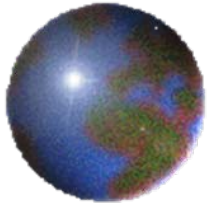

HTTP Mutual authentication and Web security

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Web security

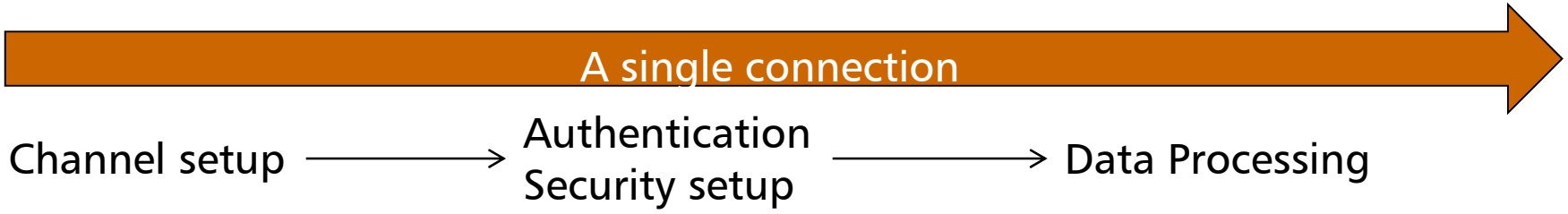
- Its importance… no need to say
  - Transaction security (credit card, PayPal etc.)
  - User data privacy
- Most online consumer and business commerce transactions rely on Web

HTTP (Web) is very tricky!

- Web/HTTP auth is tricky… why?
  - It has completely different design from other protocols with authentications
  - It has very different nature of security implications, even using the same technology
  - Let me compare this with other conventional protocols, such as IMAP/TLS

Authentication in usual protocols (mail client scenario)

- A pre-configured, single server to be connected (per an account)
- A single (or a few) authenticated connection are established, and used for several requests sequentially



Web client scenario

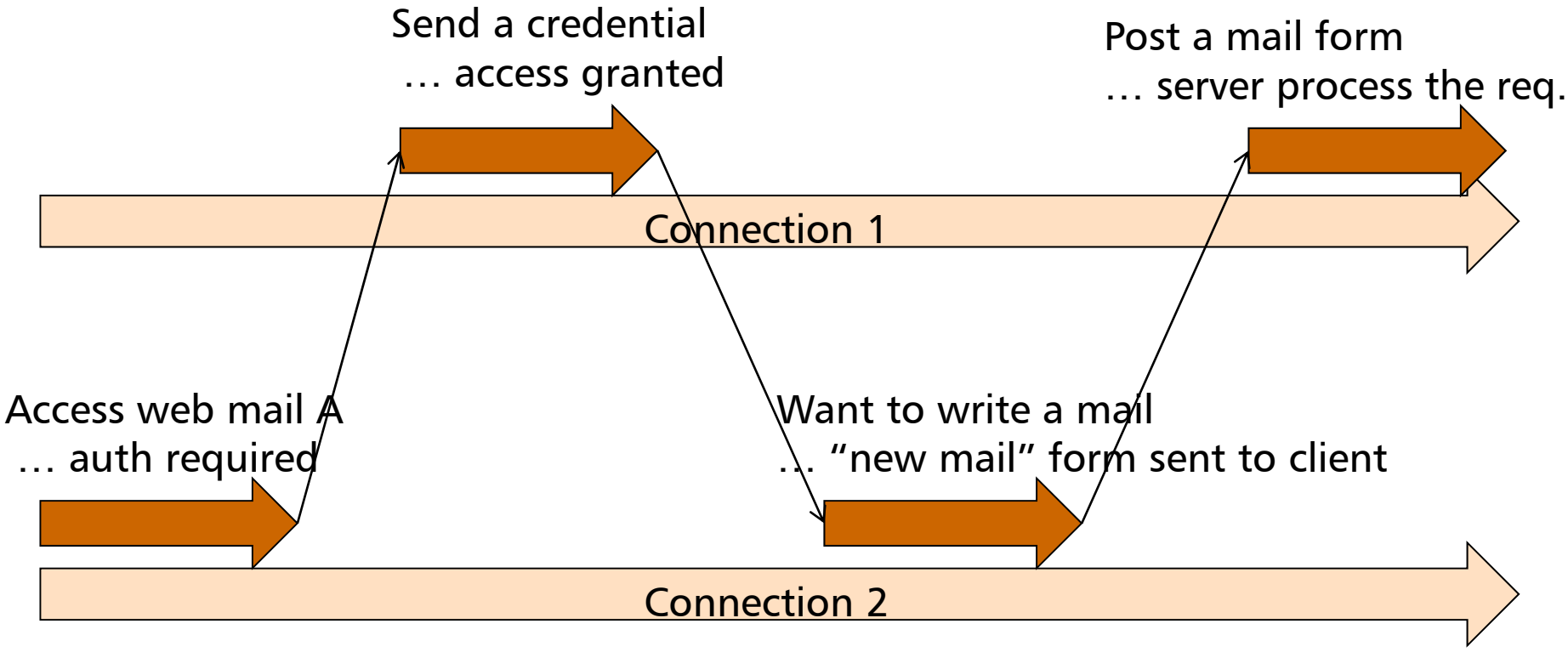
- Target host dynamically determined from URL host-part
  - It is often provided externally
    - from URL link in an email
    - from external Web site for federation (e.g. PayPal checkout, OpenID, OAuth etc.)
- No preconfigured authentication
  - When the server demands, the browser/webpage requires user credentials

