access tokens
  3. Using access tokens to authorize service requests
- Multiple protocol *flows*
  - Different User authorization
- Critique
  - Complexity
  - Compromises interoperability
  - WS-* again?

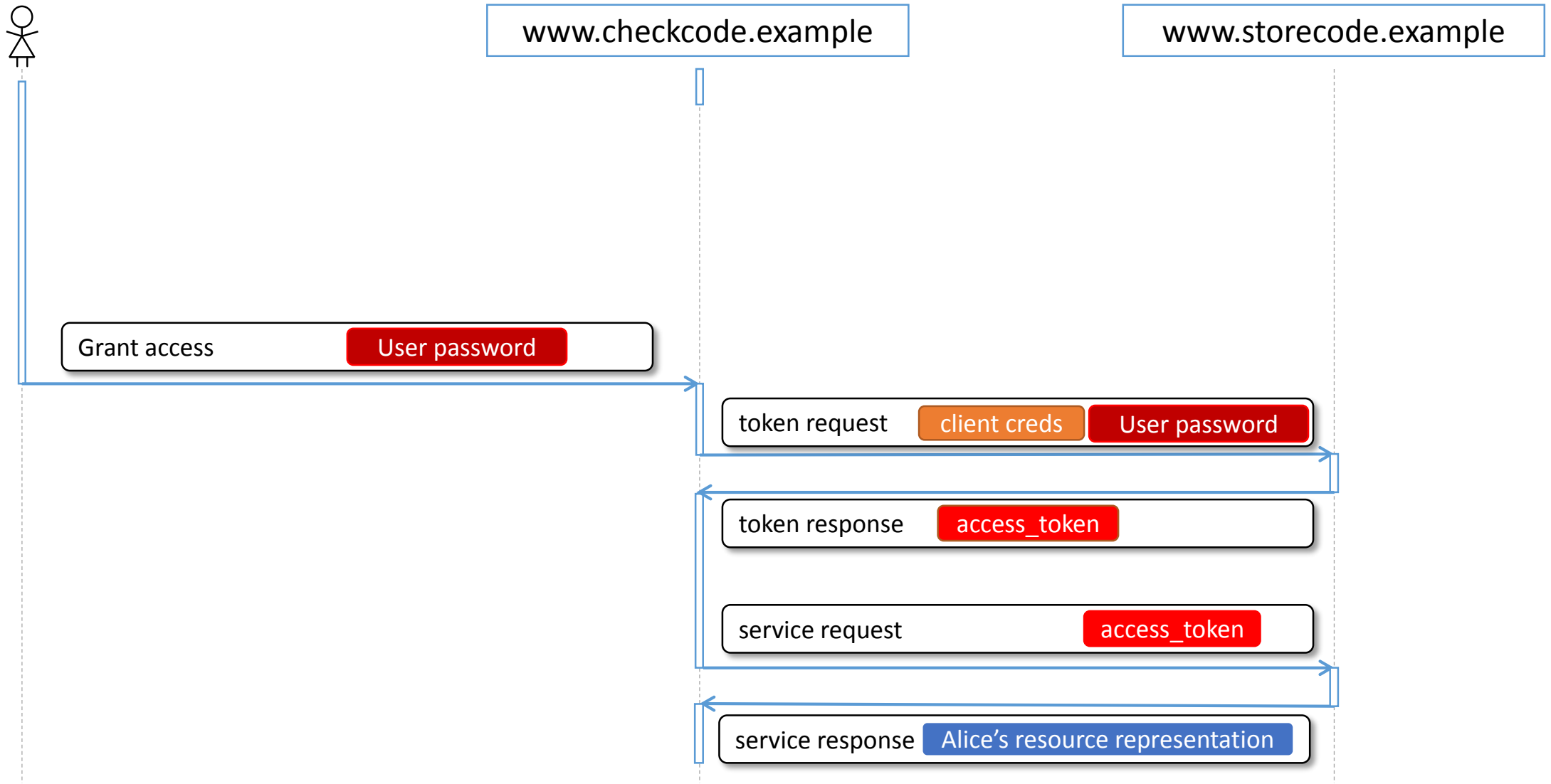
Obtaining authorization

- Authorization Code **Grant**
  - The previous protocol
- Implicit **Grant**
  - Authorization Endpoint returns the access token directly
  - Javascript Clients running on the browser
- Resource Owner Password Credentials **Grant**
  - User gives password to Client, Client uses it to obtain access token
- Client Credentials **Grant**
  - No User, Client access on its own behalve
- Extensions
  - Identity federation, SAML assertions

