Last bit on Anonymity; Privacy and Decentralization I

Information Privacy with Applications

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Administrative Items

- Final project proposals due tonight (unless we've talked)
- Anonymity assignment Thursday
- Integrated session also Thursday!

Session keys are negotiated using Diffie-Hellman Key Exchange

- First published in 1976; still around
- Alice and Bob want to share a secret key for use in a symmetric cipher. Every piece of information that they exchange is observed by their adversary Eve. How is it possible for Alice and Bob to agree on a key without making it available to Eve?

Diffie-Hellman

Publicly choose:

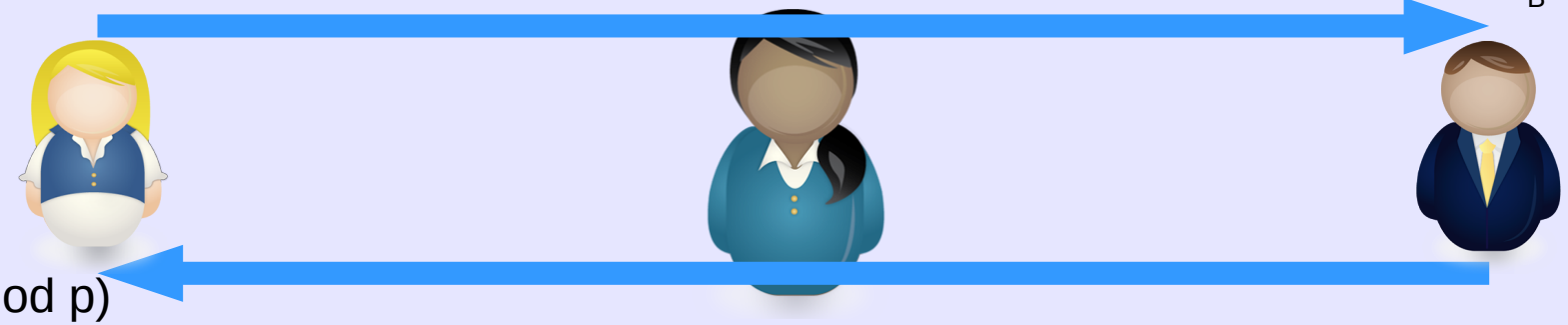
- a safe large prime *p* (e.g. Tor docs use rfc2409 section 6.2. But see Logjam)
- g, a primitive root mod p, with *2 <= g <= p-2*

Secretly generate:

- Alice and Bob randomly choose secret integers 1 <= *x, y <= p-2* respectively

$A := g^x \pmod p$

$K_B := A^y \pmod p$

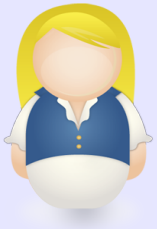


$K_A := B^x \pmod p$

$B := g^y \pmod p$

$$K_A = (g^y)^x = (g^x)^y = K_B \text{ is the key}$$

Diffie-Hellman



$x = \log_g A \pmod p$

$y = \log_g B \pmod p$

Diffie-Hellman

$x = \log_g A \pmod p$

$y = \log_g B \pmod p$

Discrete Log Problem is in NP

Diffie Hellman Problem is no harder than DL problem; there is no proof of the converse

