NTP Security Algorithms

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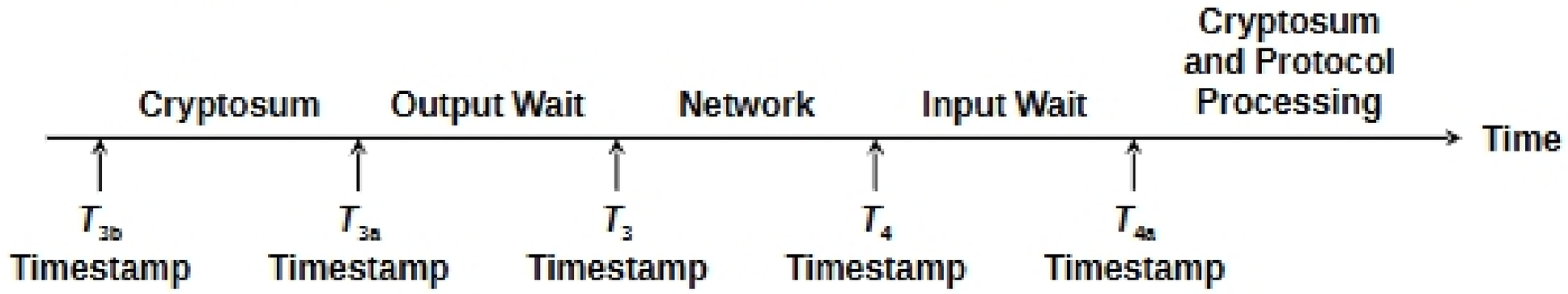
Sir John Tenniel; *Alice's Adventures in Wonderland*, Lewis Carroll

Symmetric key and public key cryptography

- Public key cryptography
  - Encryption/decryption algorithms are relatively slow with highly variable running times depending on key and data
  - All keys are random; private keys are never divulged
  - Certificates reliably bind server identification and public key
  - Server identification established by challenge/response protocol
  - Well suited to multicast paradigm
- Symmetric key cryptography
  - Encryption/decryption algorithms are relatively fast with constant running times independent of key and data
  - Fixed private keys must be distributed in advance
  - Key agreement (Diffie-Hellman) is required for private random keys
  - Per-association state must be maintained for all clients
  - Not well suited to multicast paradigm

Message propagation time budget



- We want T_3 and T_4 timestamps for accurate network calibration
  - If output wait is small, T_{3a} is good approximation to T_3
  - T_{3a} can't be included in message after cryptosum is calculated, but can be sent in next message; use T_{3b} as best approximation to T_3
  - T_4 captured by most network drivers at interrupt time; if not, use T_{4a} as best approximation to T_4
- Largest error is usually output cryptosum
  - Private-key algorithms (MD5, DES-CBC) running times range from 10 μs to 1 ms, depending on architecture, but can be predicted fairly well
  - Public-key algorithms (RSA) running times range up to 100 ms, depending on architecture, but are highly variable and depend on message content