Web and authentication

- HTTP is a (kind of) packed-based protocol
  - Each single request is independent from others
  - Even requests on the same channel are independent from each other
    - Requests on a “single session” can be sent on several different TCP/TLS connections
    - Requests on “different sessions” can be sent on the same connection

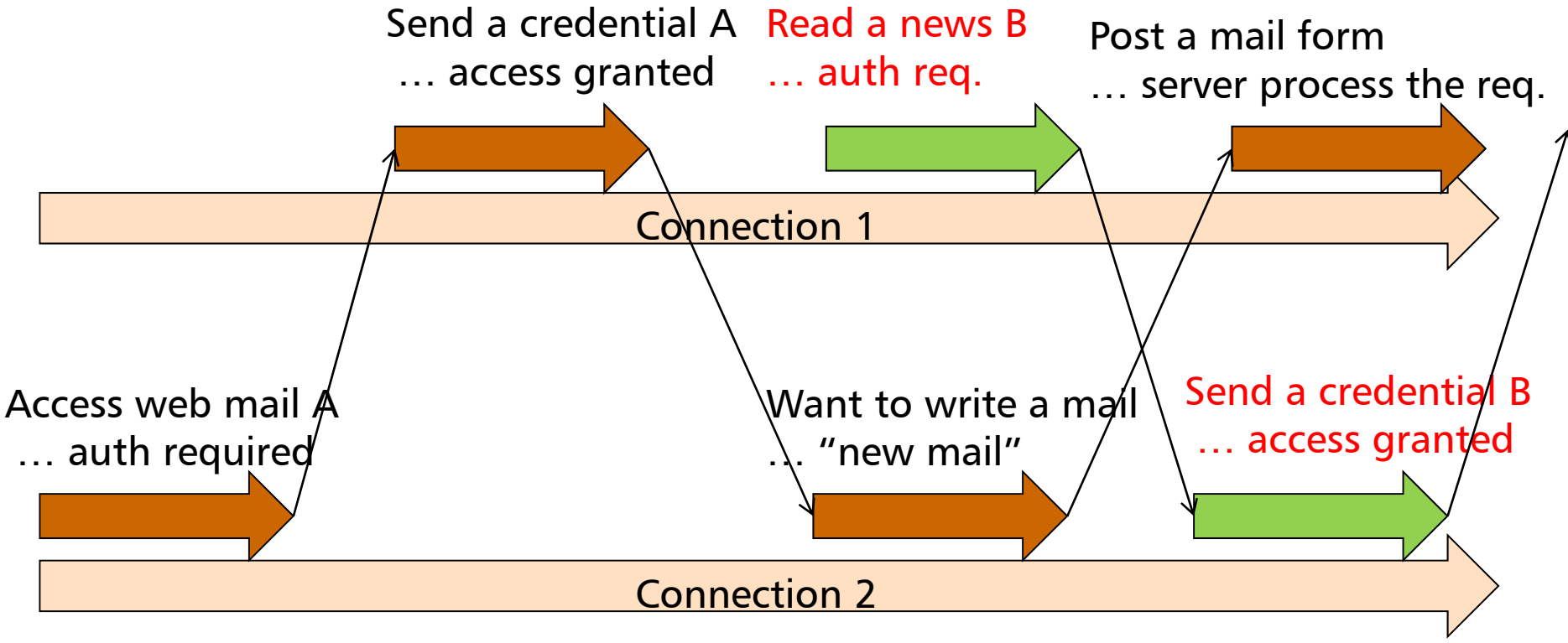
