CSE 484 / CSE M 584 (Autumn 2011)

Introduction to Cryptography (cont.)

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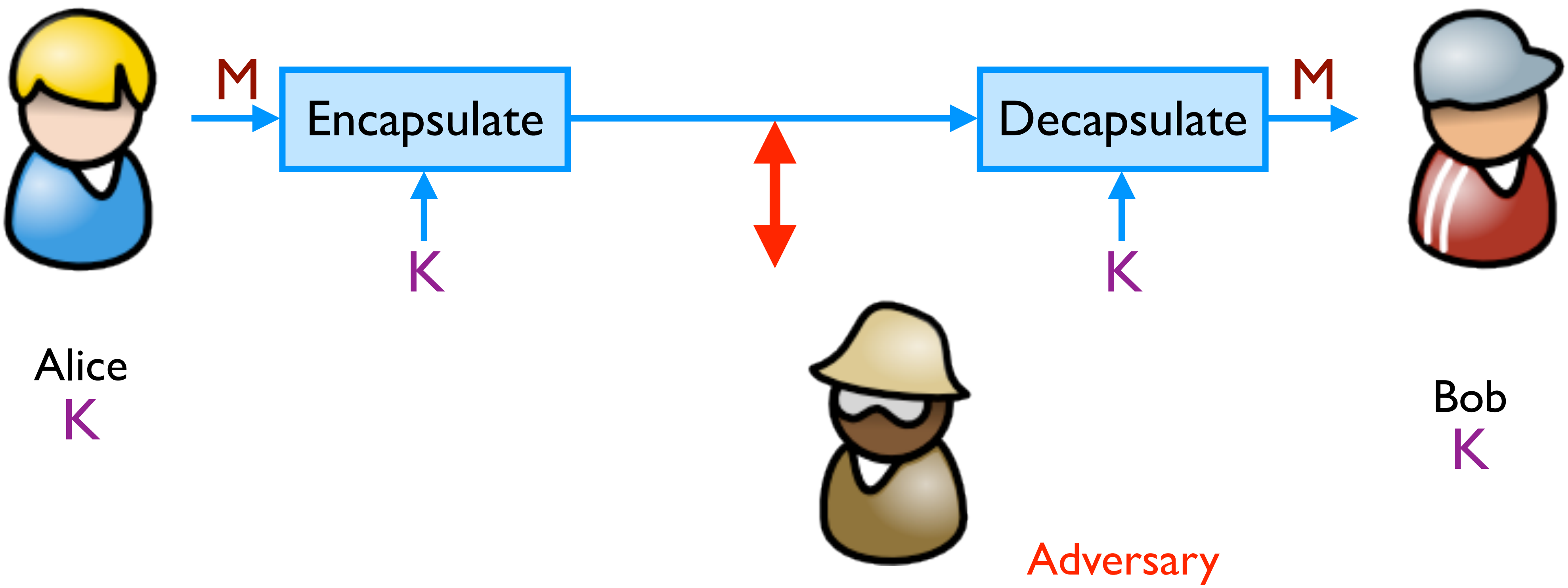
Thanks to Dan Boneh, Dieter Gollmann, John Manferdelli, John Mitchell, Vitaly Shmatikov, Bennet Yee, and many others for sample slides and materials ...

Updates Oct. 12th

- **Coffee/tea** signup sheet posted (optional)
  - Next is Friday @11 am. Meet in CSE Atrium
- **Lab 1** due next Friday (10/21) @5pm
  - TA office hours Friday before class (CSE 002)
  - My office hours today after class (CSE 210)
- **Reading:** over the next few days, Crypto chapters (Ch. 12--15, ~50 pages) in Daswani et al.