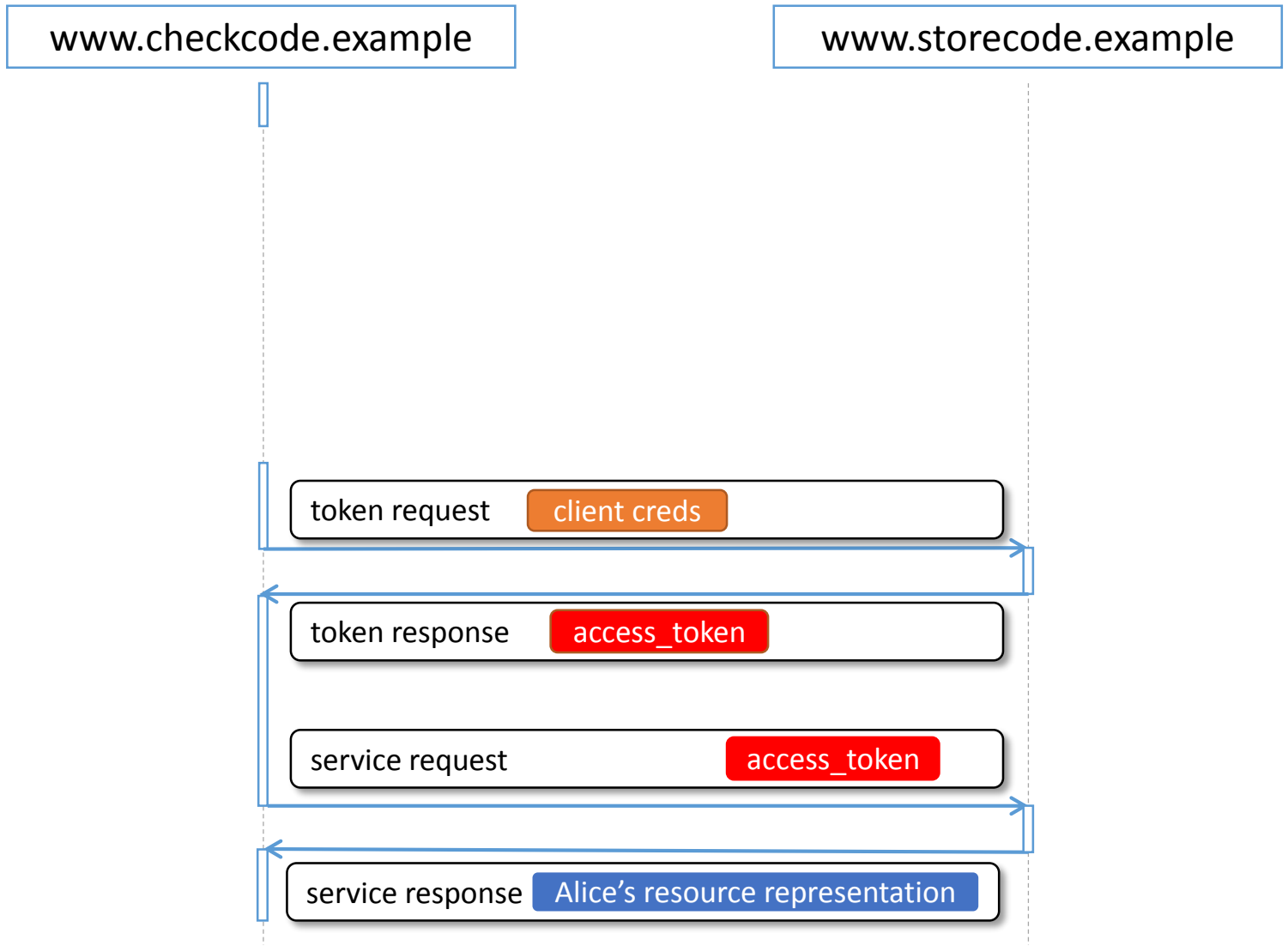
Implicit Grant



Resource Owner Password Credentials Grant



Client Credentials Grant



Accessing the Token Endpoint

```
POST /token_endpoint HTTP/1.1
Host: as.storecode.example
Content-Type: application/x-www-form-urlencoded
Authorization: Basic <client_id:client_secret>

grant_type=authorization_code
code=AbCdEf...
redirect_uri=https://redirect.checkcode.example
client_id=...&
client_secret=..
```

```
HTTP/1.1 200 OK
Content-Type: application/json;charset=UTF-8
Cache-Control: no-store
Pragma: no-cache

{
    "access_token":"2YotnFZFEjr1zCsicMWpAA",
    "token_type":"Bearer",
    "expires_in":3600,
    "refresh_token":"tGzv3JOkF0XG5Qx2TlKWIA",
    "example_parameter":"example_value"
}
```

