A Powerful and Easy to Use Lockbox

Easy to use correctly, hard to use incorrectly

Lab7

Easy to Use Correctly: NaCl “box” concept

Remember

There is no 100% security

Security, like all engineering, involves tradeoffs

Know what you are trying to secure

The adversary…

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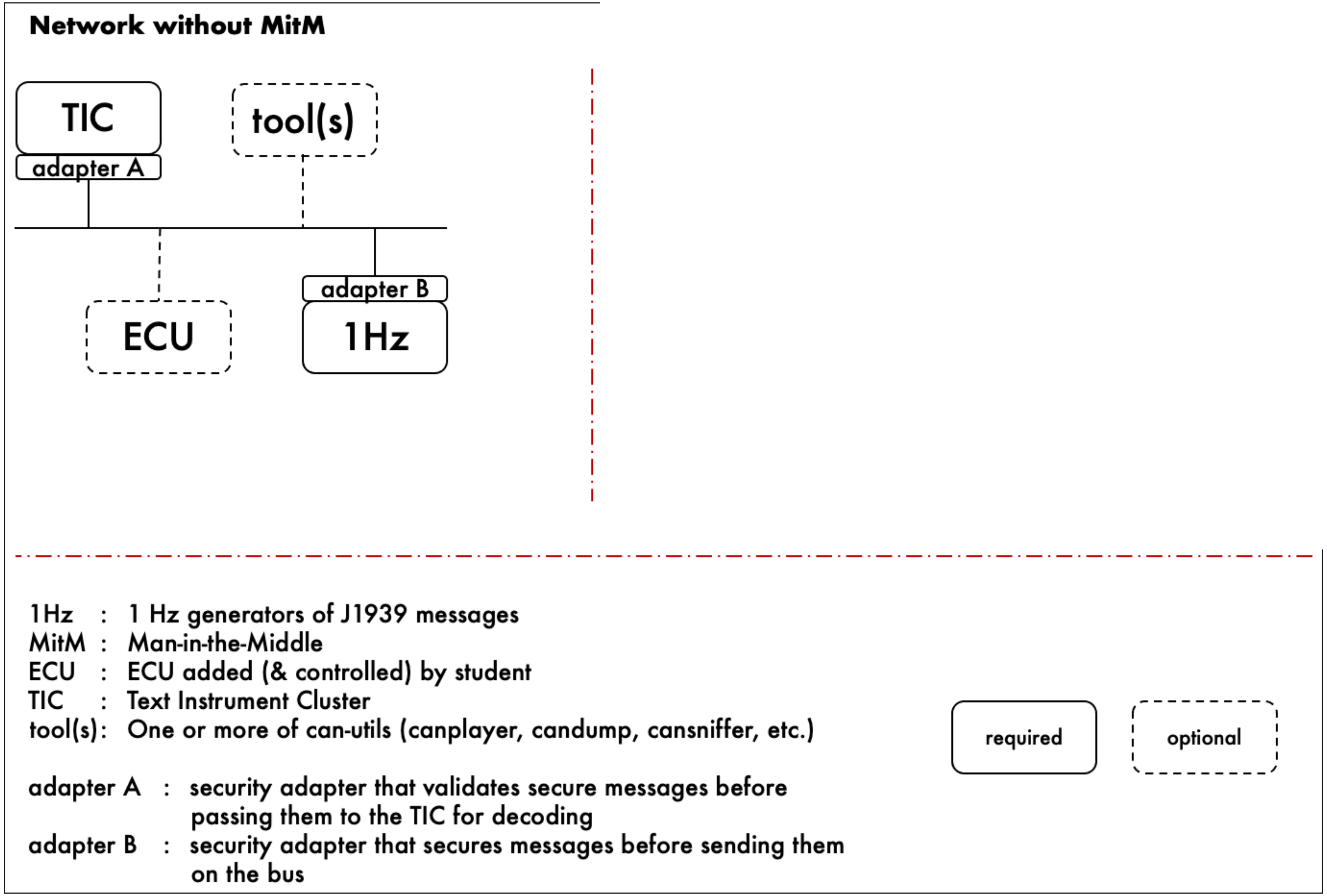
Network Configuration

