Web 2.0

Lecture 6: Accessing and Utilizing Services

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Evropsky sociální fond
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Overview

- Mashups and XHR
- Security Mechanisms
- JSON and JSONP

Mashups

- Web application hybrid/Web 2.0 application
  - *Uses APIs of two or more applications to provide new value-added functionality*
- Types
  - *Data mashup – integration/aggregation of data (read only)*
  - *Service mashup – more sophisticated workflows (read, write)*
  - *Visualization – involves UI, e.g., third-party data displayed on the Google map*
- Client-Server View
  - *client-side mashups (mainly in a browser)*
    → *JavaScript, Dynamic HTML, AJAX, JSON/JSONP*
  - *server-side mashup*
    → *server-side integration of services and data*
    → *third-party programming languages, very typical, nothing new*
    → *specialized environments: Google AppsScript, Yahoo Pipes*
- Web Apps developments will all be about mashups!

XMLHttpRequest (XHR)

- Interface to utilize HTTP protocol in JavaScript
  - *standardized by Web Applications WG at W3C*
  - *basis for AJAX*
    → *Asynchronous JavaScript and XML*
- Typical usage
  1. *Browser loads a page that includes a script*
  2. *User clicks on a HTML element*
     - *it triggers a JavaScript function*
  3. *The function invokes a service through XHR*
     - *same origin policy, cross-origin resource sharing*
  4. *The function receives data and modifies HTML in the page*

XHR Interface – Key Methods and Properties

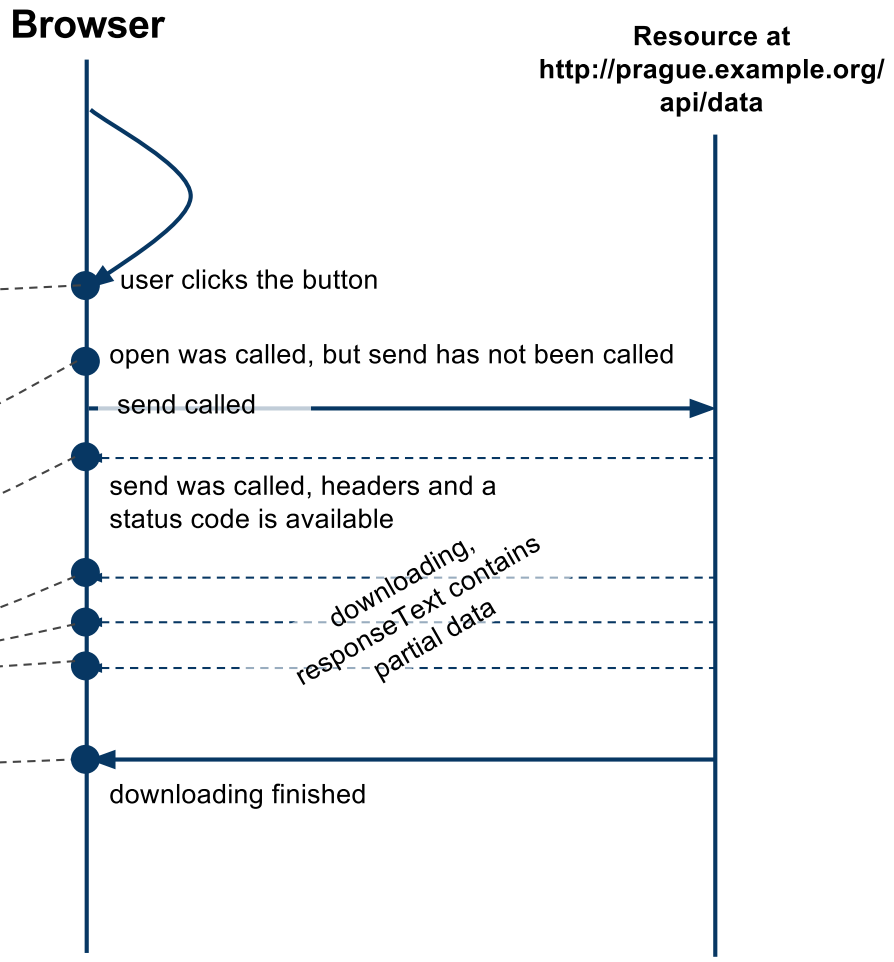
- Method and properties of XHR object
  - `open`, *opens the request, parameters:*
    `method` – *method to be used (e.g. GET, PUT, POST),*
    `url` – *url of the resource,*
    `asynch` – *true to make asynchronous call,*
    `user`, `pass` – *credentials for authentication.*
  - `onReadyStateChange` – *JavaScript function object, it is called when* `readyState` *changes (uninitialized, loading, loaded, interactive, completed).*
  - `send`, `abort` – *sends or aborts the request (for asynchronous calls)*
  - `status`, `statusText` – *HTTP status code and a corresponding text.*
  - `responseText`, `responseXML` – *response as text or as a DOM document (if possible).*
  - `onload` – *event listener to support server push.*
- See XMLHttRequest (W3C), or XMLHttRequest (Mozilla reference) for a complete reference.