Accessing the service (Resource Server)

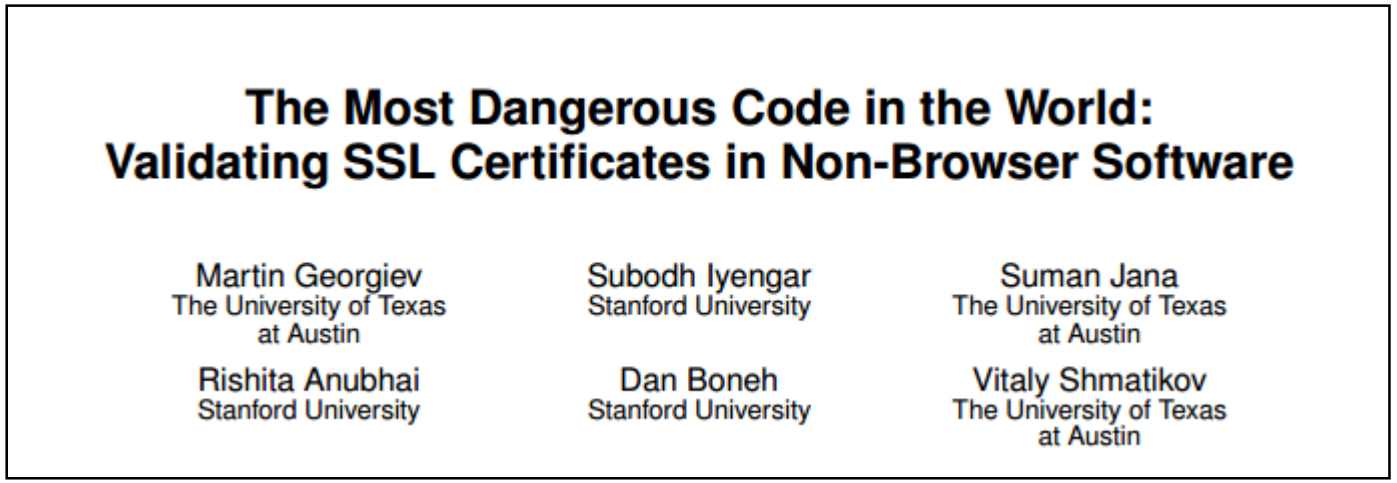
- How to associate the access token to the request message?
- Bearer – just append the token to the request message – RFC 6750
  - Just like “bearer checks” or HTTP cookies
- MAC (holder-of-key) – prove the possession of a key – still draft
  - Similar to OAuth 1.0 or to AWS (used in S3)

```
GET /resource HTTP/1.1
Host: api.storecode.example
Authorization: Bearer <access_token>
```

```
GET /resource HTTP/1.1
Host: api.storecode.example
Authorization: MAC id=“...”,
                   nonce=“...”,
                   mac=“...”
```

Bearer vs. MAC

- Bearer
  - Simpler – no signatures
  - Require HTTPS
    - Incorrect use
  - RFC 6750
  - Similar to cookie usage
    - Behare of the fallacy
    - Same origin policies
  - Discoverability
- MAC
  - Safer
  - More complex – signature
    - Client library integration



The Most Dangerous Code in the World: Validating SSL Certificates in Non-Browser Software