Web and authentication

- HTTP is a (kind of) packed-based protocol



Web and authentication

- …even an interleaving is possible

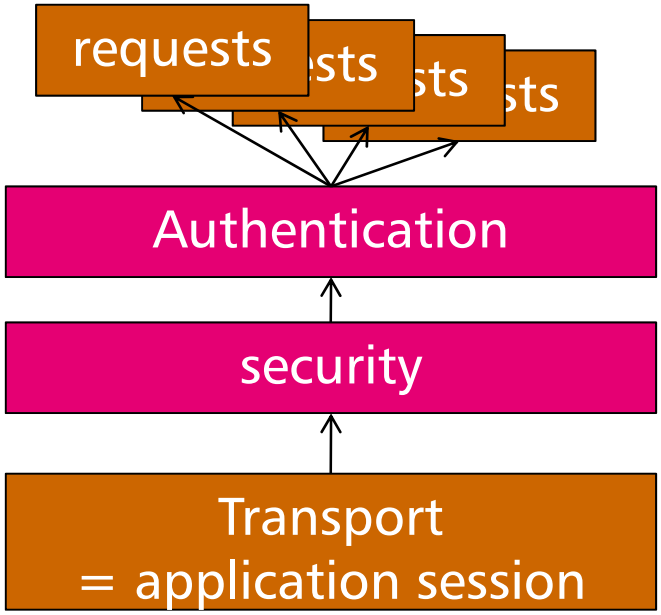


Web and authentication

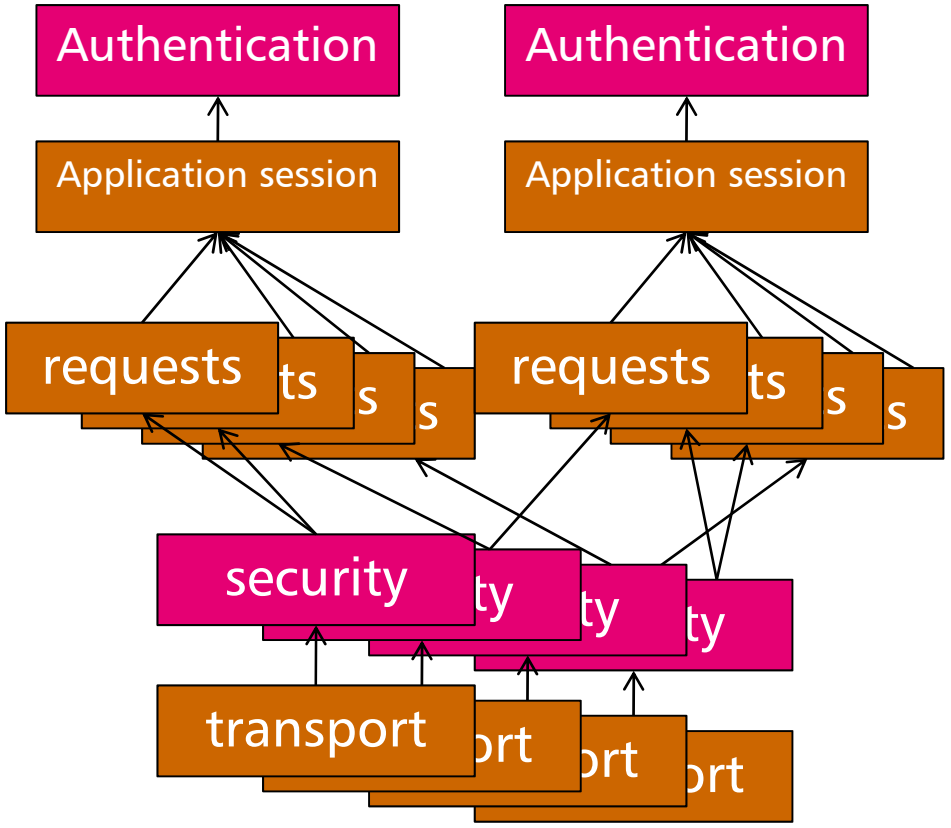
- Interleaving example: Gmail (Google)
  - Sessions of two different accounts
    (one for gmail.com domain, one for my own domain)
    runs concurrently on the same browser