How XHR works

HTML with JavaScript code
was loaded as a response to http://prague.example.org/

```
...
<input type="button" value="Show Prague!" onclick="click()" />

<script type="text/javascript">

xhr = new XMLHttpRequest();

function click() {
  xhr.open("GET", "http://prague.example.org/api/data", true);
  xhr.onReadyStateChange = stateChanged;
  xhr.send();
}

function stateChanged() {
  if (xhr. readyState == 1)  { // loading
  ...
  }
  if (xhr. readyState == 2)  { // loaded
  ...
  }
  if (xhr. readyState == 3)  { // interactive
  ...
  }
  if (xhr. readyState == 4)  { // completed
  ...
  }

}
</script>
```

pointer to JavaScript object function



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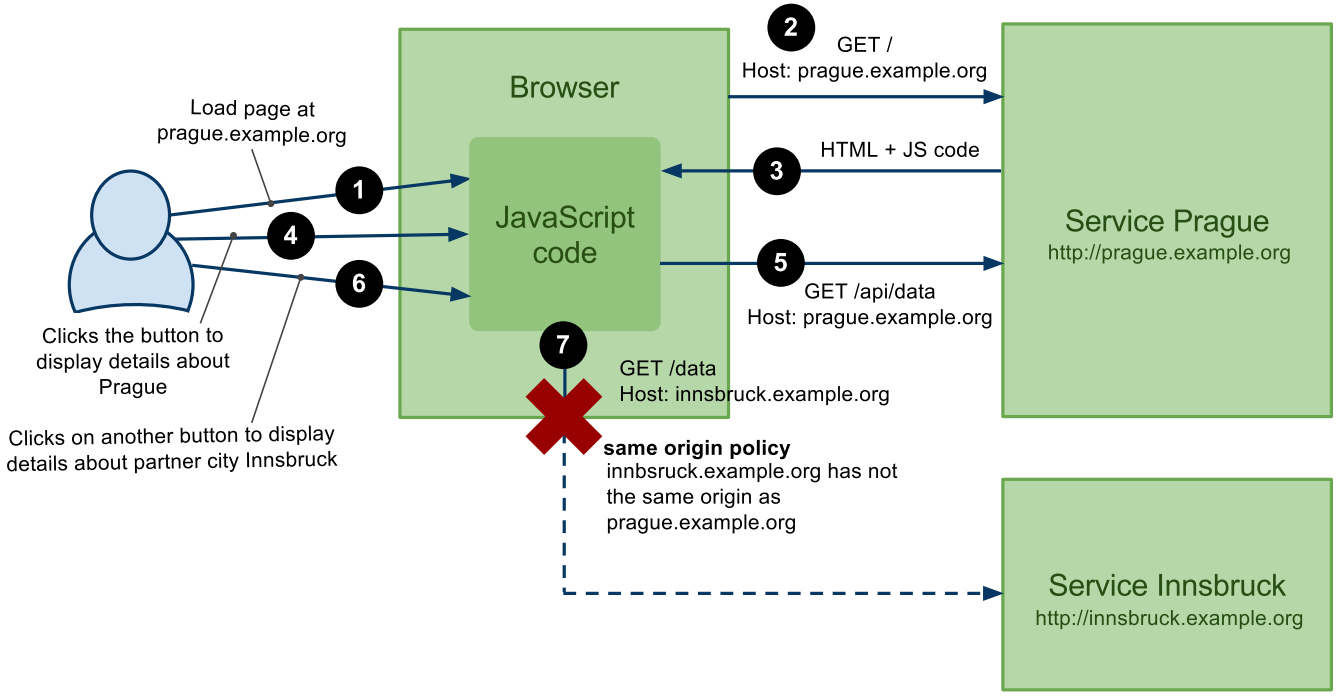
- Mashups and XHR
- Security Mechanisms
  - *Scripting Attacks*
  - *Cross-origin Resource Sharing Protocol (CORS)*
- JSON and JSONP