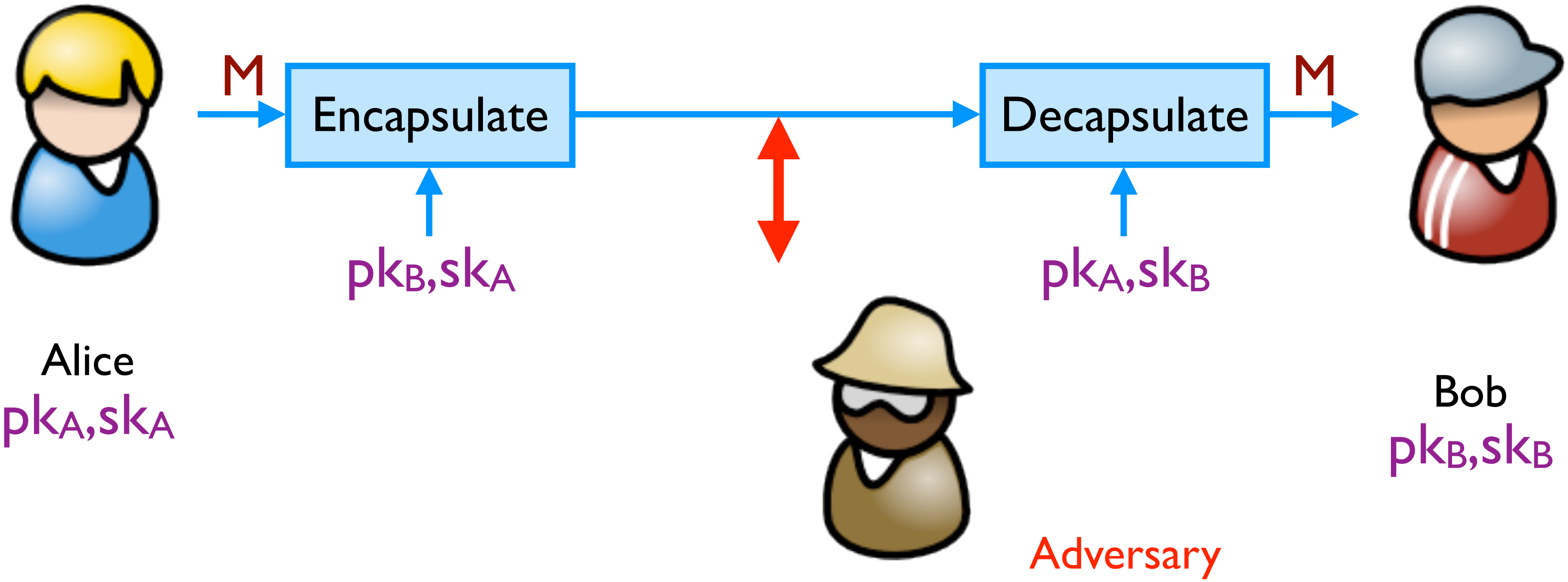
Symmetric Setting

Both communicating parties have access to a shared random string K, called the key.

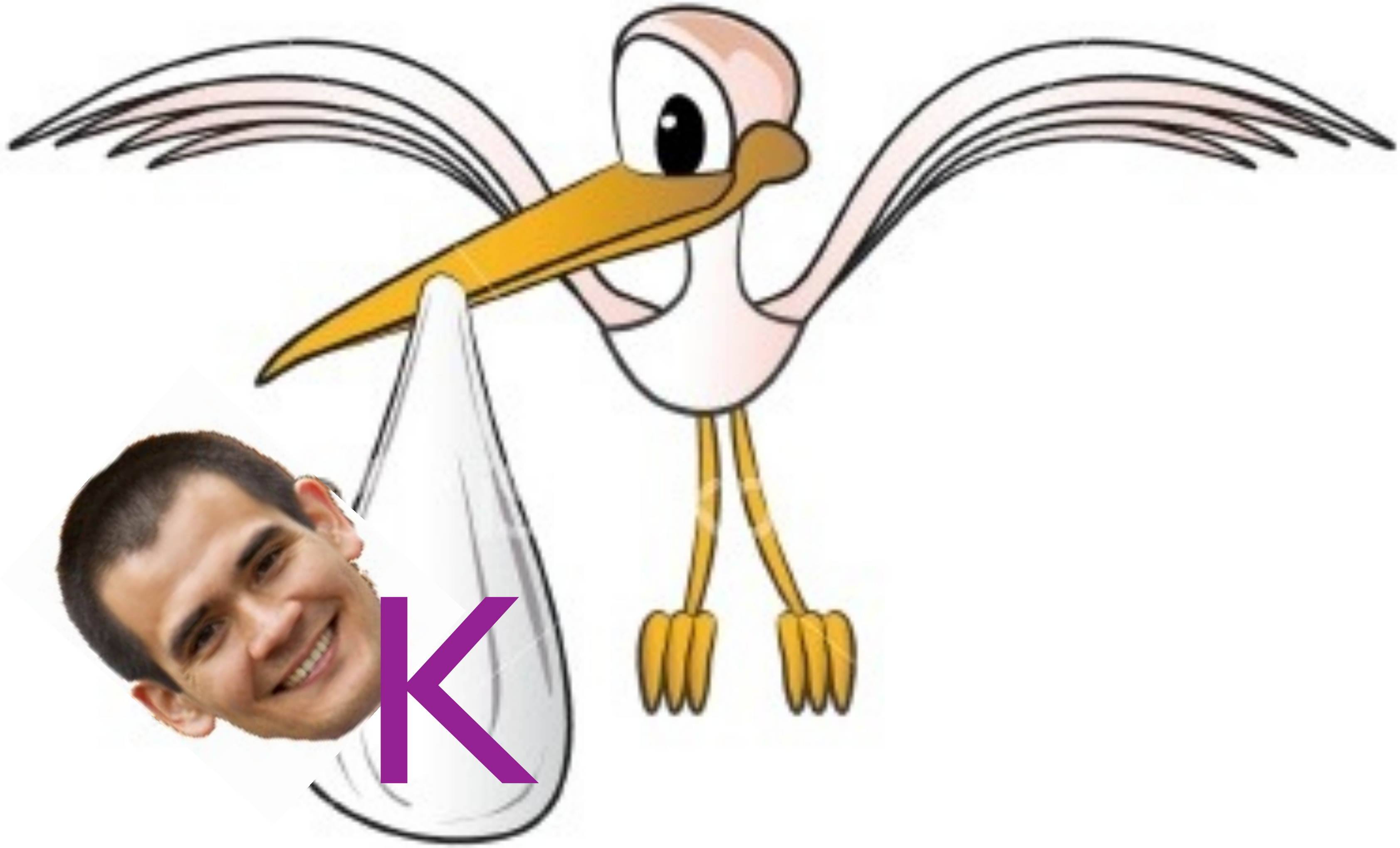


Asymmetric Setting

Each party creates a public key pk and a secret key sk.