Functionality layering

- Conventional protocols on TCP/TLS (e.g. IMAP)



- Web/https (per 1 host)

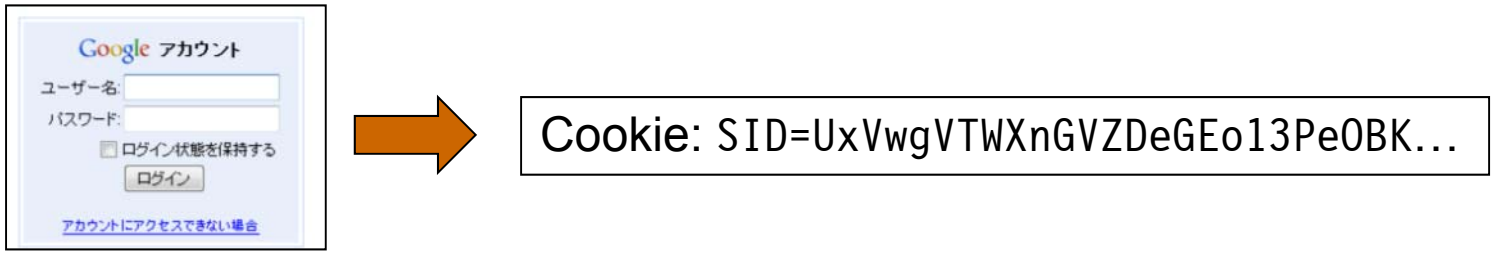


Web authentication methods

- HTTP auth (RFC 2617) has two problems
  - 1: not very strong
    - Basic = plaintext on wire
    - Digest = just a salted MD5…dictionary attack possible
  - 2: not *used*
    - Bad UI design
      - Who wants to see *that* popup dialog?
    - Lack of required flexibility to implement web apps
      - Log out, session timeout
      - Support for guest users

Web authentication methods

- Cookies are widely (ab)used
  - password checking implemented in application level using HTML and Web forms
  - Application level session ID is issued as a “cookie”
  - All authorizations and authentication status controls (such as logout, timeout etc.) are also implemented in application level



Web authentication methods

- Cookie-based authentication
  - Problems
    - Plaintext passwords always available to Web server
    - Very weak against Phishing attacks
    - Often misimplemented to cause security issues

Phishing

- A social attack on the Web
  - attacker leads victims to a wrong site with a similar looking to the genuine site
  - Steal a username and a password
  - Why happens (*only*) on Web?
    - Key: how the server authentication really works

TLS server authentication

- The client has an "*intended host*"
- The server sends a certificate to the client
  - With hostname in `CN` or `altDomainName` field
- The client checks whether
  the two hostname matches

- This works for the mail client scenario, as "intended host" is fixed. However…

TLS server authentication

- In the Web browser scenario:
  - The “intended host” is a part of the given URL
    - Dynamically determined by the browser
    - “The given URL” sometimes comes *externally*
  - So, what happens?
    - If the URL https://www.yahooo.co.jp/ is given, the browser *will* accept a connection with someone other than Yahoo! Japan™