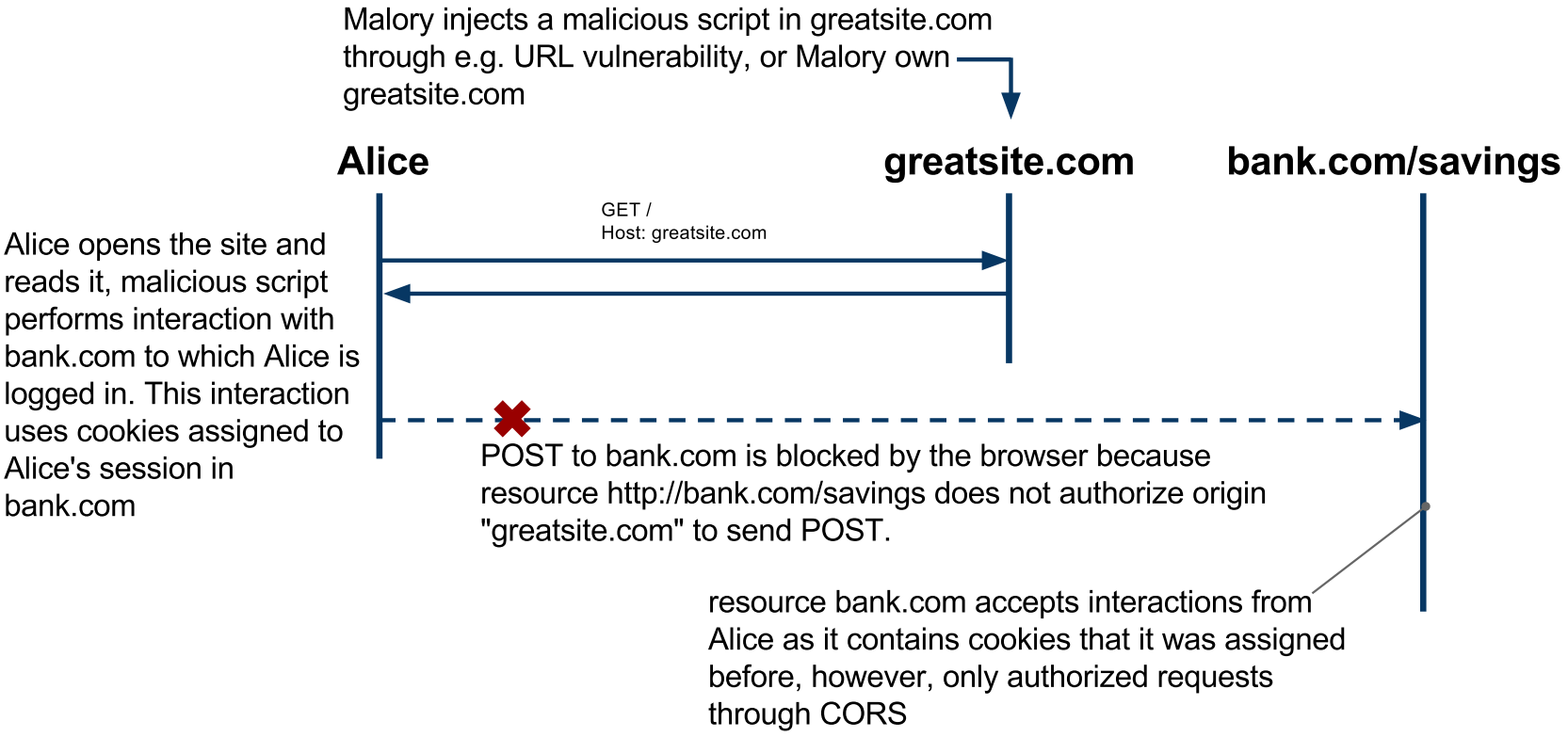
Same Origin Policy



- JavaScript code can only access resources on the same domain
  - *XHR to GET, POST, PUT, UPDATE, DELETE*
  - *Browsers apply **same origin policy***
- Solutions
  - *JSON and JSONP (GET only)*