Question

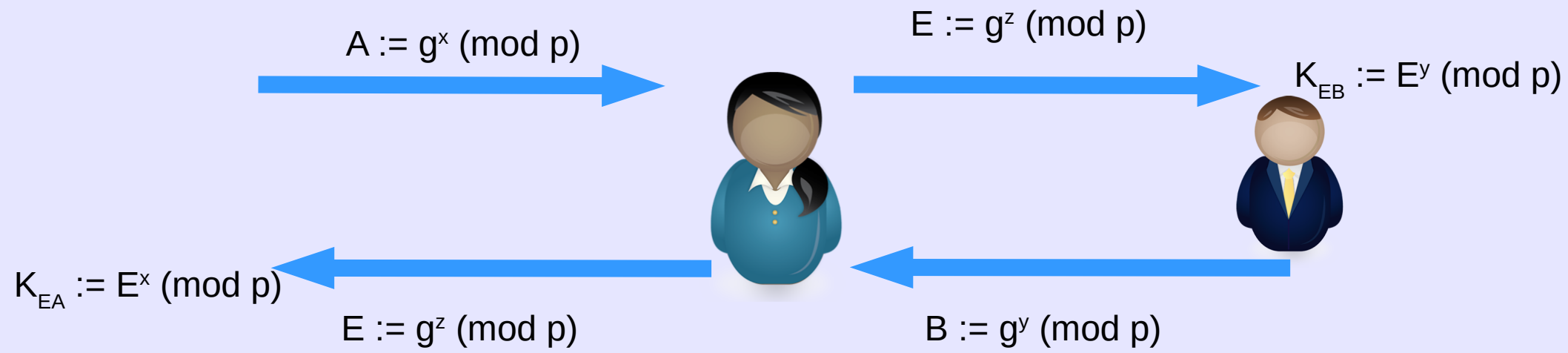
- Ian Goldberg long ago remarked that a good way to fight mass surveillance by a global passive adversary would be to “do a quick Diffie-Hellman” by default when setting up otherwise unprotected connections. He notes that this won’t help against an active attack. Can you guess what he means by an active attack?

MiTM Diffie-Hellman

Publicly choose:
a secure large prime *p*
g, a primitive root mod p, with *2 <= g <= p-2*

Secretly generate:

- Alice and Bob choose secret integers 0 <= *x, y <= p-2* respectively
- Eve picks her own secret integer, *z*



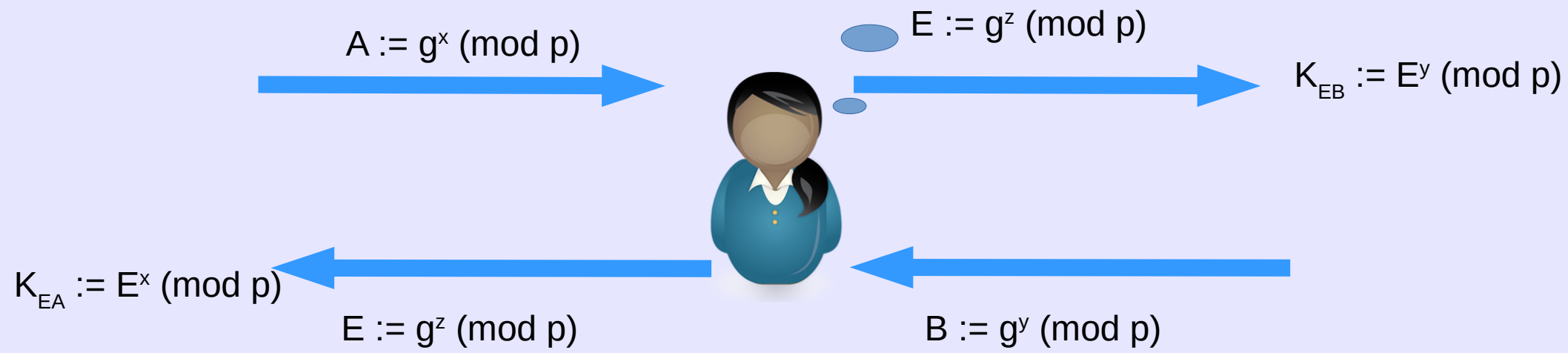
MiTM Diffie-Hellman

Publicly choose:
a secure large prime *p*
g, a primitive root mod p, with *2 <= g <*

$K_{EA} := g^{xz} \pmod p$
$K_{EB} := g^{yz} \pmod p$

Secretly generate:

- Alice and Bob choose secret integers 0 <= *x, y <= p-2* respectively
- Eve picks her own secret integer, *z*



Tor protocol, cont'd

- once session keys are agreed upon with DH, encrypt for the exit node, then encrypt the result for the relay node, and finally encrypt the result for the guard node
- send the layered result to the guard node
- guard node decrypts, gets the next hop and sends it on, then the middle key decrypts, ...
- on way back, each node uses the session key agreed on with the client OP, and passes to its neighbor in the circuit