Simple Network for this Lab



Network without MitM

1Hz : 1 Hz generators of J1939 messages
MitM : Man-in-the-Middle
ECU : ECU added (& controlled) by student
TIC : Text Instrument Cluster
tool(s): One or more of can-utils (canplayer, candump, cansniffer, etc.)

adapter A : security adapter that validates secure messages before passing them to the TIC for decoding
adapter B : security adapter that secures messages before sending them on the bus

Notes

Complexity is the enemy of security.

- Bruce Schneier

TweetNaCl demonstrates a full library in 100 tweets.

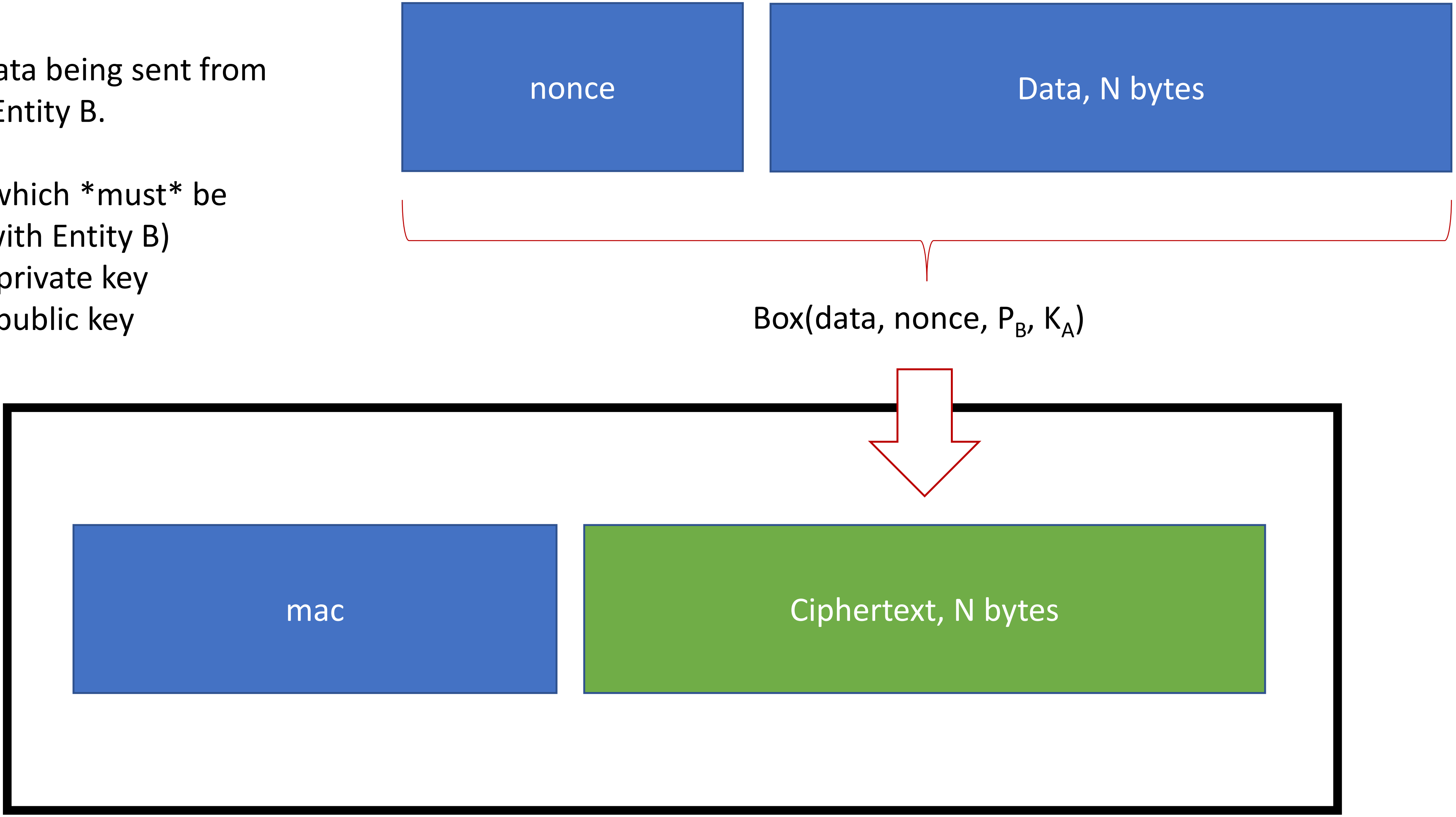
- All elliptic curve code
- All encryption and hashing code