  - *Cross-origin Resource Sharing Protocol (CORS)*

Why Same Origin Policy?

- Without the same origin policy, the following POST would be possible



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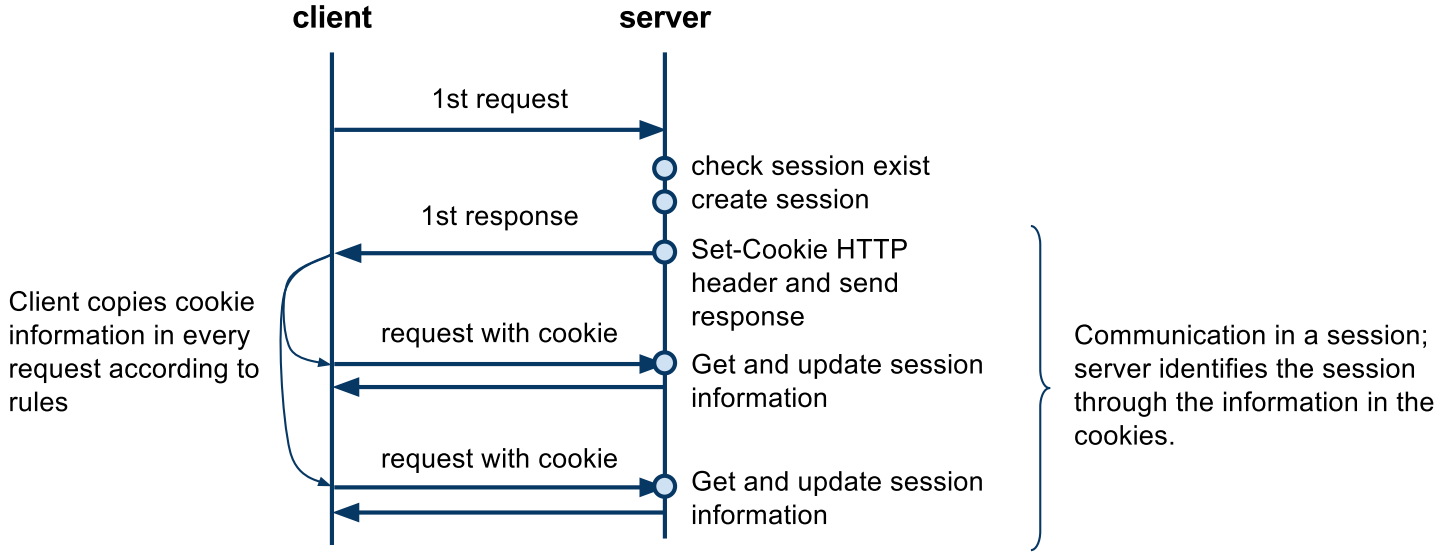
Overview

