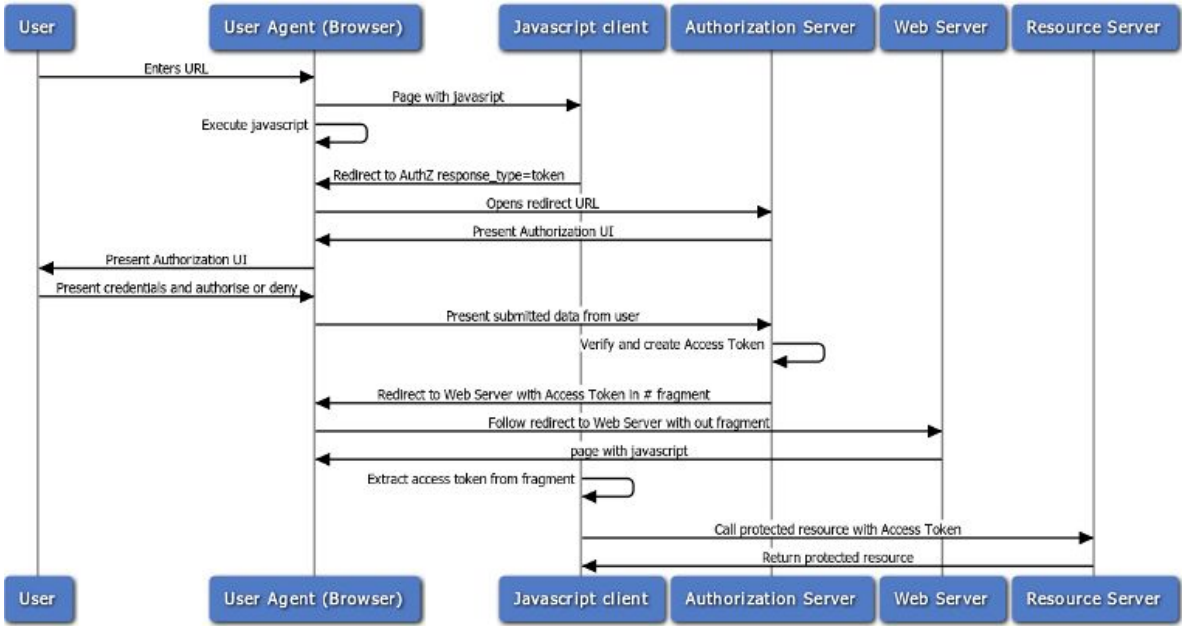
Introduction

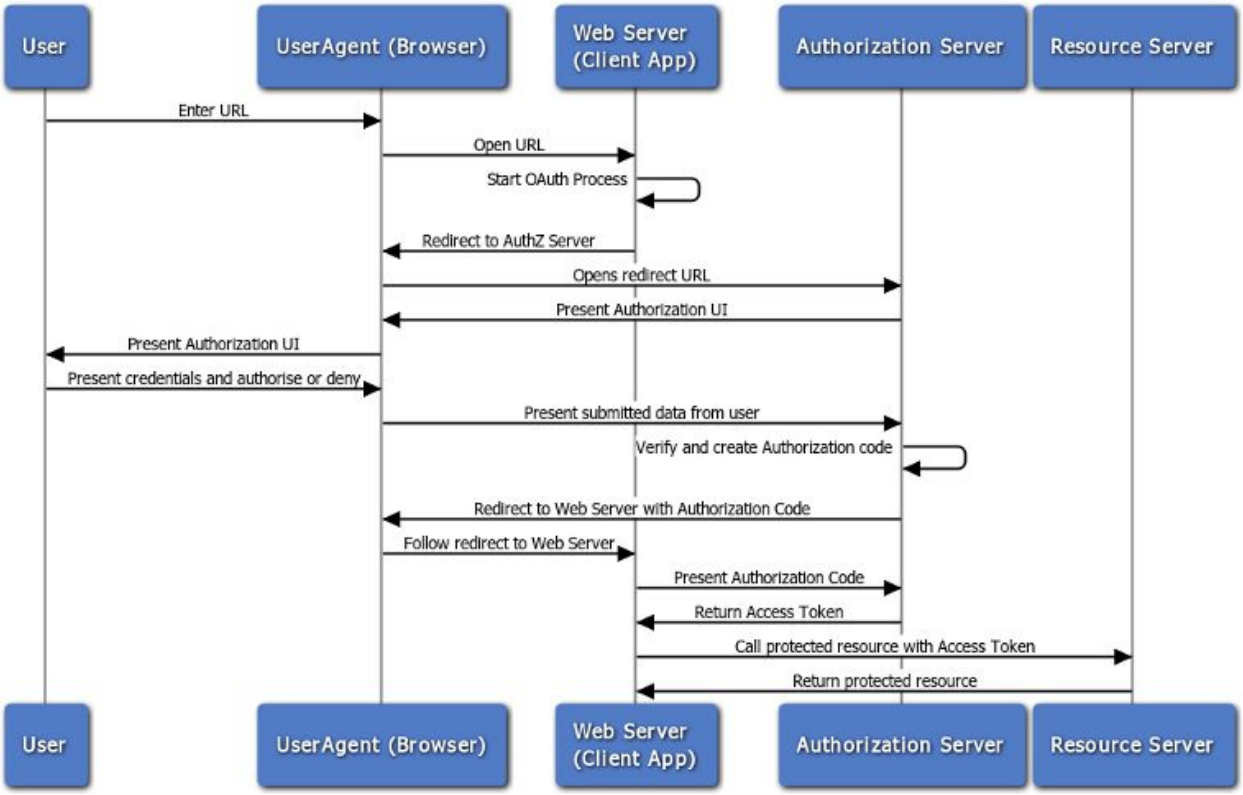
- Social sign-on: users use social networks to sign on to a third-party site
    - Microsoft, Facebook (OAuth), Google (OpenID)
- Example: Yelp
    - Yelp allows you to log on via Facebook
    - Clicking login will open a window with Facebook login
    - Facebook will prompt for permission for Yelp to access certain data
    - Returns to Yelp with successful authentication
- Security goals
    - User doesn't want unauthorized access to personal info
    - Yelp wants to ensure that user is correct
    - Facebook wants to ensure Yelp and user are who they say they are
    - Need to be secure over insecure web!
- Social Login CSRF
    - Assumptions
        - User must have previously logged into third party client via OAuth, e.g. Facebook
        - Facebook only asks for authorization the first time
    - Attacker controlled site can log into third party client and access third-party APIs on behalf of user without user's knowledge