NaCl – easy to use correctly, hard to use incorrectly

“Box”

To secure data being sent from Entity A to Entity B.

- Data
- Nonce (which *must* be shared with Entity B)
- Entity A private key
- Entity B public key

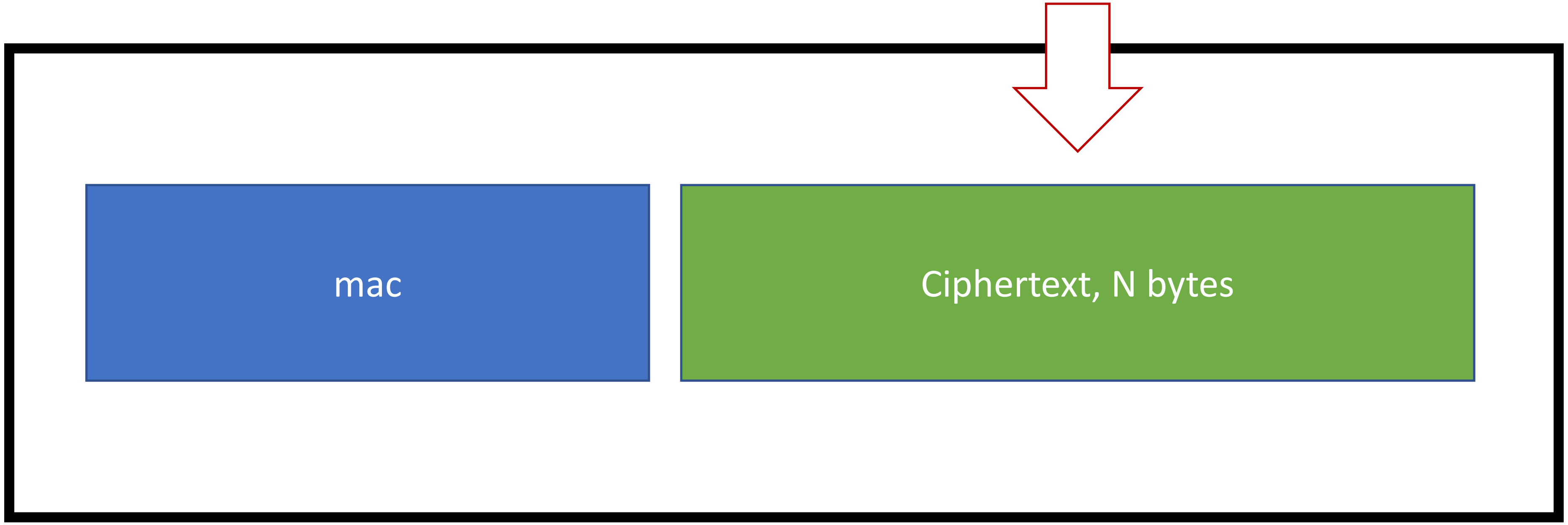


"Box"

To secure data being sent from Entity A to Entity B.

- Every time data is sent, a new nonce is required.