- Scripting Attacks
  - *Intruders make users perform action that has side effects on their resources*
  - *Intruders inject malicious code to Web pages*
- Roles in Security Scenarios
  - *Alice, Bob*
    → *Normal users, usually Alices wants to send a message to Bob or Alice accesses a Bob's site.*
  - *Eve*
    → *A user with bad intentions, usually a passive attacker.*
  - *Mallory*
    → *An active attacker, usually sends a link to a page with malicious code.*

Recall: State management in HTTP

- Request-response interaction with cookies
  - *Session is a logical channel maintained by the server*



- Stateful Server
  - *Server remembers the session information in a server memory*
  - *Server memory is a non-persistent storage, when server restarts the memory content is lost!*

Cross-site Request Forgery (CSRF)

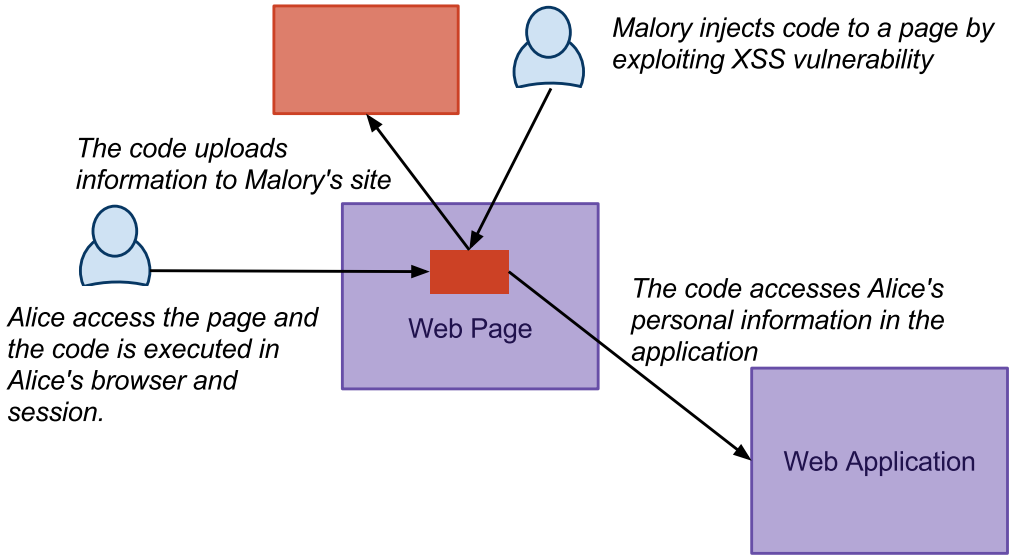
- Exploits a trust of a website in a user's browser
- Scenario
  1. *Mallory sends a link to Alice (in an email, in a chat, etc.)*
     - *The link points to a page that has HTML code with hrefs to Alice's private resources*
     - *For example, to perform an action on Alice's account, it is possible to use* `img` *like this:*

```
1 | <img src="https://bank.com/account?do=transfer_money&amount=50000"/>
```

  2. *Alice loads the page in her browser*
     - *Alice is authenticated to the bank's website, the browser sends Alice's authentication cookies with the request.*
- Issues and Prevention
  - *The bank site vilotes REST, i.e. overloading of GET for making actions*
  - *The bank should check HTTP* `referer` *header*
  - *It is a "blind" attack, Mallory does not see the result*
  - *To perform POST, current browsers today use CORS protocol*

Cross-site Scripting Attack (XSS)

- Exploits a trust of a user in a website



- Example Scenario
  1. *An attacker injects a code to a page*
  2. *A users executes the code in his/her browser's session*
  3. *The code provides information (cookies) to the attacker*
  4. *The attacker uses the cookies to access the user's data*

XSS Examples

- Twitter in Sep 2010
  - *Injection of JavaScript code to a page using a tweet*
  - *You posted following tweet to Twitter*

```
There is a great event happening at
http://someurl.com/@"onmouseover="alert('test xss')"/
```