OAuth

- OAuth 2.0 involved parties
    - Resource server
    - trusted authorization server
    - Resource owner
    - user agent
    - client
- Comparison with first OAuth
    - *flows* are protocol configurations
    - lightweight and flexible
- User Agent flow
    - Used to perform auth from a user-agent running a client application
    - Figure below details flow



- Web Server Flow
    - Used between client server and resource server/auth server
    - Figure below details flow



- Protocol parameters

    - **redirection URI**: tells where the authorization server should sent its response (the access token) to. This in effect determines where the user agent navigates to after authorization.
    - **state**: a nonce that is strongly bound to a resource owner's session. It is attached to the request when client app tells user agent to redirect to auth server.
        - prevents Social CSRF
- Threat model
    - network attackers
    - malicious sites
    - malicious redirectors
    - existing CSRF vulns in clients
- Security goals are modeled in Datalog-like policies

WebSpi

- A library of idioms useful in modeling web app security
- Model constituents
    - **Principals**: users and servers
        - own credentials / pub-priv keys
        - WebSurfer
    - **Processes**: Receives and responds over channels; does actions
        - CredentialFactory
        - HttpClient (e.g. browsers)
        - HttpServer
    - **Channels**: communication pathways
        - net: HttpClient communicates with HttpServer
        - httpClientRequest: user submits http request & uri to HttpClient over this private channel
        - httpClientResponse: HttpClient returns response through this private channel
- Security policies
    - Assume(...): Adds given statement to global knowledge
        - Assume(UserSends(user,message))
    - Expect(...): Must be able to prove statement at this point in the code
        - Expect(ServerAuthorizes(s,u,d)): prove that server s is willing to authorize user u to get data d
    - "security policies are defined as Horn clauses extending a predicate `fact`"
        - "A Horn clause with exactly one positive literal is a **definite clause**; a definite clause with no negative literals is sometimes called a **fact**; and a Horn clause without a positive literal is sometimes called a **goal clause** (note that the empty clause consisting of no literals is a goal clause)."

    - Says(...): if a fact e is true, then it is assumed to be said by any principal. If a principal is compromised, then the principal is untrusted and can say anything.
- Modeling
    - Three processes: process running on HttpServer, client process on HttpClient, user process using a user-agent
    - LoginUserAgent() process
        - in(httpClientResponse, (....))
            - gets a login page info in (...) from channel httpClientResponse, which is the response received by httpclient when requesting login page
    - LoginApp() process
- Attacker model
    - Dolev-Yao
    - All channels and tables in WebSpi are private by default
    - AttackerProxy
        - receives commands on public chan "admin", and sends results out on public chan "result".
        - Manage principals
        - Network attacks
        - Start malicious client sites / client webapps
        - Inject malicious javascript to HttpClient

OAuth 2.0: ProVerif Analysis

- OAuth 2.0 Model
    - Login application
        - process LoginApp + user-agent LoginUserAgent
        - Models form-based login
    - Data Server
        - Models resource servers
    - user-agent flow
        - OAuthImplicitServerApp: auth servers
        - OAuthUserAgent: resource owners
    - web server flow
        - OAuthExplicitClientApp: clients
        - OAuthExplicitServerApp: auth servers
- Positive ProVerif verification
    - attacker model: network, malicious resource owners, malicious clients, malicious sites, malicious javascript, OAuth implicit + explicit flows
        - no http redirectors, no CSRF on honest apps
- Attacks
    - Social CSRF

- Token redirection