Martin Georgiev
The University of Texas at Austin

Subodh Iyengar
Stanford University

Suman Jana
The University of Texas at Austin

Rishita Anubhai
Stanford University

Dan Boneh
Stanford University

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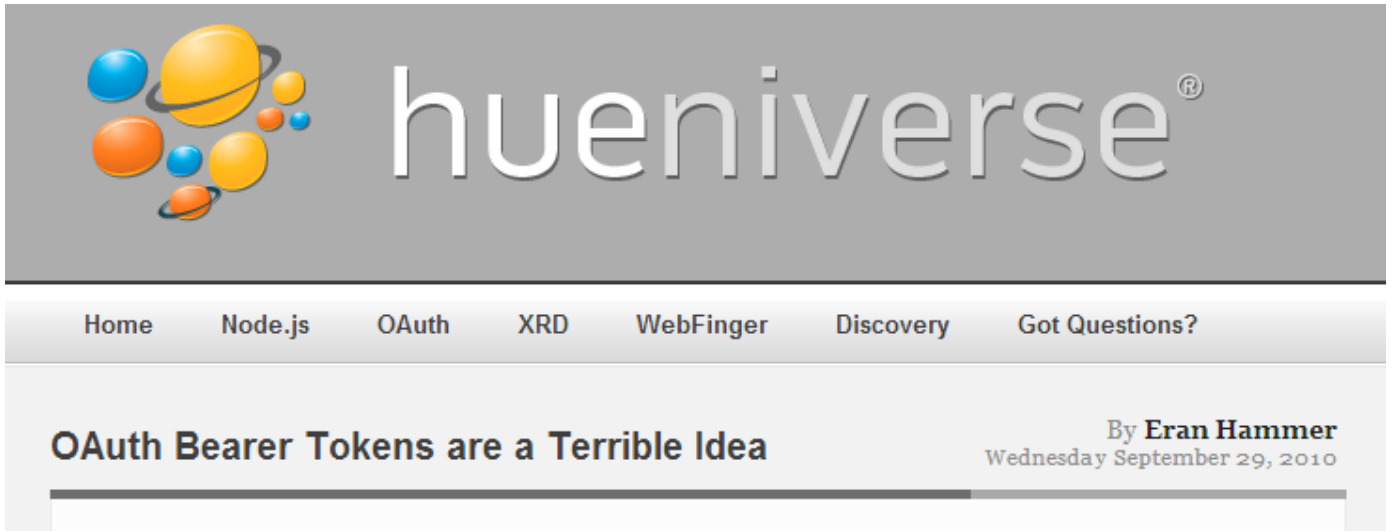

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Home Node.js OAuth XRD WebFinger Discovery Got Questions?

OAuth Bearer Tokens are a Terrible Idea

By Eran Hammer
Wednesday September 29, 2010

Token structure

- Not covered by the RFCs
- Token content options
  - Artifact (reference/handle) – reference to stored data
    - Store Hash(artifact) and not artifact directly
    - At least 128 bits of entropy
    - Revocation – just clear the stored data
  - Assertions – contains the (cryptographically protected) data
    - JWT – JSON Web Token
    - Revocation – harder (e.g. maintain revocation list)
- Token data
  - Validity period
  - Grant (User, Client, Scopes)
  - Type ({code, access_token, refresh_token})
  - Usage (e.g. code should be used only once)