  - *Twitter parses the link and wraps it with `<a>` element*

```
There is a great event happening at
<a href="http://someurl.com/@"onmouseover="alert('test xss')"
    target="_blank">http://someurl.com/@"onmouseover=
    "alert('test xss')"/</a>
```

  - *See details at Twitter mouseover exploit*
- Other example: Google Contacts

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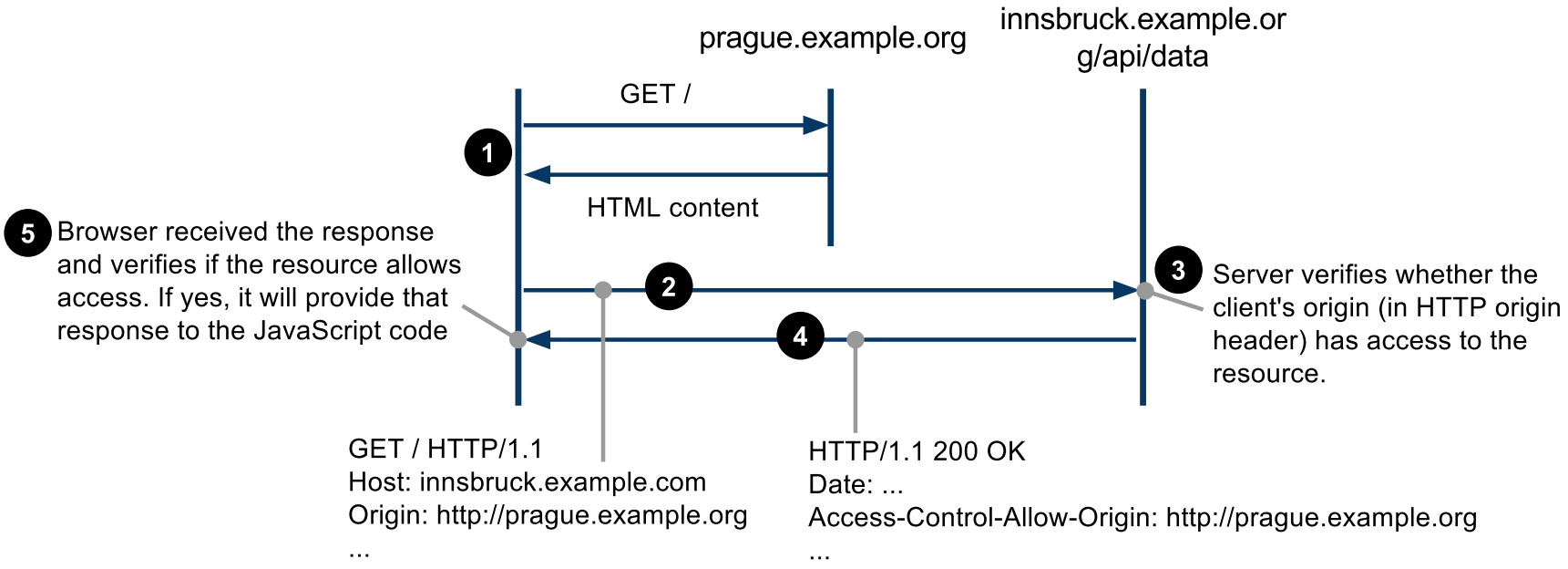
Overview