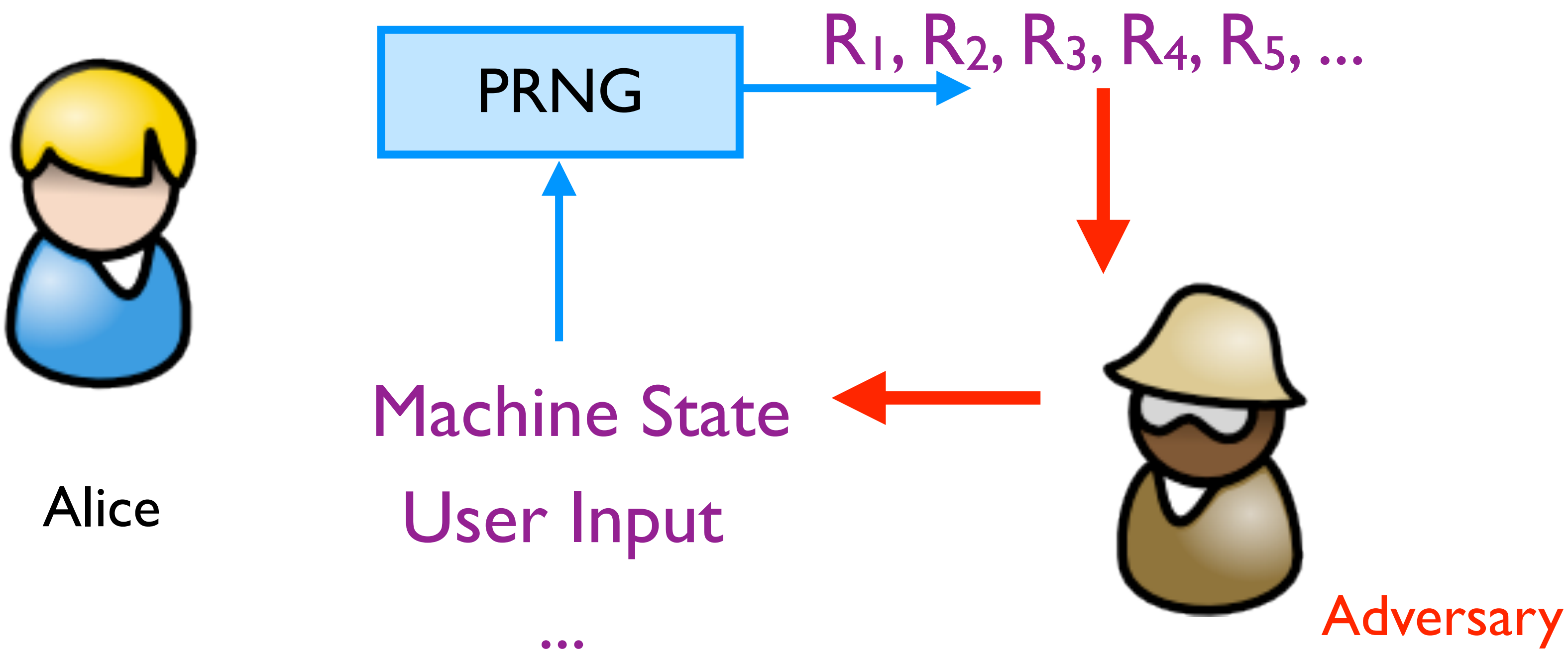
Where do keys come from?



(http://4.bp.blogspot.com/_8MUCc1TyEQ0/SV1WcICKXuI/AAAAAAAAAro/Vh5Jr929oT4/s1600-h/stork)

“Random” Numbers

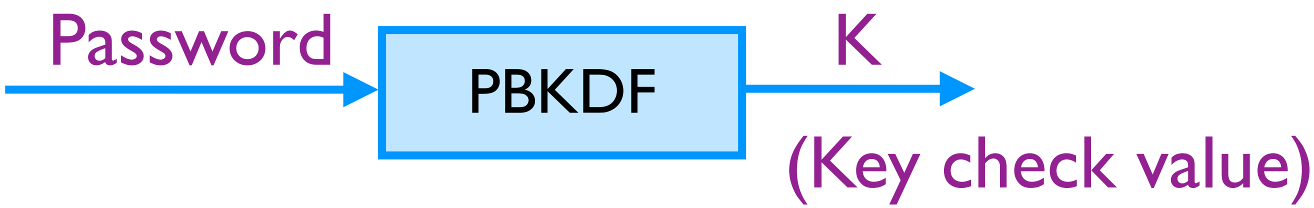
Pseudorandom Number Generators (PRNGs)



