Computer security: message authentication

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MASSACHUSETTS
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Security goals

- Confidentiality
- Authentication
  - Message
  - User
- Authorization

RC4 (or ARC4)

```
byte S[256];
procedure RC4_generate() return key-byte {
    i ← (i + 1) mod 256;
    j ← (j + S[i]) mod 256;
    swap (S[i], S[j]);
    t ← (S[i] + S[j]) mod 256;
    return S[t];
```

Initialization from a seed

```
procedure RC4_init (seed)
    for i from 0 to 255 do {
            S[i] ← i;
            K[i] ← seed[i];
    }
    j ← 0;
    for i from 0 to 255 do {
            j ← (j + S[i] + K[i]) mod 256;
            swap( S[i], S[j]);
    }
    i ← 0; j ← 0;
```

Sign and verify using Hmac

procedure sign (*m*, *k*) {

$t \leftarrow \mathrm{H}((k \oplus \text{outerpad}) + \mathrm{H}((k \oplus \text{innerpad}) + m))$

return *t*;

}

procedure verify (*m*, *t*, *k*) {

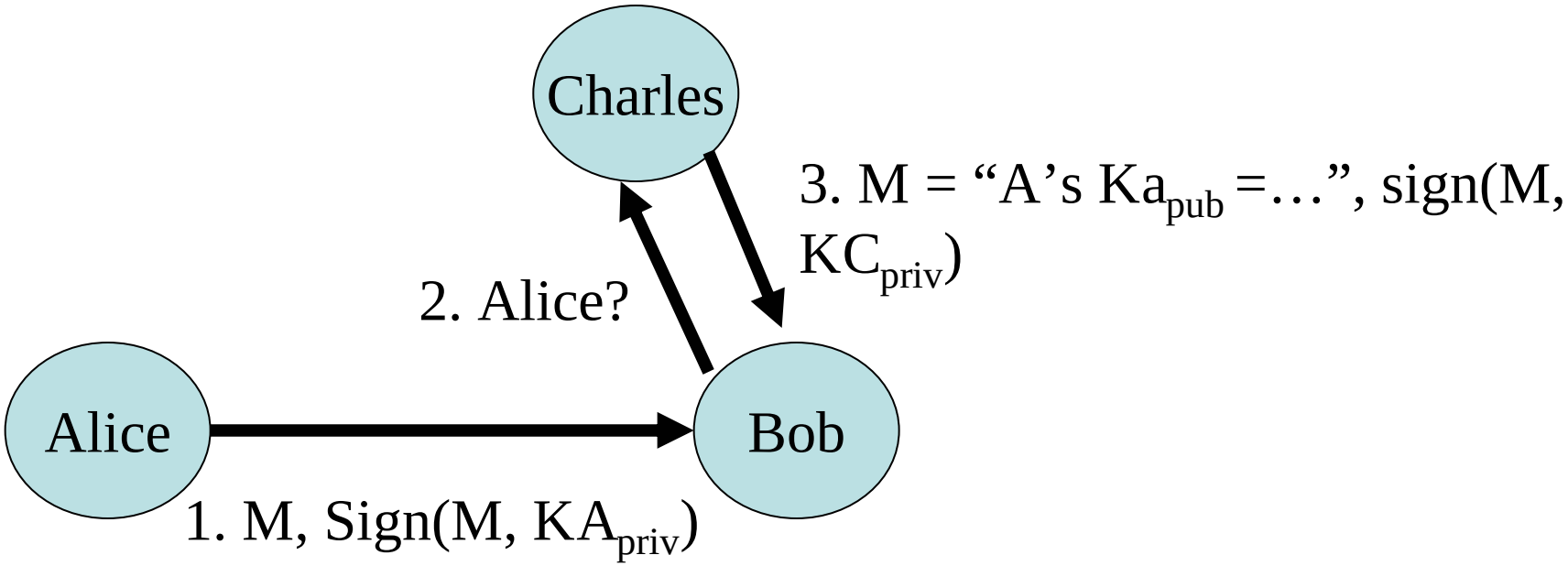
$h \leftarrow \mathrm{H}((k \oplus \text{outerpad}) + \mathrm{H}((k \oplus \text{innerpad}) + m))$

if ($h = t$) **return** accept;

else return reject;

}

key distribution



- 3 is a *certificate* for Alice's public key
- Charles is called a *certificate authority*

RSA public-key cipher

- p, q primes
- $n \leftarrow p * q$
- $z \leftarrow (p-1) * (q-1)$
- Pick e relative prime to z
- Pick d s.t. $e*d = 1 \pmod z$
- K1 = (e, n)
- K2 = (d, n)
- Message m s.t. $0 \leq m < n$