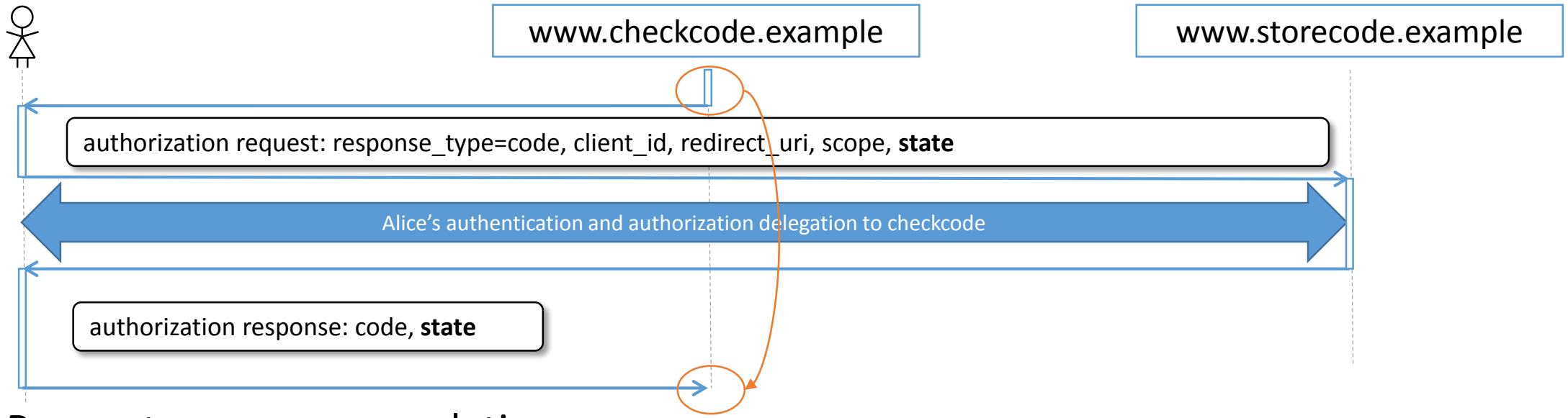
Refresh tokens

- Two lifetimes
- Access tokens – short lifetime
  - Bearer usage
- Refresh tokens – long lifetime
  - Usage requires client credentials
  - Useful for revocation

- Token Endpoint - obtain new access token given a refresh token

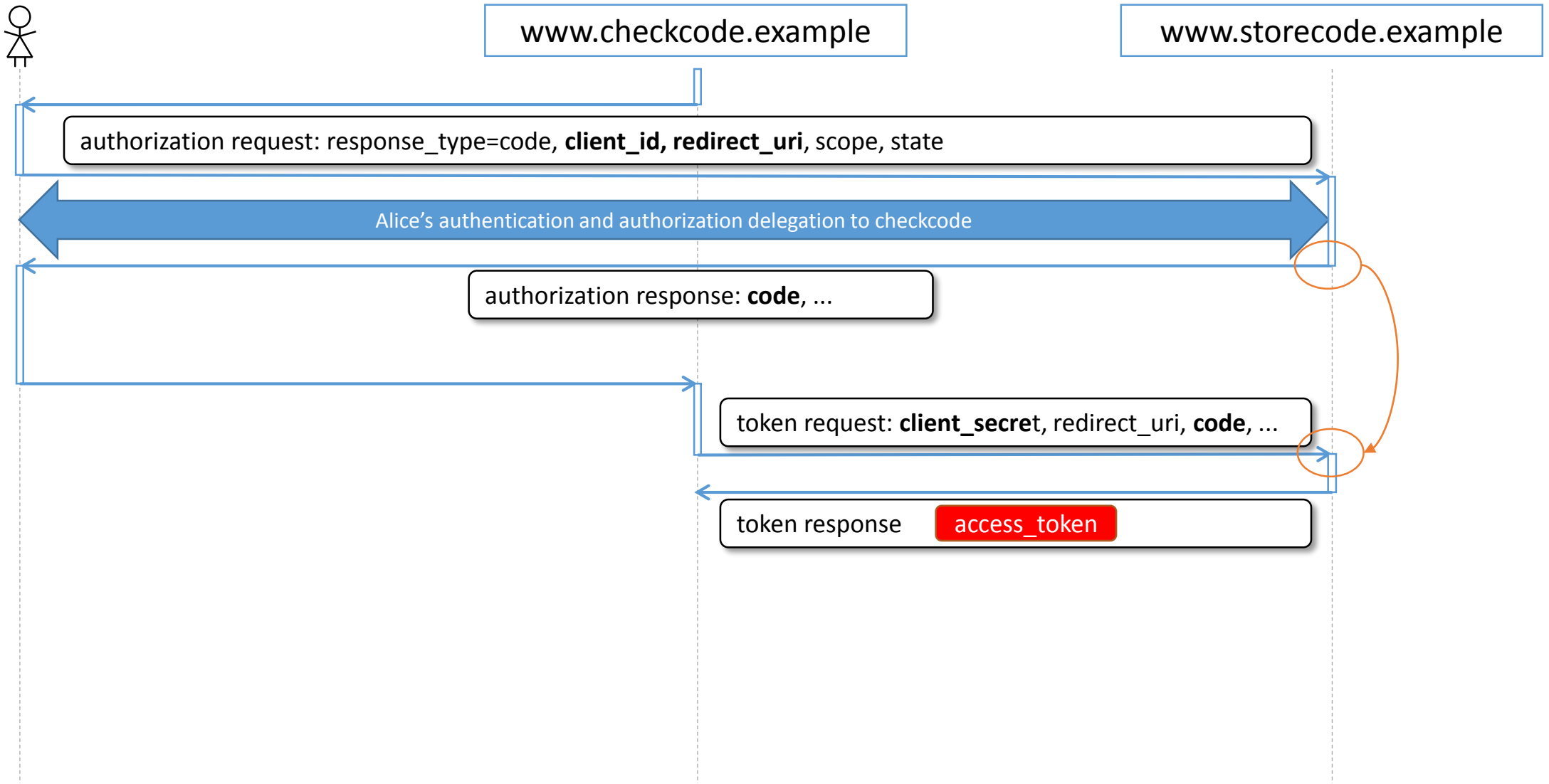
- Critique: state management on the client