Getting keys: PBKDF

Password-based Key Derivation Functions

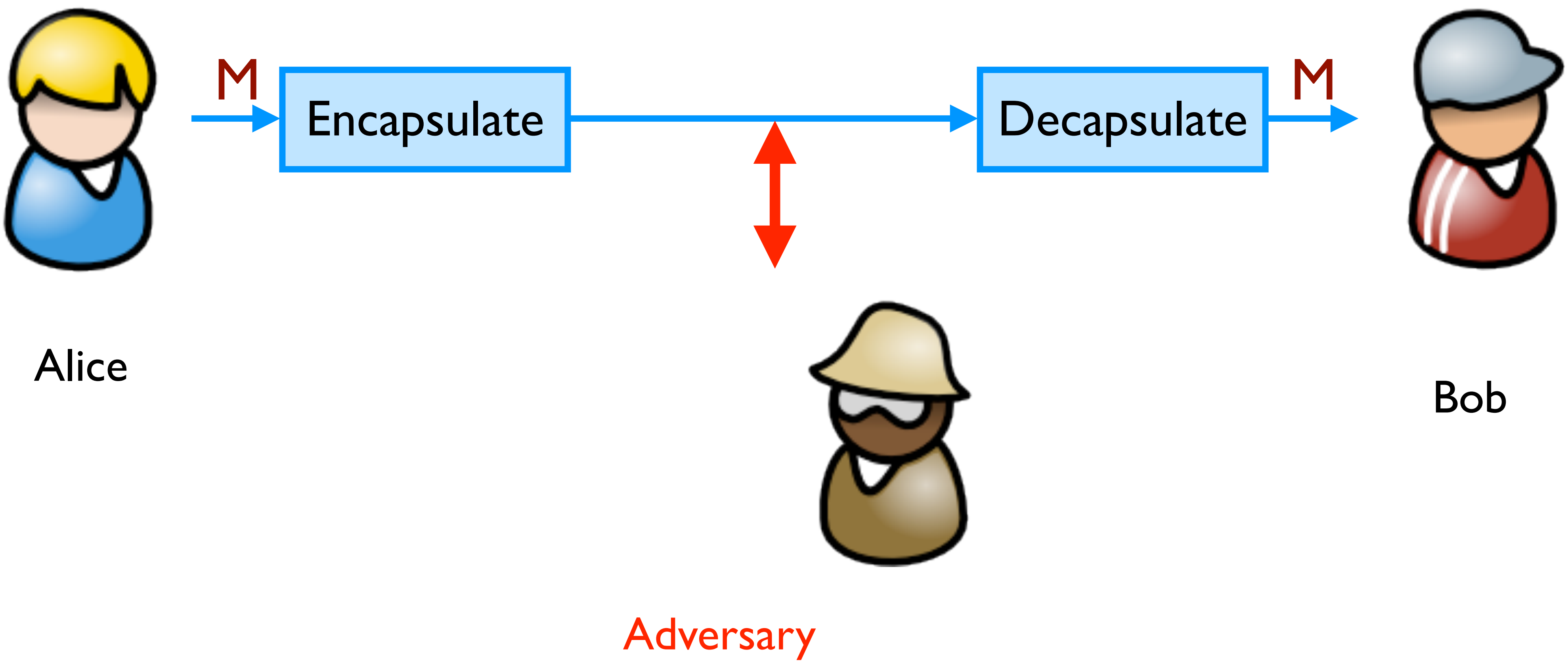
Alice



Getting keys: CAs

Each party creates a public key pk and a secret key sk.

(Public keys signed by a trusted third party: a certificate authority.)



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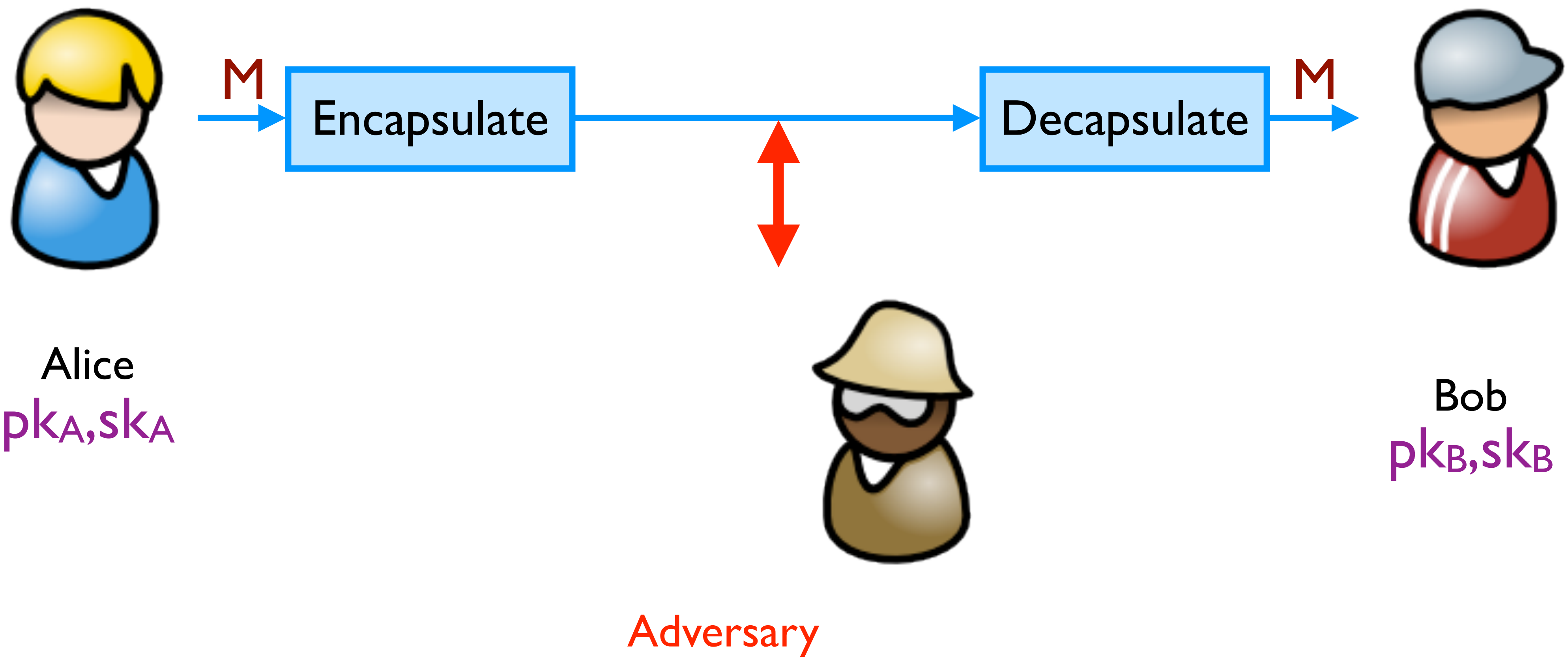

