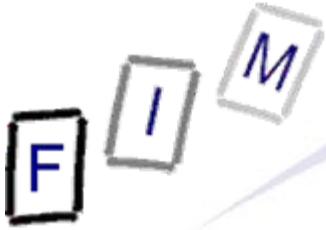

Mag. iur. Dr. techn. Michael Sonntag

Ajax Security in Groupware

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Institute for Information Processing and
Microprocessor Technology (FIM)
Johannes Kepler University Linz, Austria

E-Mail: sonntag@fim.uni-linz.ac.at
http://www.fim.uni-linz.ac.at/staff/sonntag.htm

Introduction

- What is "Ajax"?
  - → Promises for groupware
- Inherent security issues
  - → Client-side data verification, cross-domain integration etc.
- Exacerbated security issues
  - → Communication security, code injection, client-side code, …
- Possible solutions
  - → Implementation and design approaches
- Conclusions
  - → Open problems
  - → Recommendations

What is "Ajax"?

- Ajax = Asynchronous JavaScript and XML
  - → Not a new technology, but new hype (?)
- Basic idea: Make the web more like an application
  - → No form submit & page reload, but working on a single page
- Implementation:
  - → Normal webpage enhanced with JavaScript
  - → On some event, JavaScript generates an XML request
  - → The request is sent to the server the page originates from
  - → Answer calculated by server and sent back in XML
  - → JavaScript decodes the response and displays it
- Modifications and alternatives:
  - → XML replaced by other format, e.g. JSON or plain text
  - → Applets, Flash, …
    - » Locally installed plugins

Promises of Ajax for groupware

- Special advantages for groupware
  - → No need for installing local applications (easy "distribution")
  - → Both outgoing and incoming information possible at any time without interrupting the user
    - » More timely alerts on actions by others
    - » No need for submitting a webpage to send information
  - → Reduced response times: Only sent what is exactly needed
- Mash-ups: Content from several servers on a single page
  - → Integration of infos and interaction from several sources
    - » Only for display and separate usage
    - » Actual data exchange or interaction between the platforms still requires additional work; easier with Ajax (on same page!)
  - → Actions in one platform can be used for notifications or personalization in all participating systems

Inherent security issues

- Asynchronicity: No longer 1 user = 1 server thread
  - → Requests might be outdated when actually served
  - → Responses might be sent to the wrong page
    - » Result of long calculation; user changed static (=quick) page
  - → JavaScript must cope with ANY information sent to it!
- Server-side data verification: Never trust the client
  - → Typical task: Client-side form validation with server help
  - → Server must revalidate everything (= validate twice)!
    - » Groupware can use the intermediate verification for notifications!
- Session tracking: All Ajax calls should be within a session
  - → Session ID (hidden field, link parameter) must be encoded by JavaScript and checked on server
    - » Even when the Ajax call is session-independent
    - » Otherwise they become public services anyone can use!

Inherent security issues

- Cross-domain integration (mash-ups):
  - → All data must go through a single server: JavaScript cannot contact servers other than the one the page was loaded from
    - » At least in theory: Numerous bugs exist which allow this!
      - – Result: Any information from one of the participating servers can be sent to an arbitrary other server!
- Page validation & testing: Checking e.g. for WAI-conformity
  - → How to check webpages changed dynamically on the client?
    - » What if markup (not just data) is sent by the server?
  - → Typically browsers allow no access to the "compound" page, only to the in-memory object representation (DOM, …)
  - → Testing more difficult: Simulating user input? Verifying the response? → DOM modification/inspection?
- Similar to distributed computing: More difficult to program
  - → More bugs to be expected!