Security: authorization request

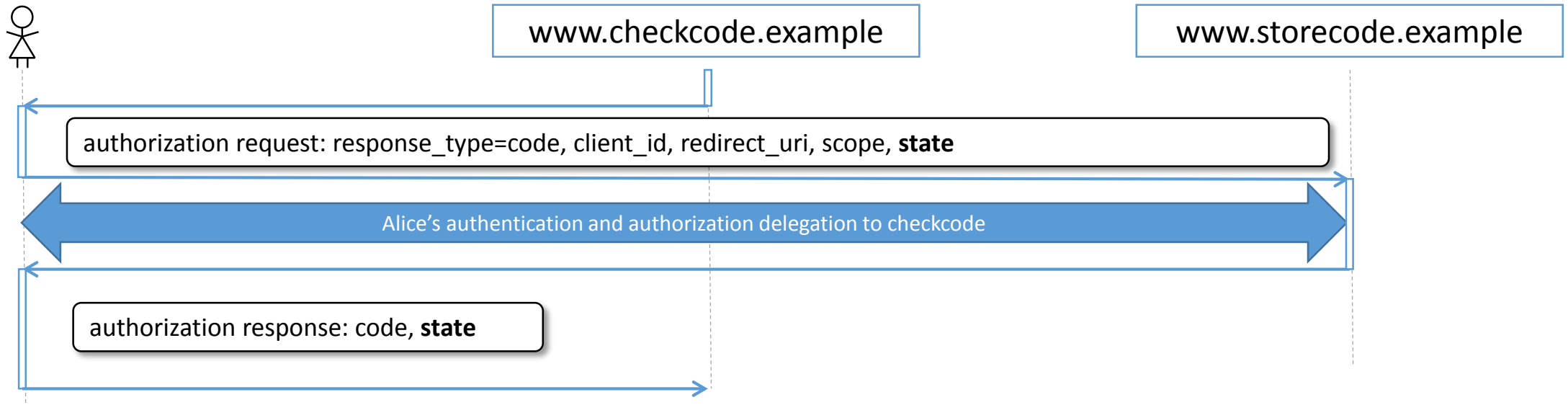


- Request-response correlation
  - **state** parameter - unpredictable
  - Session-fixation attack
- Code search
  - At least 128 bit of entropy
  - Small usage period (e.g. 5 minutes)
  - Code bound to a client_id
  - Code usage throttled by client_id