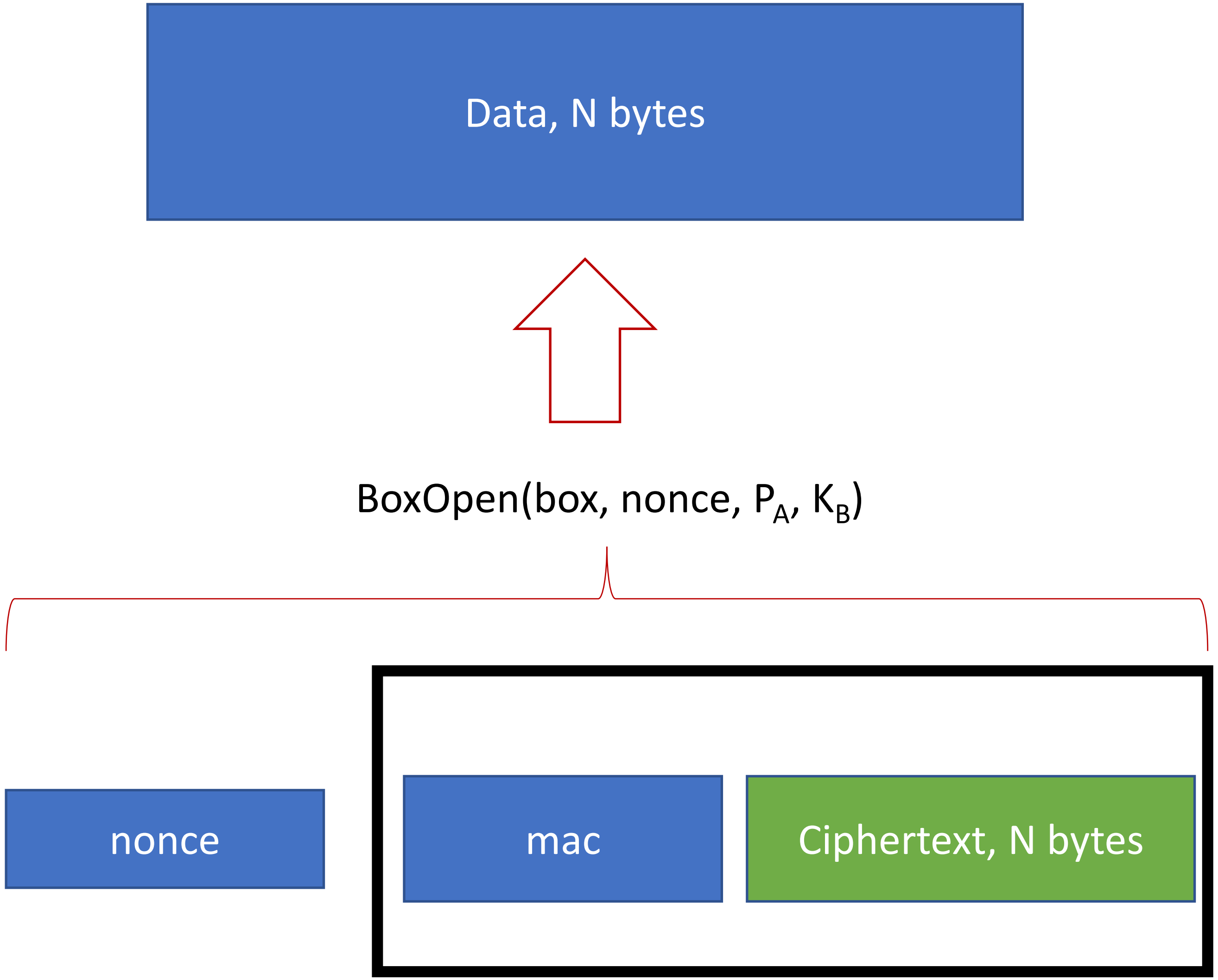
Box(data, nonce, P_B, K_A)



“BoxOpen”

To validate and decrypt data being sent from Entity A to Entity B.