Transform

$C \leftarrow m^e \pmod n$

Reverse Transform

$C^d \pmod n =$
$m^{ed} \pmod n =$
m

$p = 47, q = 59$

$n \leftarrow 2773$

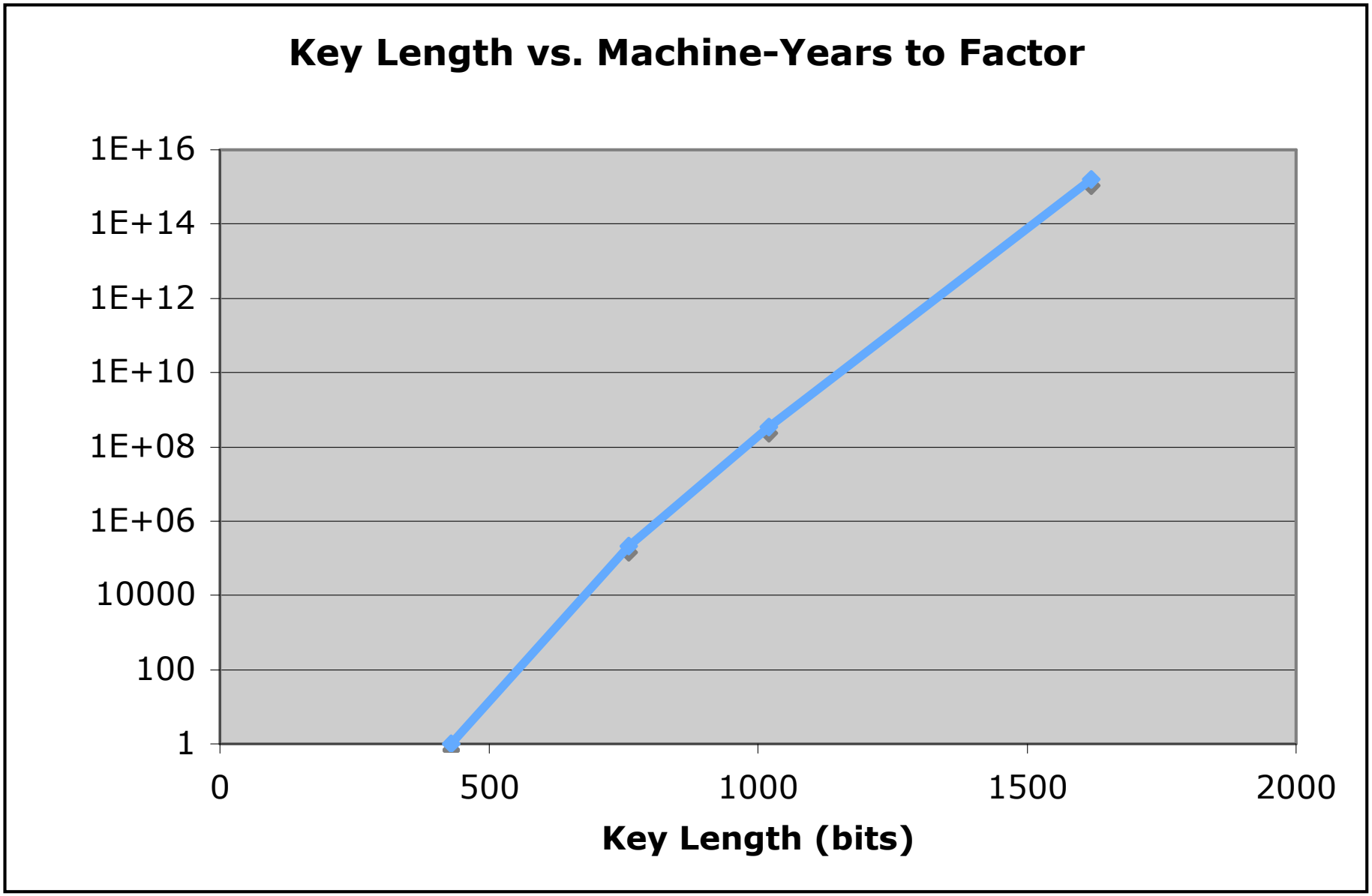
$z \leftarrow 2668$

$e = 17, d = 157$

$m \leftarrow 31$

$c \leftarrow 31^{17} \pmod{2773} = 58$

$587^{157} \pmod{2773} = m$



2005: 640-bit key factored in 3 months using 80 2.2Ghz Opterons

Sign and verify using RSA

procedure sign (*m*, *Kpriv*) {
    t ← hash(*m*)
    t ← RSA-transform (*h*, *K*priv)
    return *t*;
}

procedure verify (*m*, *t*, *Kpub*) {
    h ← RSA-reverse (*t*, *K*pub)
    if (hash(*h*) = *t*) **return** accept;
    else return reject;
}

Needs further refinement!