Current Phishing countermeasures

- Phishing site blacklists
  - Hard to maintain
  - Impossible to be perfect
- EV SSL certificates
  - Sacrifices Web openness in trade with financial security requirements
  - Users still need to check the EV status bar display

Problem statement

- We have to fix the Web authentication by technology which is
  - Enough secure!
    - Addresses many current issues on the authentication
  - And, implementable, deployable and usable!
    - Web people reject *all* ideas which decrease services' flexibility and users' experiences
    - Not just scalability or security

Use cases to be targeted

- Usual “Web applications”

  … our proposal’s main target

  - Small ones such as Wiki, Trac etc.
  - Large ones such as Google, Yahoo, etc.

  - Application-specific auth scope designs
  - Needs flexibility, depending on pages

- “Intranet-type” sites
  - Users always authenticated to used
  - All pages authenticated with same credential

HTTP “Mutual” auth.

- New access authentication method for HTTP
  - Secure (↔ HTTP Basic/Digest, HTML Form)
    - No offline password dictionary attack possible from received/eavesdropped traffic
  - Easy to use (↔ TLS client certificates)
  - Provides *Mutual authentication*: clients can check server’s validity
    - Authentication will ONLY succeed with servers possessing valid authentication secrets
    - Phishers can’t make authentication to succeed

HTTP Mutual authentication proposal

- Some design decisions
  - Use HTTP-level authentications
    - Works well with HTTP architecture and existing Web application designs
  - Use with TLS encryption/server authentication
    - Already working quite well, *minus Phishing*
  - Strong protection of user identity
    - No information leakage on eavesdropping
    - Mutual authentication to detect Phishing attacks

HTTP Mutual authentication proposal

- Technologies introduced:
  - PAKE-based authentication
    - Based on ISO 11770-4 KAM3
    - Enables strong authentication, Only relying on passwords
    - Both EC and DL supported … if people wants
  - Channel binding with both HTTP and TLS
    - To prevent any forwarding-type Phishing trials
    - TLS required to prevent transport-level MITM attacks
  - Auth architecture extensions to regain usability

Sample implementations

- Modified Firefox 3.6
- Apache extension modules
- Reference implementations on Ruby

- Existing on our project Web page
  - *… but currently down ☹,*
    due to the earthquake and related blackouts
  - Will be on-line as soon as possible

Other possibilities: SASL

- SASL (RFC 4422)
  - Provides unified methods for user authentication on many applications
    - Single user database and library can be used for many applications
    - Single library can support several authentication methods from PLAIN to CRAM, NTLM or Kerberos
  - How about use for Web?

Other possibilities: SASL

- SASL (RFC 4422)
  - May be used well for “intranet”-type application
    - But not easy for usual user Web applications
  - How about use for Web as a general?
    - My answer is “not simple”
  - Auth-method flexibility leads to “security downgrade attack”
    - In mail clients, there must be a “no plaintext authentication” preference checkbox (& it’s enough)
    - But how we do it for Web browser?

Other possibilities

- TLS user authentications
  - Passwords: TLS-EAP, TLS-PSK, TLS-SRP etc.
  - Client certificates
  - At first glance, it seems to be a good idea for doing auth. in transport level, but…
    - Please remind the protocol architecture once

Other possibilities

- TLS user authentication for Web?
  - Layering problem exists
    - Impossible/hard to match authentication sessions (required by application design) with transport sessions
  - UI issues
    - Even worse than current HTTP authentications
      - Authentication must be done before the URL is known to the server
  - ◆still works for intranet-type applications
    - OK if only single, whole-the-server authentication done
  - ◆We may need a way to use certificates wisely…

Thanks!

- Some resources:
  - Draft: draft-oiwa-http-mutualauth
  - My homepage: https://staff.aist.go.jp/y.oiwa/index-en.html
    - online, have a link to the page below
  - Project homepage: https://www.rcis.aist.go.jp/special/MutualAuth/
    - Implementations and more resources exists
    - Currently down, will be up after I go back to Tokyo ☺