Announcements

- Homework #3 due in class today
- Reading
  - Today: 7.1 - 7.2
  - Tuesday: 7.3

Computer And Network Security

- Issues
  - secrecy: can someone read a message
  - authentication: determine who you are communicating with
    - this can be one way or two way
  - nonrepudiation: verify that something send can't be recanted
  - integrity: a third party can't change a message in flight
  - denial of service: make the system unavailable to others
- Threat Model
  - must consider acceptable risks
    - value of item to be protected
    - $2,000 of computer time to steal 50 cents of data
      - this is a sufficient deter someone
      - **but** computers keep getting faster
  - who do you trust?
    - employees
    - vendor of security software
    - network provider

Where to Provide Security?

- Short Answers: at all levels
- physical:
  - wrap gas or tripwires around cable
- link:
  - encryption protects the wire but not the router
- network:
  - firewalls filter packets
  - end-to-end encryption
- session/presentation:
  - “secure” socket layer
- application:
  - PGP signed messages
  - application specific authentication

Other Attacks

- Random Messages
  - Will a random message likely be a valid message
  - Need to have redundancy in the message
  - **tension** more redundancy ease cryptoanalysis
- Replay Attacks
  - can the same message be sent twice?
    - transfer $10,000 from Smith to Jones
    - make an exact copy of a metro fare card
  - need to ensure messages apply exactly once
    - use a timestamped lifetime
    - sequence numbers

Digital Water Marks

- Issue: If I have a copy of a digital object, I can make many
  - if you pay per-copy for the object, how to you prevent copies?
- Goal: Track where an object came from
  - make every object unique
  - the objects should not appear different

Cryptography

- Terms
  - plaintext (P): the raw message to be sent
  - key (K): data used to protect one or more messages
  - ciphertext (C): output of applying key to plaintext
  - encrypt (E): a function to combine the key and plaintext
  - decrypt (D): a function to combine ciphertext and key
    - may be the same as E
  - $C = E_k(P)$ and $D_k(E_k(P)) = P$
- Substitution Cipher
  - Ceaser Cipher
    - shift letters by a constant amount
    - key is how many letters to shift
  - Monoalphabetic substitution
    - for each letter pick some a different letter to use
    - key is 26 characters representing substitution
    - can use properties of language to break it

Transposition Cipher

- Block of text is used to break up digrams
- To Break:
  - each letter is itself, so normal distribution of letters is seen
  - guess number of columns (verify with known plaintext)
  - order columns using trigram frequency

M	E	G	A	B	U	C	K
7	4	5	1	2	8	3	6
p	l	e	a	s	e	t	r
a	n	s	f	e	r	o	n
e	m	i	l	l	i	o	n
d	o	l	l	a	r	s	t
o	m	y	s	w	i	s	s
b	a	n	k	a	c	c	o
u	n	t	s	i	x	t	w
o	t	w	o	a	b	c	d

Plaintext

pleasetransferonemilliondollarsto
myswissbankaccountsixtwotwo

Ciphertext

AFLLSKSOSELAWAIATOOSSCTCLNMOMANT
ESILYNTWRNNTSOWDPAEDOBUOERIRICXB

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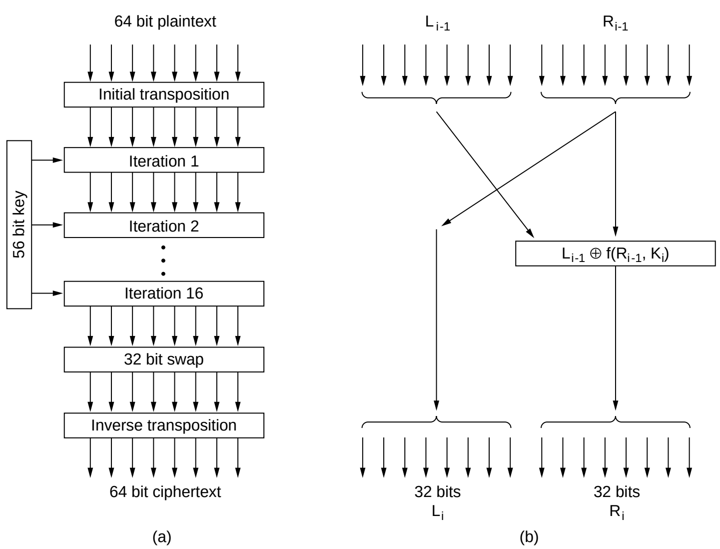
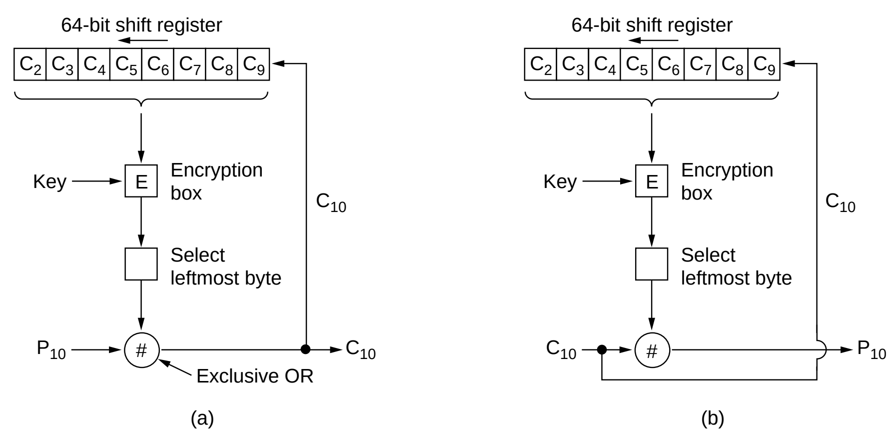
One Time Pad

- Key Idea: randomness in key
- Create a random string as long as the message
  - each party has the pad
  - xor each bit of the message with the a bit of the key
- Almost impossible to break
- Some practical problems
  - need to ensure key is not captured
  - a one bit drop will corrupt the rest of the message

DES

- Block cipher: uses 56 bit keys, 64 bits of data
- Uses 16 stages of substitution
- Variations
  - cipher block chaining: xor output of block n with into block n+1
  - cipher feedback mode: use 64bit shift register
    - can produce one byte at a time





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