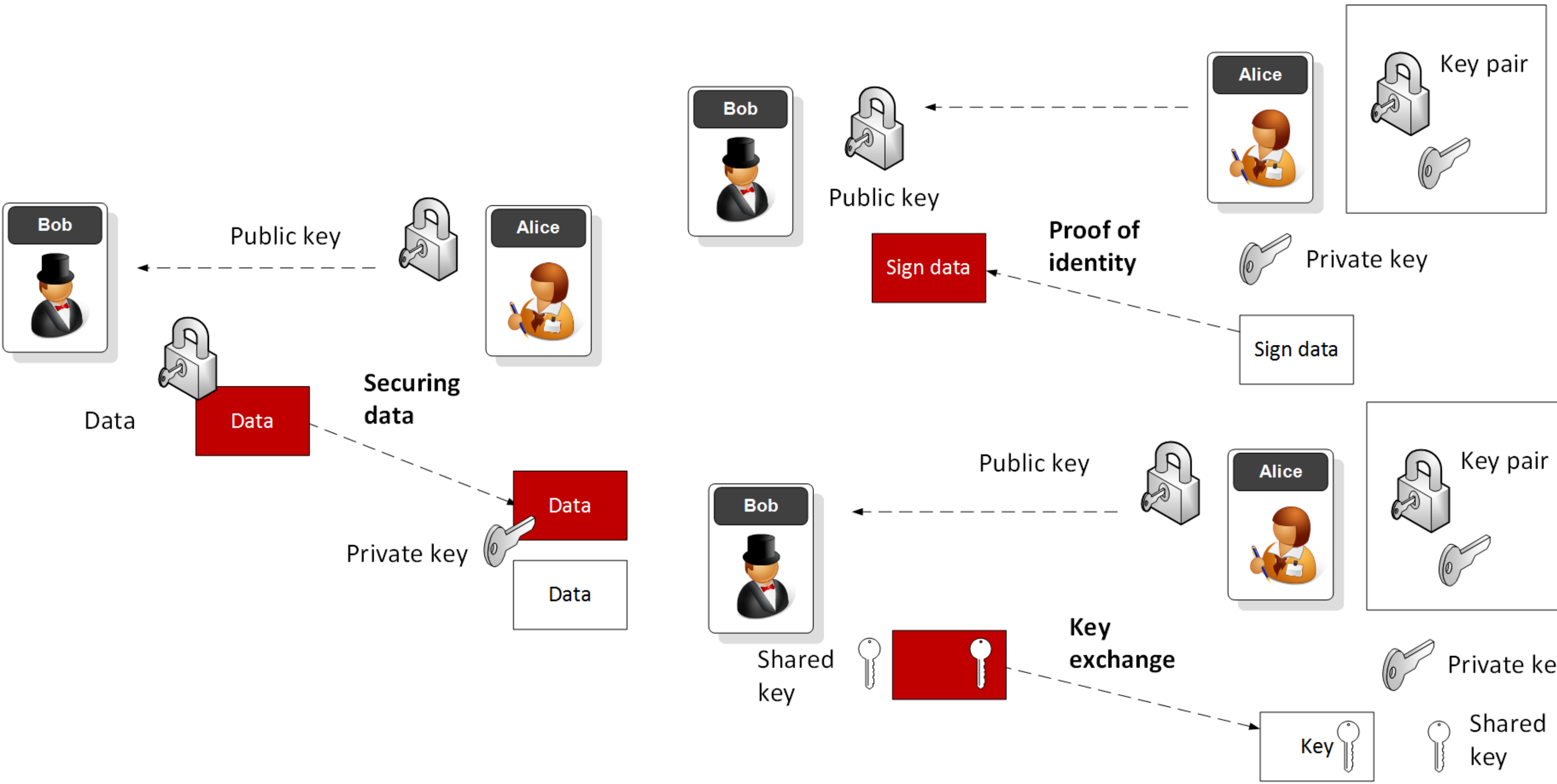
Public Key

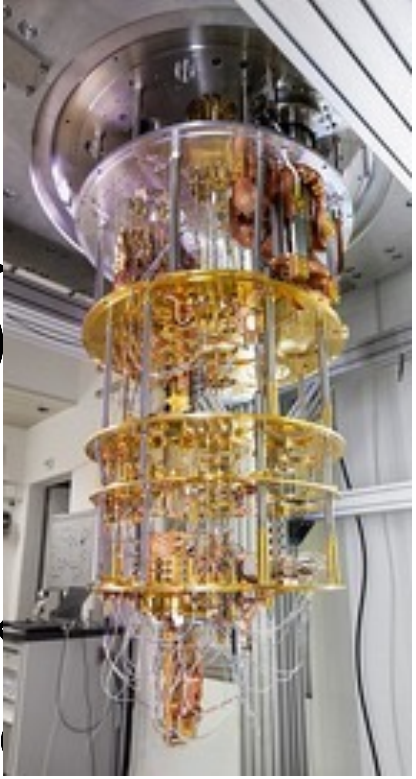
Basics
RSA
Applications (Encryption and Signing)