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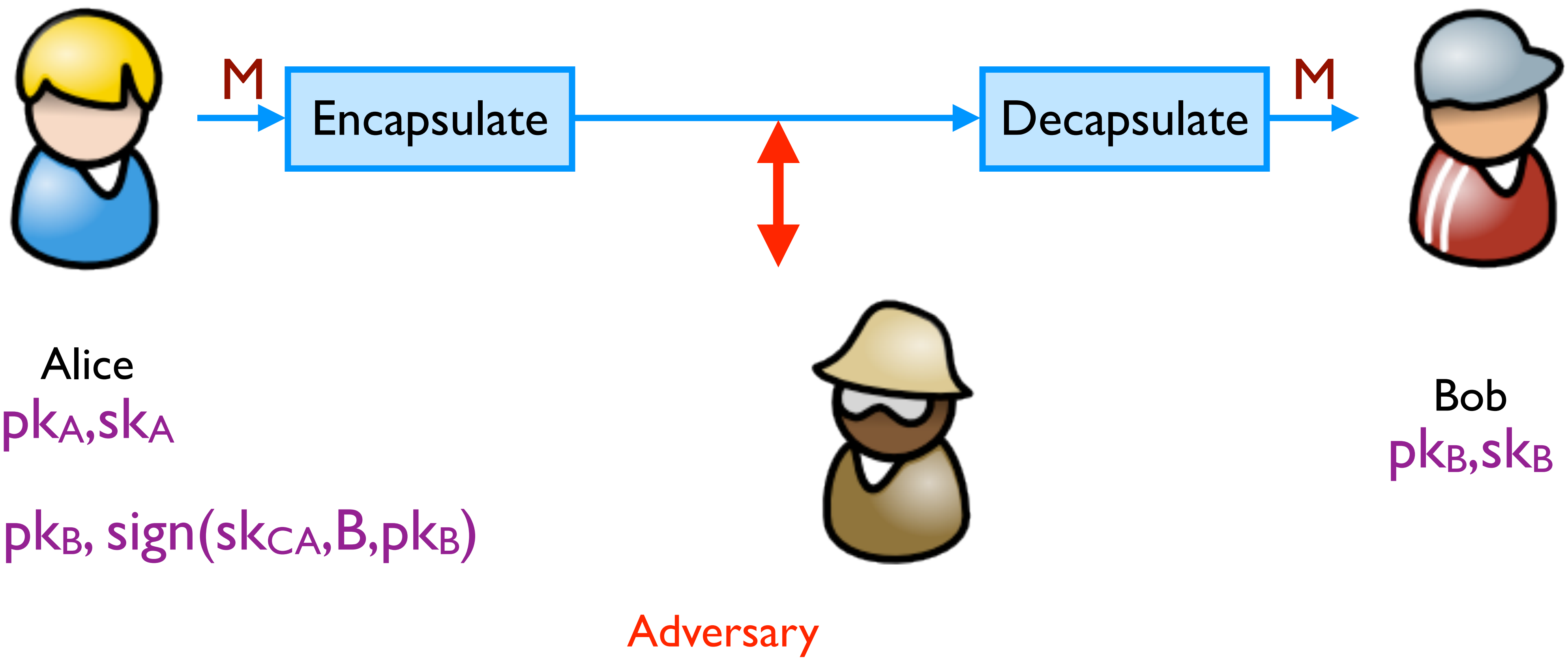

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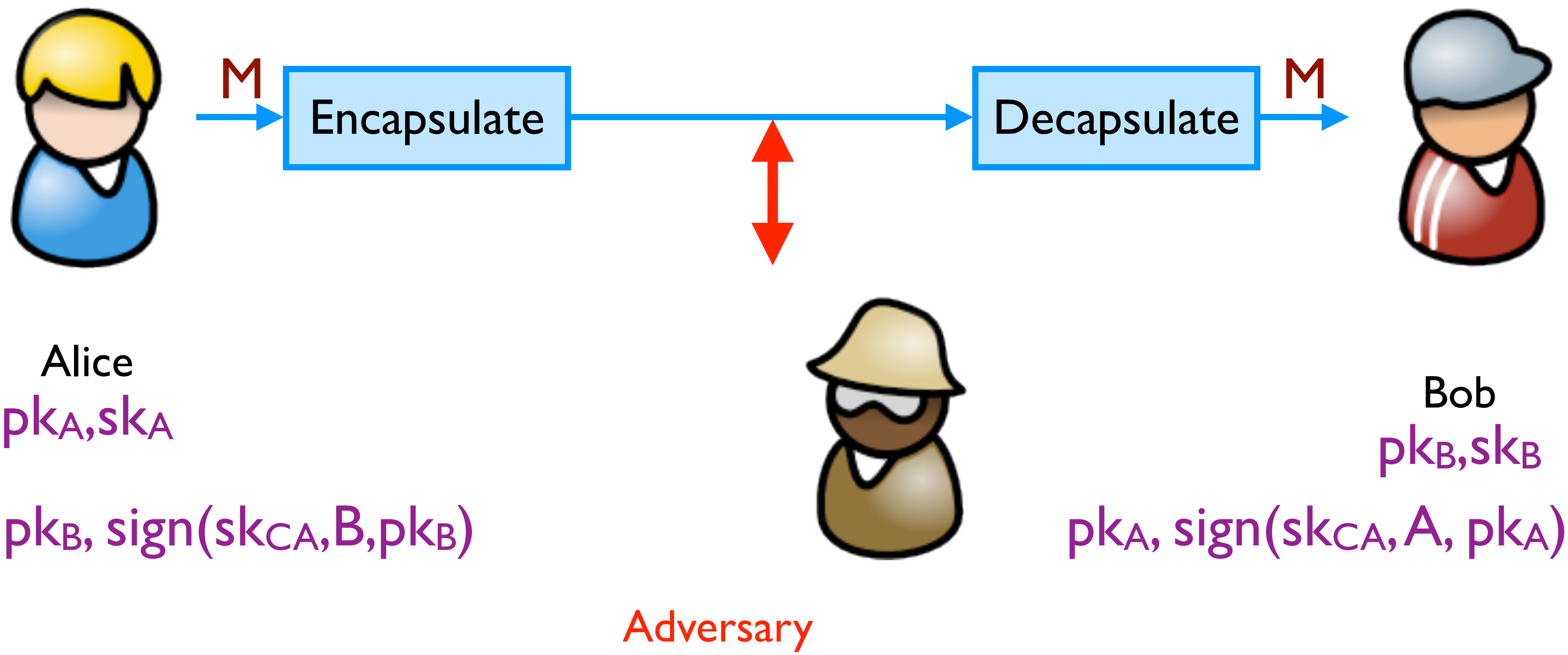