Security: code exchange



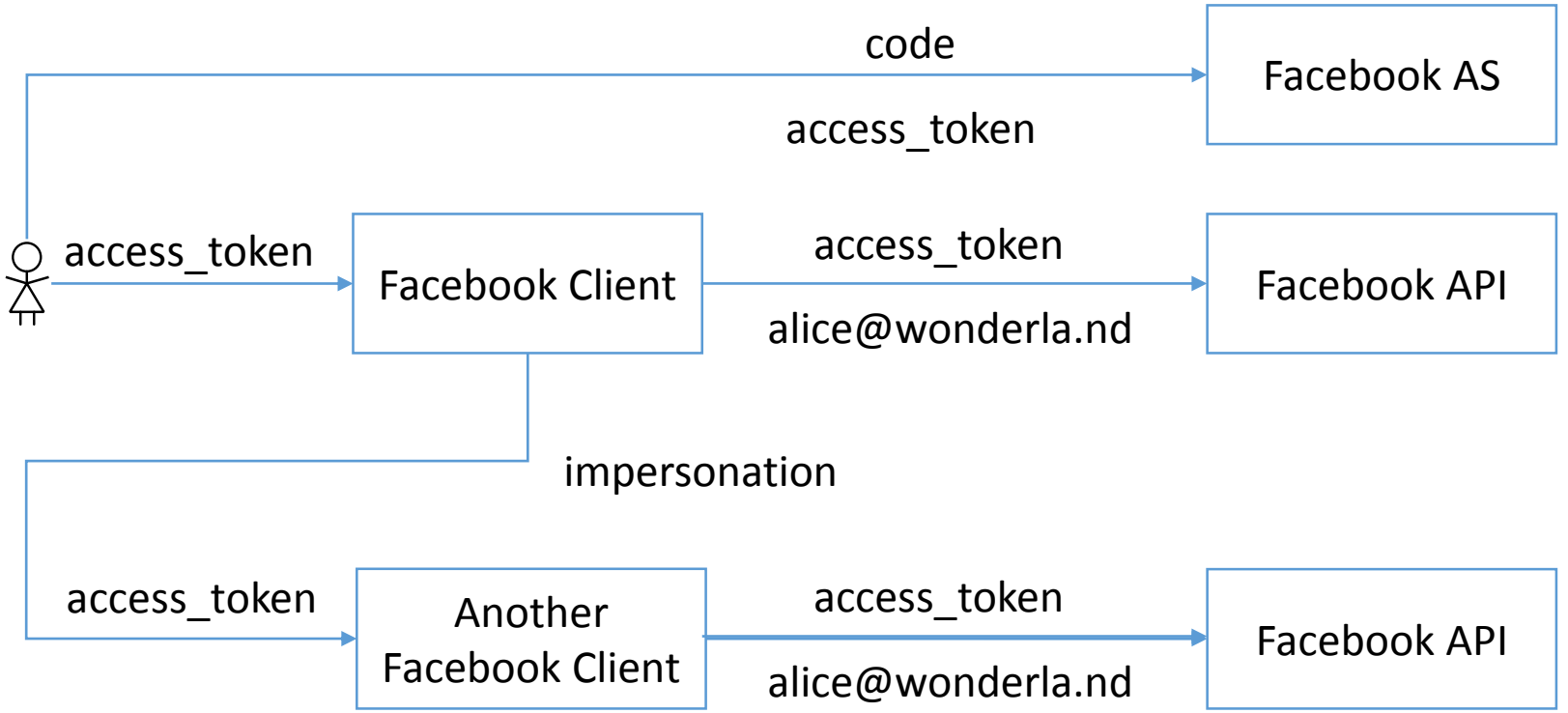
Mobile: authorization request



- Use a "web view"
  - e.g. Windows 8 **WebAuthenticationBroker**
- Use an external browser - how to obtain the response parameters?
- Redirect
  - Use localhost
  - Special redirect URI **urn:ietf:wg:oauth:2.0:oob** (Google uses it but not on RFC)
  - Custom redirect URI scheme

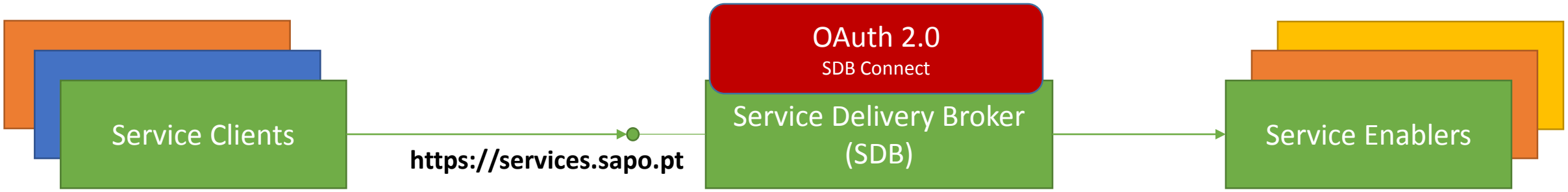
OAuth 2.0: for authorization not authentication

- Not safe for authentication in the *general case*
- OpenID Connect – OAuth 2.0 + authentication



SDB - Service Delivery Broker

- Brokering between service clients and service enablers (*implementations*)
  - Access Control (OAuth 1.0, API keys, ...)
  - Caching, protocol and format translation, ...
- Public market place - https://store.services.sapo.pt
- Multi-tenant



References

- IETF Web Authorization Working Group - http://datatracker.ietf.org/wg/oauth/
  - RFCs
  - Drafts

- Eran Hammer
  - OAuth 2.0 and the Road to Hell - http://hueniverse.com/2012/07/oauth-2-0-and-the-road-to-hell/
  - OAuth 2.0 - Looking Back and Moving On - http://vimeo.com/52882780

- John Bradley - http://www.thread-safe.com/2012/07/the-oauth-2-sky-is-not-falling.html