Secure Communication

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Lecture 14

Wrap-Up

We saw...

- Symmetric-Key Components
  - SKE, MAC
- Public-Key Components
  - PKE, Digital Signatures
- Building blocks: Block-ciphers (AES), Hash-functions (SHA-3), Trapdoor PRG/OWP for PKE (e.g., DDH, RSA) and Random Oracle heuristics (in RSA-OAEP, RSA-PSS)
- Symmetric-Key primitives much faster than Public-Key ones
  - Hybrid Encryption gets best of both worlds

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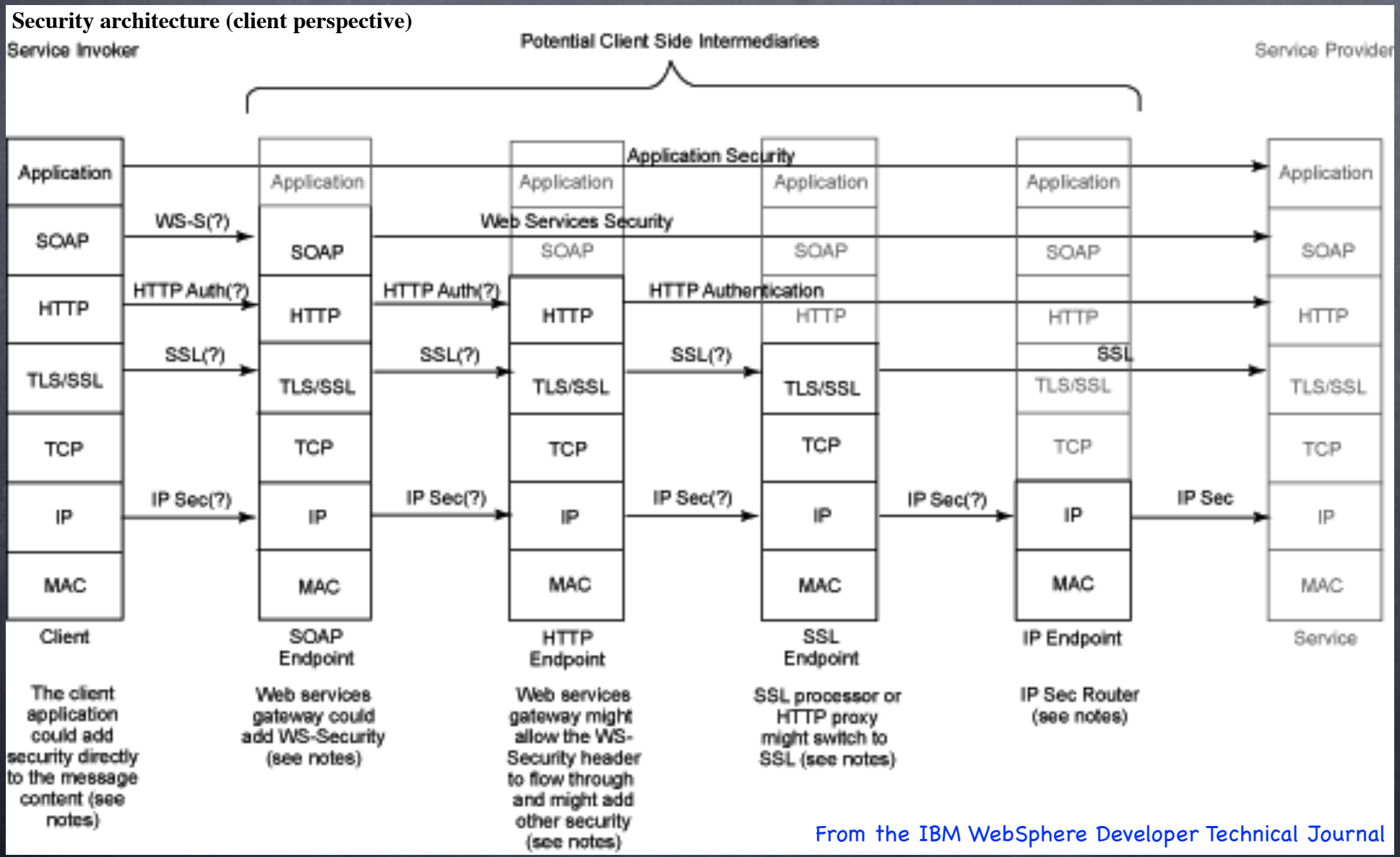
  - To not insert bugs by doing crypto engineering oneself
  - e.g.: SSL/TLS (used in https), IPSec (in the "network layer")

Security Architectures
(An example)



From the IBM WebSphere Developer Technical Journal

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  - Makes several efficiency improvements possible

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- Client-Client communication (e.g., email) Clients share public-keys in ad hoc ways

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Certificate Authorities

- How does a client know a server's public-key?
  - Based on what is received during a first session? (e.g., first ssh connection to a server)
- Better idea: Chain of trust
  - Client knows a certifying authority's public key (for signature)
    - Bundled with the software/hardware
  - Certifying Authority signs the signature PK of the server
    - CA is assumed to have verified that the PK was generated by the "correct" server before signing
    - Validation standards: Domain/Extended validation

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  - Solution: Use fresh public-keys/do a fresh key-exchange for each session (authenticated using signatures)

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Authentication for free: MAC serves dual purposes!

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Several details on closing sessions, session caching, resuming sessions ...

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- Back-Doors (?) in the primitives used in the standards

Beyond Communication

- Encryption/Authentication used for data at rest
  - e.g., disk encryption, storing encrypted data on a cloud server, ...
- Security definitions like SIM-CCA do not directly extend to all these settings
  - New concerns that do not arise in setting up communication channels
  - e.g., circular (in)security: encrypting the SK using its own PK

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- Quantum cryptography (secure communication)