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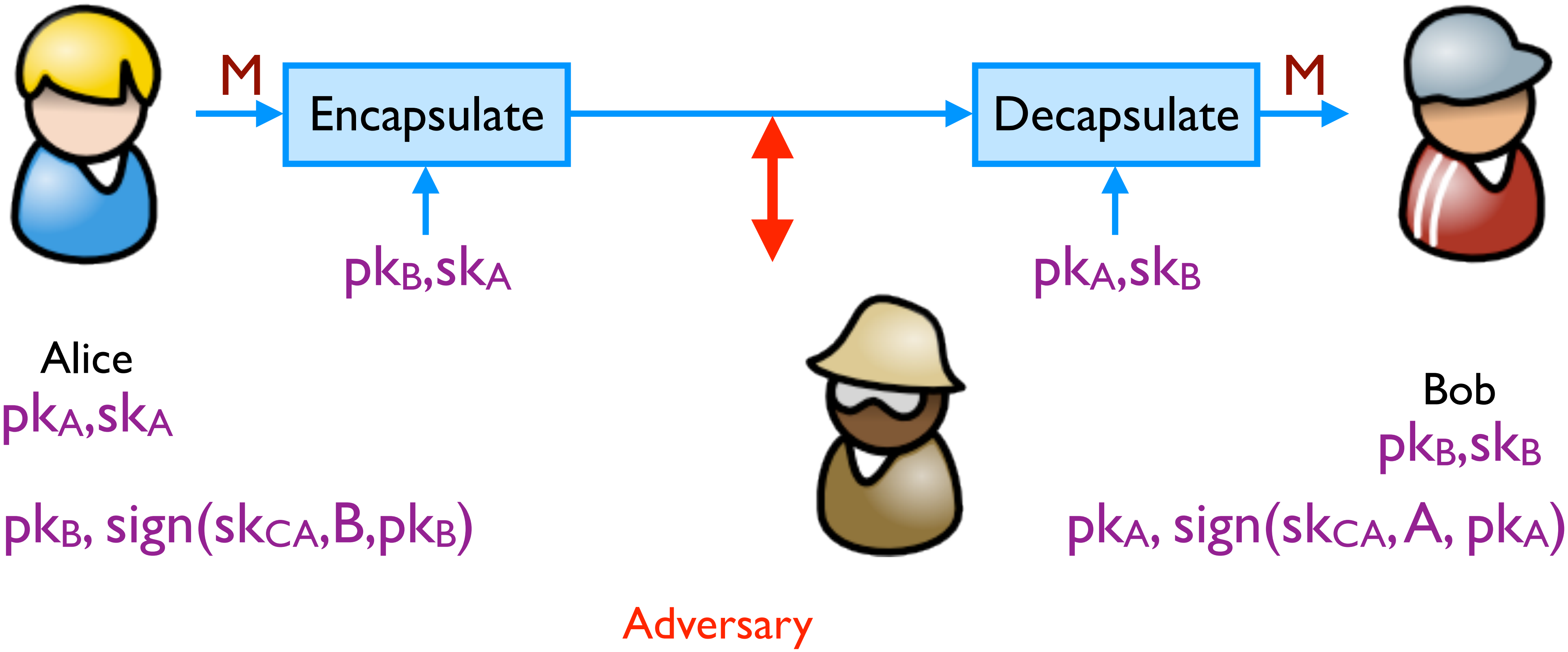
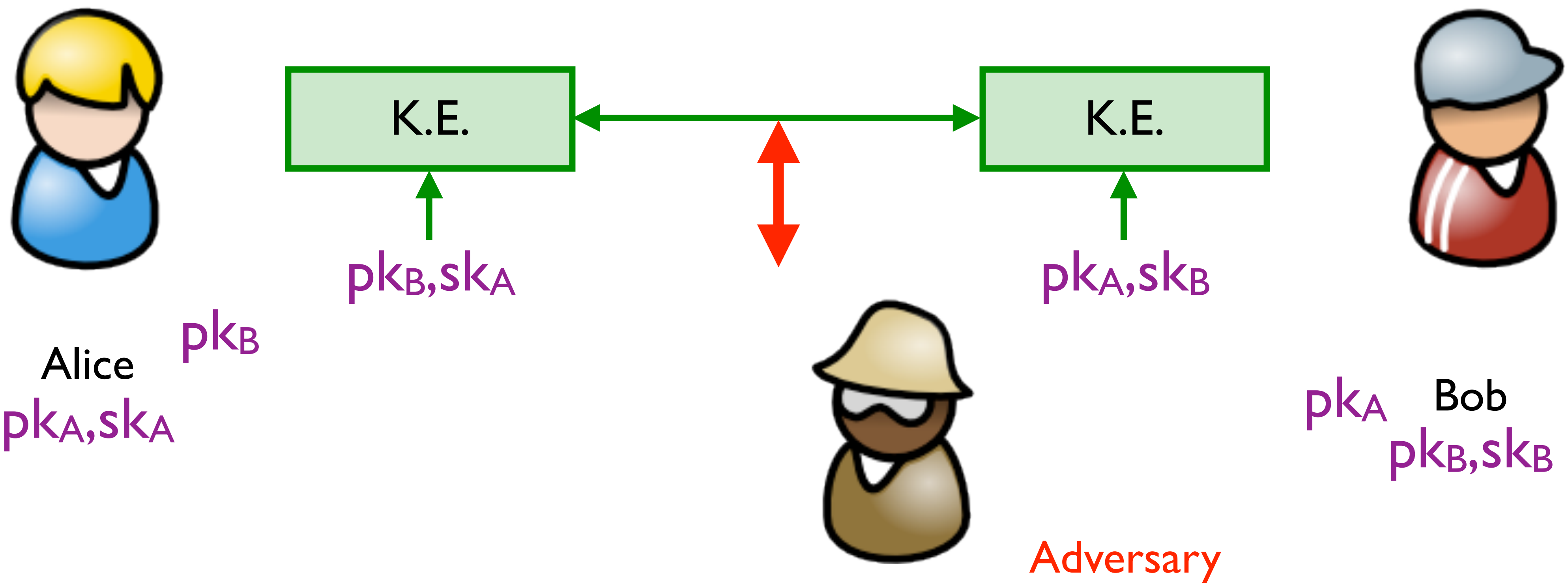