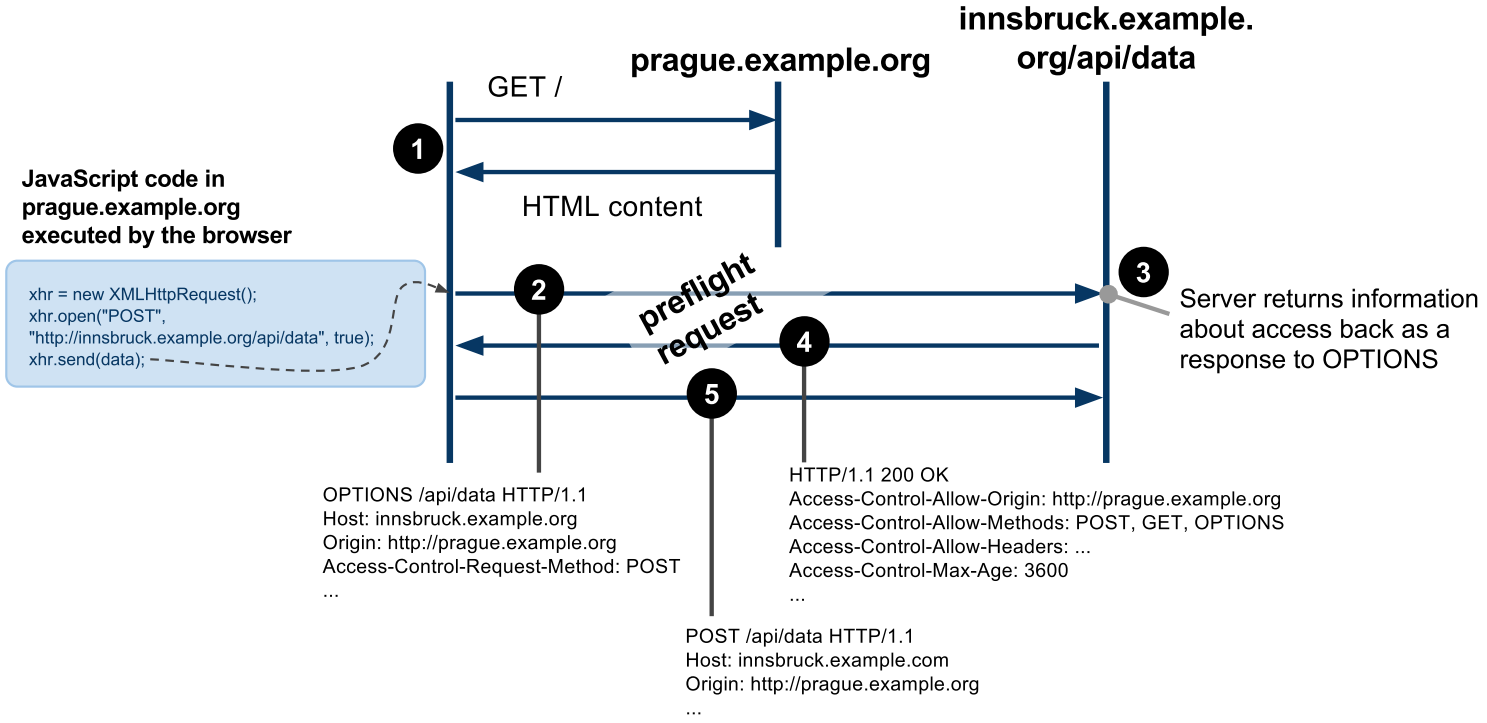
- Increasing number of mashup applications
  - *client-side mashups involving multiple sites*
  - *mechanism to control an access to sites from within JavaScript*
- Allow for **cross-site HTTP requests**
  - *HTTP requests for resources from a different domain than the domain of the resource making the request.*
- W3C specification, working draft
  - *see Cross-origin Resource Sharing*
  - *already browsers support it*
    → *see HTTP Access Control at Mozilla*

CORS Protocol – GET



- Read-only resource access via HTTP GET
- Headers:
  - `Origin` – *identifies the origin of the request*
  - `Access-Control-Allow-Origin` – *defines who can access the resource*
  - *either the full domain name or the wildcard (*) is allowed.*

CORS Protocol – other methods and "preflight"



- Preflight request queries the resource using `OPTIONS` method
  - *requests other than GET (except POST w/o payload) or with custom headers*
  - *A browser should run preflight automatically for any XHR request meeting preflight conditions*
  - *The browser caches responses according to* `Access-Control-Max-Age`

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Recall: JSON

- JSON = JavaScript Object Notation
  - *Serialization format for data representation*
  - *Very easy to use in JavaScript*
    → no need to use a parser explicitly
  - *Also great support in many programming environments*
- Key constructs
  - ***object** is a collection of comma-separated key/value pairs:*

```
{"name" : "tomas", "age" : 18, "student" : false,  "car" : null}
```