Tor strengths and weaknesses

- Strengths
  - widespread adoption
  - low latency
  - easy to run nodes, easy to use as a client: adds to security
  - bridges, pluggable transports for censorship circumvention
  - fingerprint resistance (Tor Browser)
  - Applications ecosystem (SecureDrop, Briar, Ricochet, OnionShare, Tails, ...)
- Weaknesses
  - traffic analysis by a global/pervasive passive adversary
  - end-to-end timing attacks
  - content is revealed to exit node
  - blockable exit nodes

Who runs exit nodes?

- Universities
  - MIT+, Michigan, CMU, UNC, Karlsruhrer IT, Stanford, Clarkson, U. Washington, Utah+, Caltech, RIT+, Bowdoin, Northeastern+, Princeton
- Bad people too! (Why might they do that?)
- Not Arizona :-(
  - yet (-:

Who runs hidden services?

- Propublica, Duckduckgo, Facebook, Scihub, Riseup, Protonmail, Debian, Whonix, The Intercept, Wikileaks, Securedrops for The Freedom of the Press Foundation, The Guardian, The Associated Press, NY Times, USA Today, Washington Post, etc., TORCH (these are all onion links)
- A bunch of people with illegal stuff
- Hidden services are easy to set up (demo)
  - even inside firewalled networks

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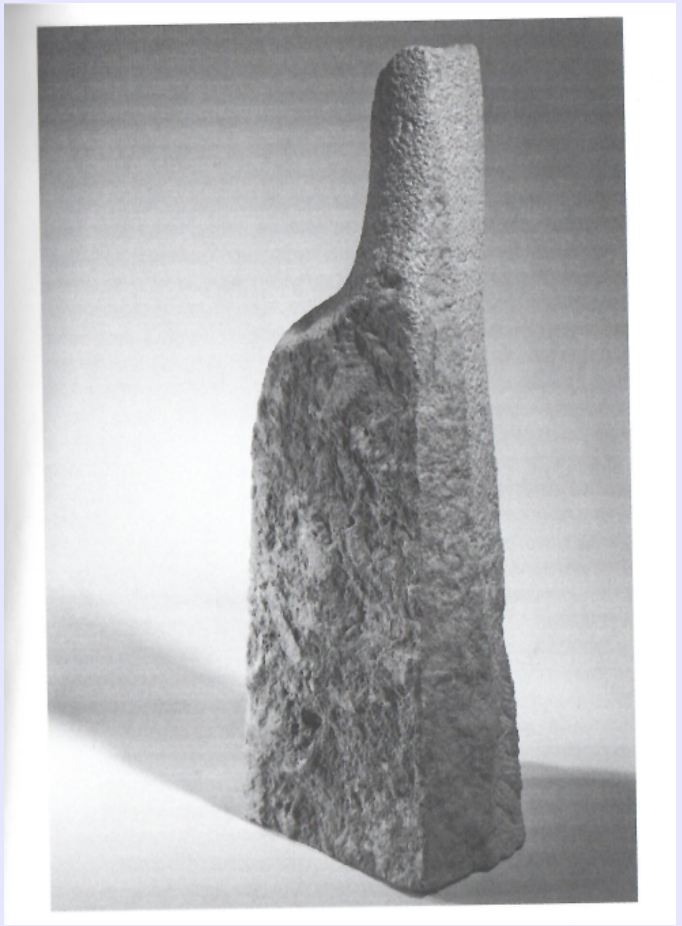
Privacy and Decentralization I

- The tools you choose to use influences your practice
  - What happens when your tools are services, provided by another party?