Getting keys: Key exchange

Key exchange protocols: A tool for establishing a shared symmetric key from public keys



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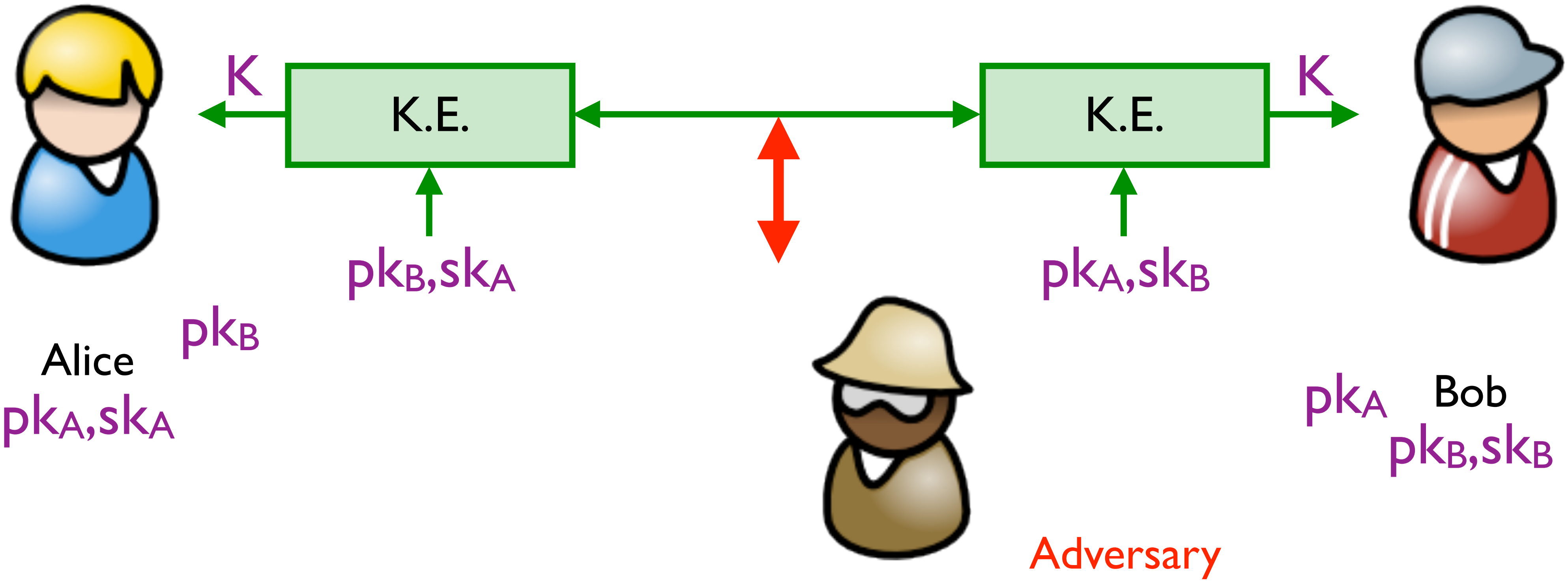
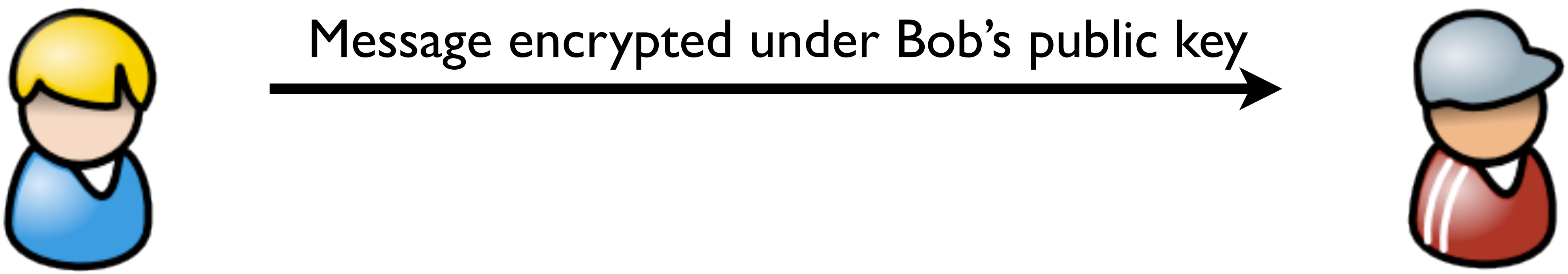