Exacerbated security issues

- Comm. security: Server sends code executed on clients
  - → Man-in-the-middle–attacks very attractive
  - → Intermediate values are sent (e.g. password in wrong field)
- Multiple entry points: Each Ajax call is a separate script
  - → Framework or strict security guidelines needed
  - → Potential programming and maintenance problem
    - » But: Each function clearly separated and smaller
- Code injection: Server can send anything
  - → Clients cannot verify the code sent from the server
  - → Problems with mash-ups: Code from third party servers cannot even be verified by the main (=proxy) server!
- Client-side code: JavaScript is very "bug-prone"
  - → No type checking, weak objects, etc.!
- Program code accessible on client

Possible solutions: Implementation

- Server-side data verification
  - → Revalidate everything validated through Ajax on the client
  - → Verify the state: Is this Ajax call allowed for the page, the client currently is on?
    - » Requires extended state infos on server, e.g. unique tokens for each "main" page, which must be passed back with Ajax calls!
- Client-side input verification
  - → Clients should verify data from server too, if possible
    - » But: Code cannot be verified
    - » The verification code itself comes from the server too…
      - – See communication security!
      - – Therefore pointless against "attacks", only helps with errors
- Timeouts on the client
  - → Avoid lock-ups on server problems
  - → Reduces the danger of inconsistencies between **A**jax calls

Possible solutions: Implementation

- Proxy server must inspect information passed on
  - → When assembling a page from different sources, only pass on data, but never code, and inspect in thoroughly
    - » Do not pass on encrypted or obfuscated code or data
    - » Some code will be necessary: verify it and then host it locally!
  - → Investigate interdependencies between services
    - » They are running within the same security context on the client!
- Use an encrypted communication channel
    - » Includes secure comm. with "base servers" for mash-ups!
  - → Prevents tampering of (dynamically sent!) code
    - » Encryption through JavaScript code on client is NOT secure!
    - » Ensures that Ajax calls are encrypted too
  - → Requires server verification: Encryption alone is insufficient
    - » Depending on program "distribution", clients might need identification and verification too

Possible solutions: Design

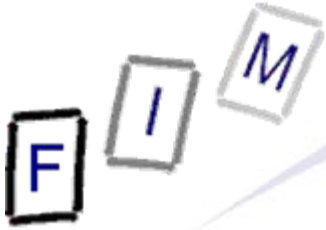
- Restrict data and invocation models for Ajax
  - → Use the GET model: Retrieve information from the server by Ajax, but don't change the server's state through it
    - » Avoids problems because of asynchronicity!
    - » Receiving notices : Server sends updates to display
      - – No influence on actual "behaviour", e.g. form contents!
  - → Sending notices as one-way only
    - » The client informs the server, but doesn't expect an answer
      - – Awareness features in groupware!
  - → I.e. avoid "data loops"
    - » Client 1 → Server → Client 1 or in reverse (S → C → S)
    - » Careful with mash-ups: Loops over third-party servers possible!
    - » Less problematic if the user is within the loop
      - – But problems possible even then

Possible solutions: Design

- Keep the business logic on the server
  - → Ajax: Transfer some (or all) logic to the client
  - → This cannot be any business critical or security related logic!
    - » The server cannot verify the result unless it recreates it
  - → All the "base" data must be sent back and the server then calculates any results or consequences from it (again)
    - » Danger of inconsistencies between what users see
      - – Calculated by JavaScript
    - » and what happens on the server!
      - – Calculated by a different program in PHP, C++, ...
  - → Alternative: The server trust the clients completely
    - » Secure client identification in SSL through mutual authentication

Conclusions

- Open problems:
  - → Page validation and testing
    - » Test all parts separately
    - » Use framework and strict guidelines for assembly
  - → Code accessibility
    - » Cannot really be avoided
    - » Make sure no secret information is ever sent to the client!
  - → Legal responsibility: Proxying has legal consequences….
    - » Regarding both licenses and liability!
- Recommendations:
  - → Ajax can greatly enhance the UI and its responsiveness
    - » But use it for this only, not for distributing the program
  - → Make sure the connection is secured
  - → Drop the "A" in "Ajax" if possible: Avoid asynchronicity
    - » Programming harder; additional problems, e.g. synchronization



Questions?

Thank you for your attention!