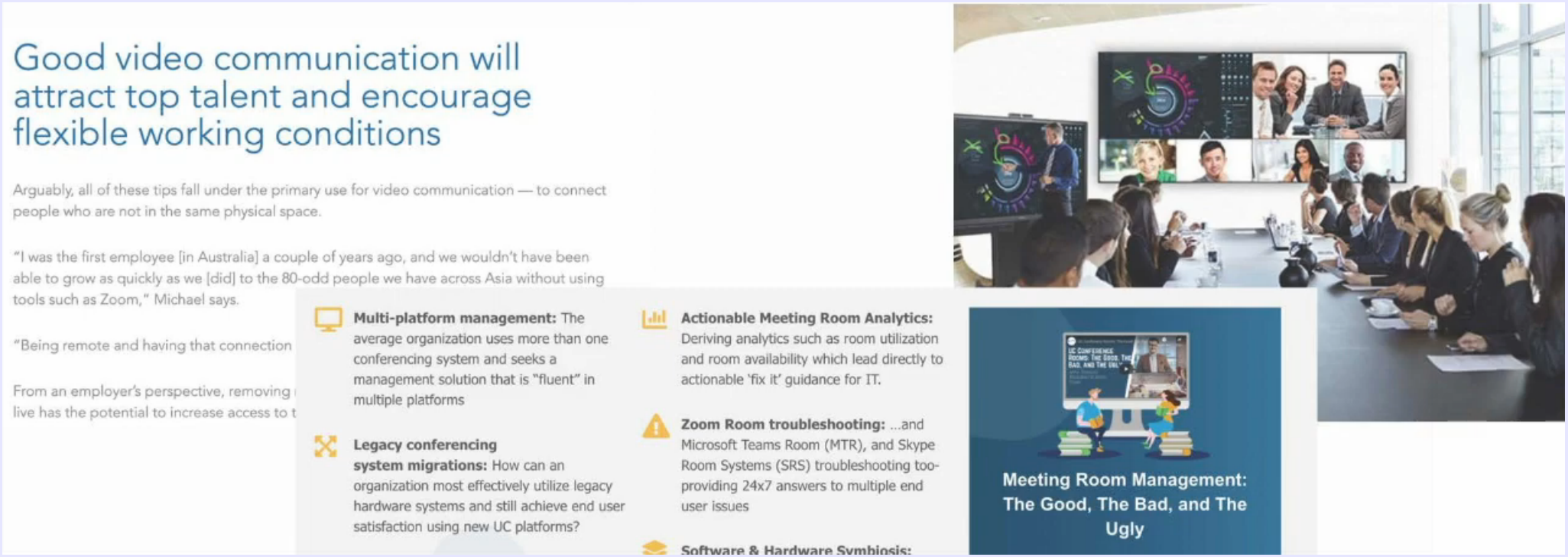
Batya Friedman, *Value Sensitive Design*

- How do you ensure that practice influences your use and choice of tools?



Batya Friedman, *Value Sensitive Design*

- Zoom was not made for education, but for business management



from Gürses, Rectanglez-R-Us

- e-learning and ed-tech has been a thing for a while now
- COVID-19 has been a boon
- Big part of the sell with ed-tech is to increase efficiencies through use of analytics available online (or via other technologies)

- Zoom went from 10M to 300M users, partly by removing the limited use restriction for educational uses
- Zoom is valued at 29x its revenue in the last year
  - Free users cost; they will need to convert them to something valuable.
  - What is a common model for providing “free” services on the Internet?

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from Gürses, Rectanglez-R-Us

- Third-party service providers are available *now,* in the short term
  - useful when a pandemic forces many students online
- What are the long-term implications of that transition?

Principal agent problems

- Zoom bombs: Zoom is a global organization, so the needs of individual institutional licensees are not paramount.
- For a while, response to Zoom bombs was: “we’ll do some, and the rest is your responsibility” until the clamor was too loud

- Downsides of the Zoom licensing model?
- “Unbundling of institutions:” pressure to grow for Zoom resulting in hollowing out of various parts of Universities?
- “Context collapse”
- What is this new abstraction of the classroom, that takes place on commercial services like Zoom, or Facebook, or Google Docs, and who is it available to?
- Zoom security “sucks”

Tools and Self-Determination

- *Who should decide on the tools that are used?* Should faculty, students and staff decide for themselves? For which tools? What happens if something goes wrong?
- (What is “predatory inclusion?”)