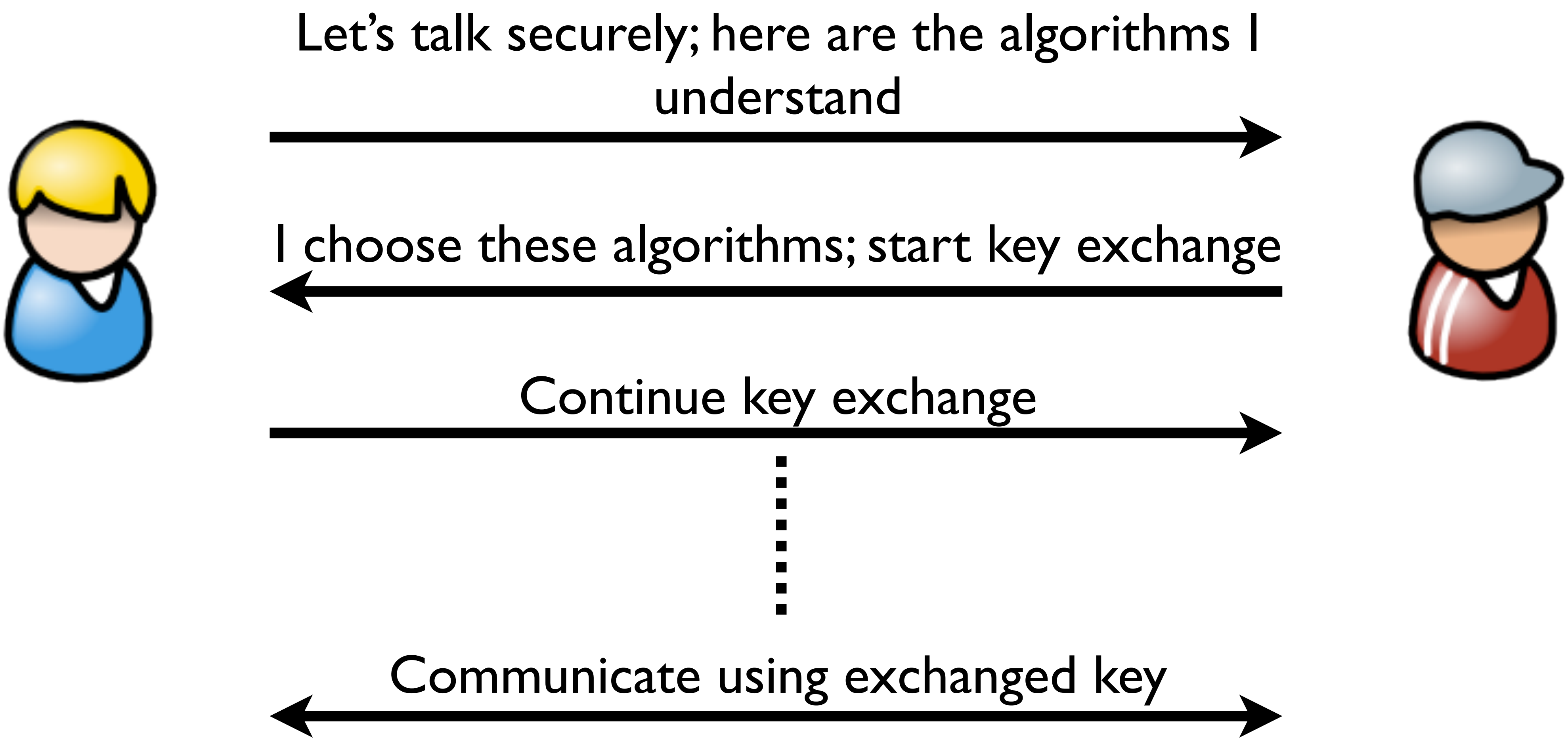
One-way Communications

PGP is a good example



Interactive Communications

In many cases, it's probably a good idea to just use a standard protocol/system like SSH, SSL/TLS, etc...



Let’s Dive a Bit Deeper

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(*Informal* example; ignoring, e.g., signatures)

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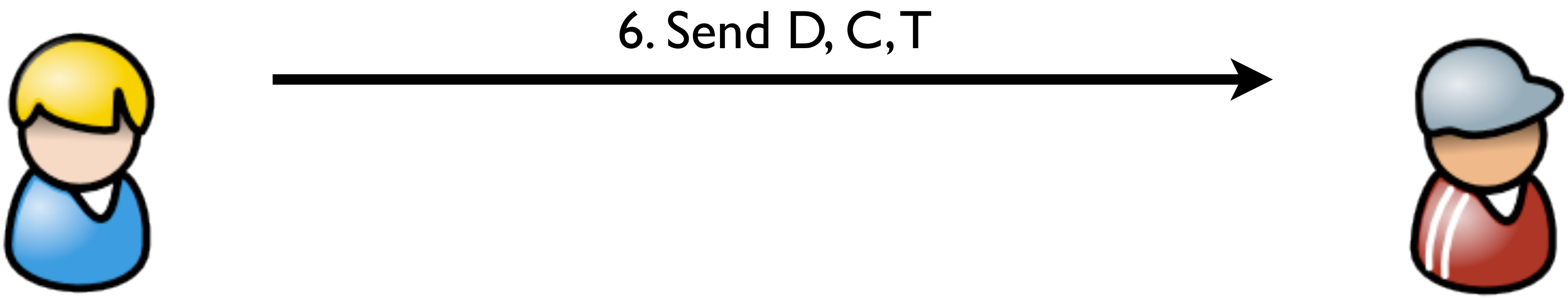

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11. Bob uses K1 to decrypt C

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(Last step will probably also use random numbers; will need to rekey regularly; may need to avoid replay attacks,...)

What cryptosystems have you heard of? (Past or present)

History

- Substitution Ciphers
  - Caesar Cipher
- Transposition Ciphers
- Codebooks
- Machines

- Recommended Reading: **The Codebreakers** by David Kahn and **The Code Book** by Simon Singh.
  - Military uses
  - Rumrunners
  - ....

Classic Encryption

- Goal: To communicate a secret message
- Start with an *algorithm*
- Caesar cipher (substitution cipher):

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

GHIJKLMNOPQRSTUVWXYZABCDEF
```

Then add a secret key

- Both parties know that the secret word is "victory":

  `ABCDEFGHIJKLMNOPQRSTUVWXYZ`

  VICTORY`ABDEFGHJKLMNPQSUWXZ`

- "state of the art" for thousands of years

Kerckhoff's Principle

- Security of a cryptographic object should depend **only** on the secrecy of the secret (private) key
- Security should not depend on the secrecy of the algorithm itself.
- Why?