Prof Bill Buchanan OBE
https://asecuritysite.com/rsa/

Public Key Methods



Public Key Methods



- **Integer Factorization**. Using prime numbers. Example: RSA. Key size: 2,048 bits (modulus) Digital Certificates.
- **Discrete Logarithms**. $Y = g^x \bmod P$. Example: Prime number size: 2,048 bits. Key handshak
- **Elliptic Curve Relationships**. Example: Ellipti Private key: 256 bits. Public key: 512 bits. Bitcoin, IoT, Web, etc.

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http://asecuritysite.com/crypto04
http://asecuritysite.com/encryption

Eve

p

9,137,187,070,061,098,912,312,979,400,361,251,189,847,923,809,497,258,114,688,790,849,334,008,324,856,676,348,809,151,285,118,821,829,375,998,699,013,311,467,364,662,378,853,216,263,996,490,005,611,058,805

p

9,885,919,140,818,765,444,174,626,190,703,294,219,553,850,295,249,705,938,896,539,634,343,302,401,155,295,752,383,276,739,584,190,165,200,823,122,225,274,427,125,934,163,475,191,779,288,529,189,149,818,011

(p-1)*(q-1)

90,329,492,549,158,751,736,593,291,654,313,033,317,391,509,546,977,632,830,551,342,194,781,230,803,832,847,247,315,213,556,011,813,523,182,777,529,551,800,128,685,586,665,697,818,108,995,125,892,738,489,085,065,564,398,419,119,705,178,003,889,155,415,914,402,310,708,147,858,313,669,176,692,847,865,236,706,085,105,432,191,429,510,583,595,108,030,256,069,207,938,161,732,170,083,525,341,774,967,620,008,260,040

Eve

With Diffie-Hellman we need the other side to be active before we send data. Can we generate a special one-way function which allows is to distribute an encryption key, while we have the decryption key?

Bob

Alice

Encryption/ Decryption → Communications Channel → Encryption/ Decryption

Solved in 1977, By Ron Rivest, Adi Shamir, and Len Aldeman created the RSA algorithm for public-key encryption.

RSA

- Two primes p, q.
- Calculate N (modulus) as p x q eg 3 and 11. n=33.
- Calculate PHI as (p-1)x(q-1). PHI=20
- Select e for no common factor with PHI. e=3.
- Encryption key [e,n] or [3,33].
- (d x e) mod 20 = 1
- (d x 3) mod 20 = 1
- d= 7
- Decryption key [d,n] or [7,33] (link)

RSA

Calc

Example

- Encryption key [e,n] or [3,33].
- Decryption key [d,n] or [7,33]
- Cipher = M^e mod N

eg M=5.

- Cipher = 5^3 mod 33 = 26
- Decipher = C^d mod N
- Decipher = $(26)^7$ mod 33 = 5