  - ***array** is an order list of values:*

```
[ "prague", "innsbruck", 45 ]
```

  - *can be nested: objects as values in an **array**:*

```
[ { "name" : "tomas", "age" : 18 },
  { "name" : "peter", "age" : 19 } ]
```

  - *and the other way around: array as values in an **object**:*

```
{ "cities" : ["prague", "innsbruck"],
  "states" : ["CZ", "AT"] }
```

  - *A complete grammar see JavaScript Object Notation*

JSON in JavaScript

- Native data format

```
// data needs to be assigned
var data = { "people" : ["tomas", "peter", "alice", "jana"] };

// go through the list of people
for (i = 0; i < data.people.length; i++) {
    man = data.people[i];
    // ... do something with this man
}
```

- Responses of service calls in JSON
  - *Many support JSON, how can we load that data?*
- Example Request-Response

```
GET http://pipes.yahoo.com/pipes/pipe.run?_id=638c670c40c97b62&_render=json

{"count":1,"value":
   {"title":"Web 2.0 announcements",
    "description":"Pipes Output",
    "link":"http:\/\/pipes.yahoo.com\/pipes\/pipe.info...",
    "pubDate":"Mon, 07 Mar 2011 18:27:20 +0000",
    "generator":"..."
    ...
   }
}
```

JSONP

- Service that supports JSONP
  - *allows to specify a query string parameter for a wrapper function to load the data in JavaScript code*
  - *otherwise the data cannot be used in JavaScript*
    → *they're loaded into the memory but assigned to nothing*
- Example
  - *if a resource at* `http://someurl.org/json_data` *returns*

```
{ "people" : ["tomas", "peter", "alice", "jana"] }
```

    then the resource at
    `http://someurl.org/json_data?_callback=loadData` *returns*

```
loadData({ "people" : ["tomas", "peter", "alice", "jana"] });
```

- A kind of workaround for the same origin policy
  - *only* `GET`*, nothing else works obviously*
  - *no XHR, need to load the data through the dynamic* `<script>` *element*

JSONP in JavaScript

- JSONP example
  - *loads JSON data using JSONP by dynamically inserting* `<script>` *into the current document. This will download JSON data and triggers the script.*

```
1  var TWITTER_URL = "http://api.twitter.com/1/statuses/user_timeline.json?" +
2    "&screen_name=web2e&count=100&callback=loadData";
3
4  // this needs to be loaded in window.onload
5  // after all document has finished loading...
6  function insertData() {
7      var se = document.createElement('script');
8      se.setAttribute("type","text/javascript");
9      se.setAttribute("src", TWITTER_URL);
10     document.getElementsByTagName("head")[0].appendChild(se);
11     // And data will be loaded when loadDta callback fires...
12 }
13
14 // loads the data when they arrive
15 function loadData(data) {
16     // we need to know the the structure of JSON data that is returned
17     // and code it here accordingly
18     for (i = 0; i < data.length; i++) {
19         data[i].created_at // contains date the tweet was created
20         data[i].text // contains the tweet
21     }
22 }
```

JSON Vulnerability

- What it is
  - *JSON array data accessible via GET (normal access is via XHR)*
  - *Attacker may load the data in a `script`, redefine `Array` object, and assign the data to a variable.*
  - *Attacker's page with a script that you access:*

    → your browser uses your cookies to load the resource

```
1  <script type="text/javascript">
2  var yourData;
3  Array = function() {
4      yourData = this;
5  }
6  </script>
7
8  <script src="yourdomain.cz/yoursecretdata.json" type="text/javascript"></script>
```

- Prevention
  - *Using prefix in the data – the prefix makes the JSON data invalid; the client must strip the prefix before parsing the data as JSON*

```
1 | [ "a": "account", 433, 5543 ]
```

  - *Use only POST for sensitive data*