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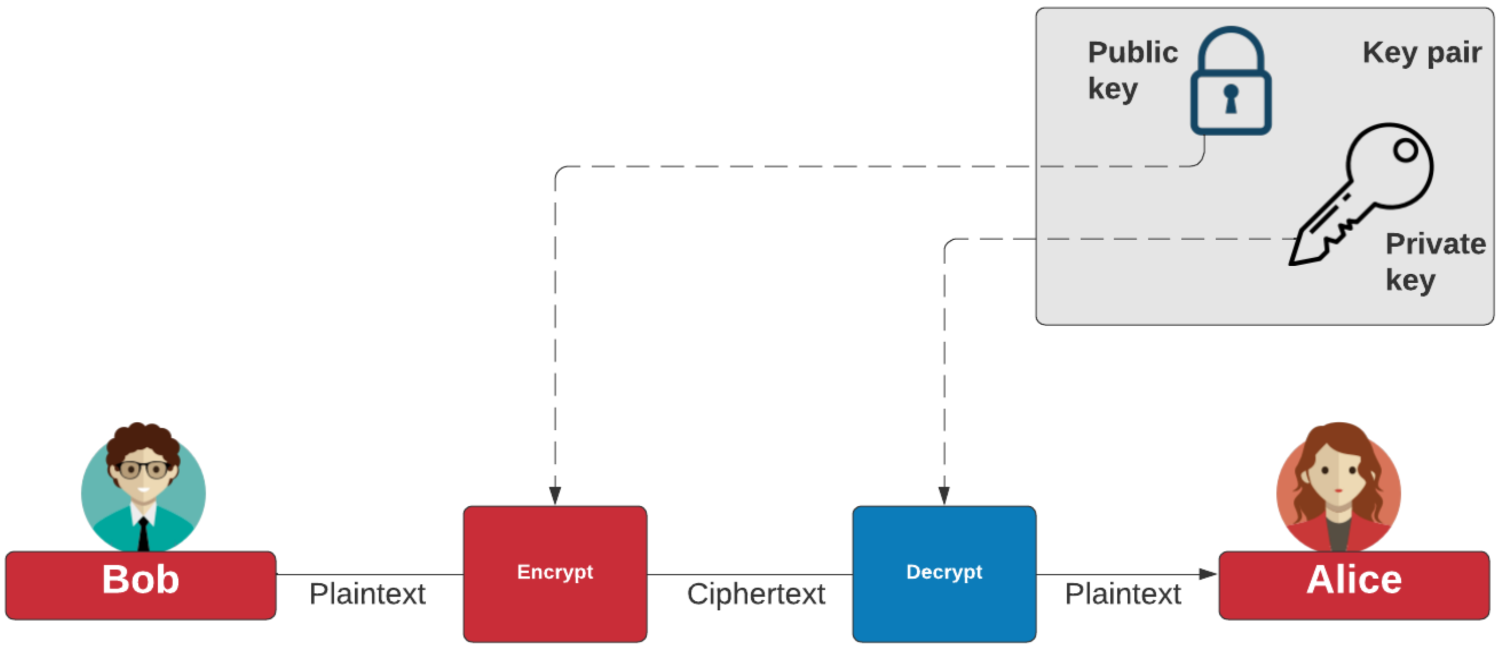
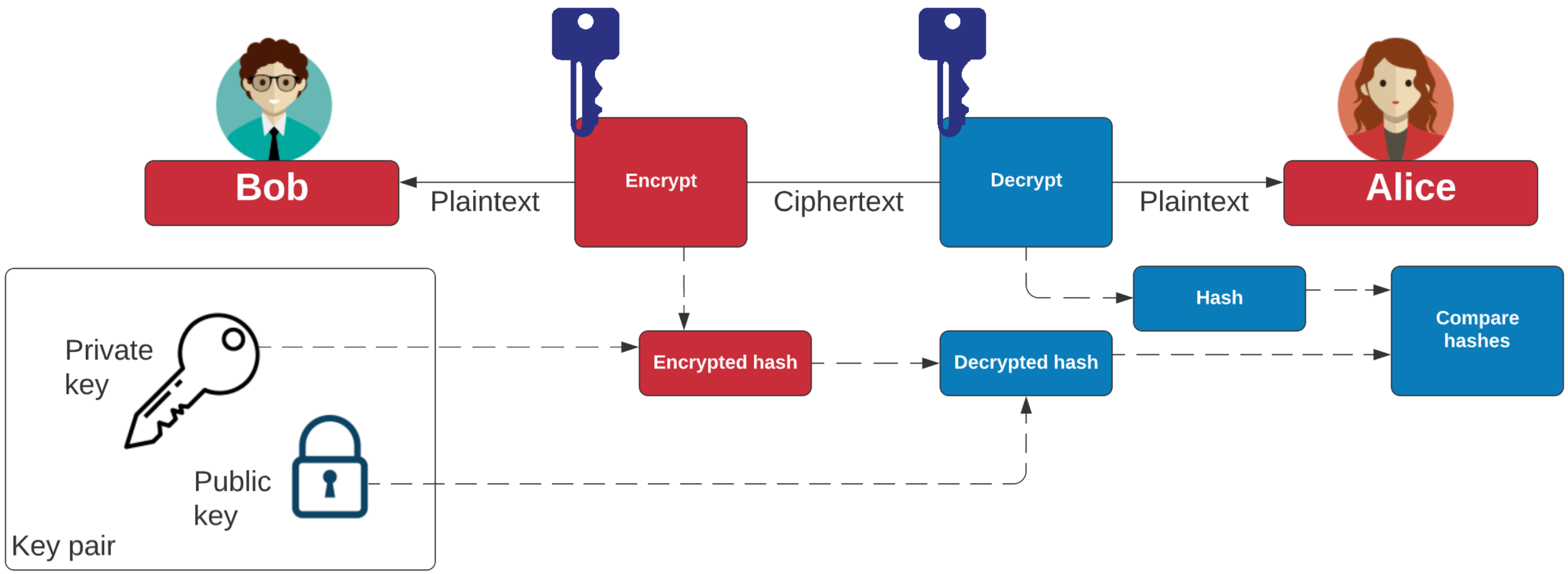
Public Key Encryption



Public Key Digital Signing



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