- “box” (mac || ct)
- Nonce (which was provided by Entity A)
- Entity A public key
- Entity B private key



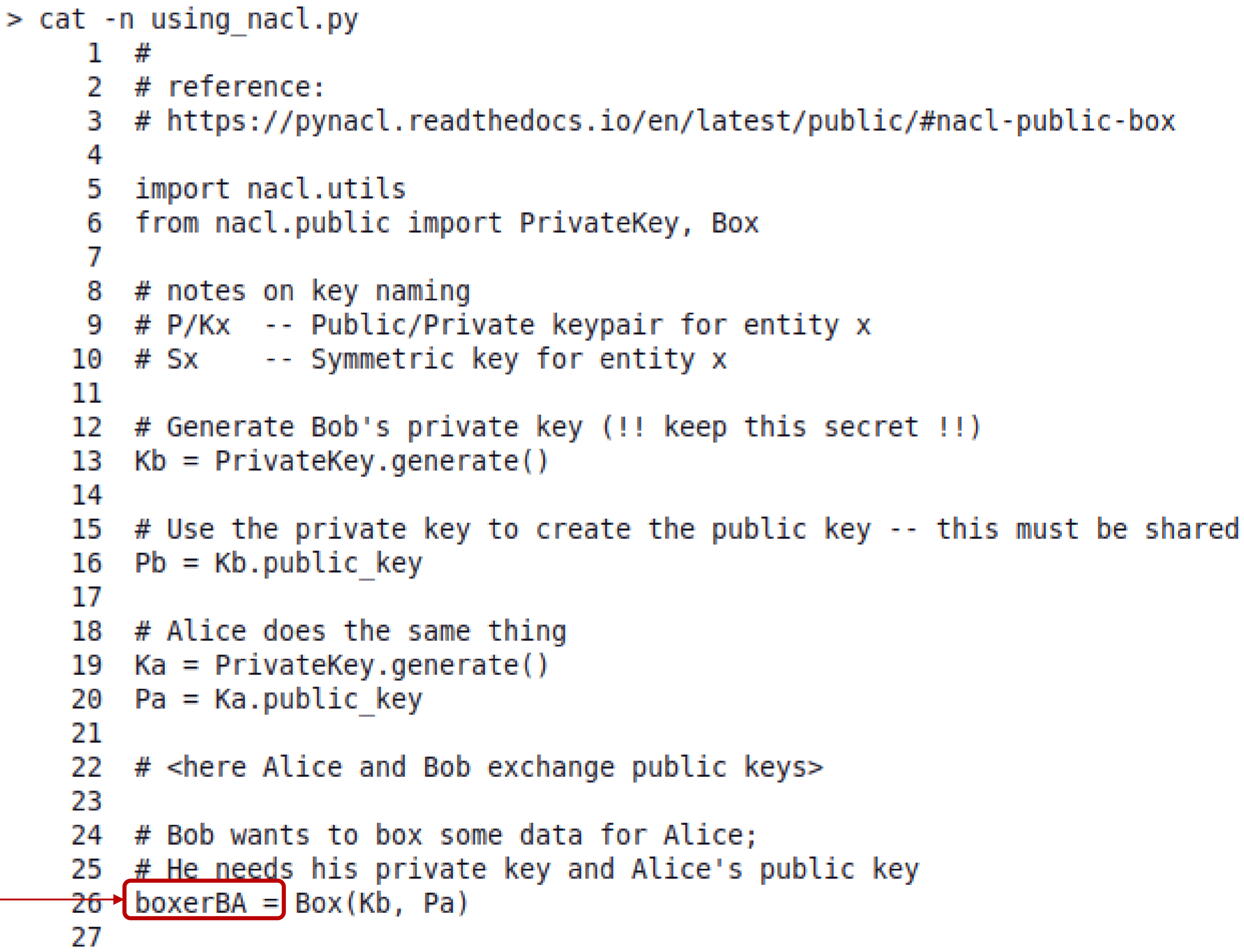
Notes

- Every library seems to label the functions a little differently

- In “TweetNaCl” the functions are very straightforward:
  - nacl.box()
  - nacl.boxopen()

- In python library it takes a couple of steps.

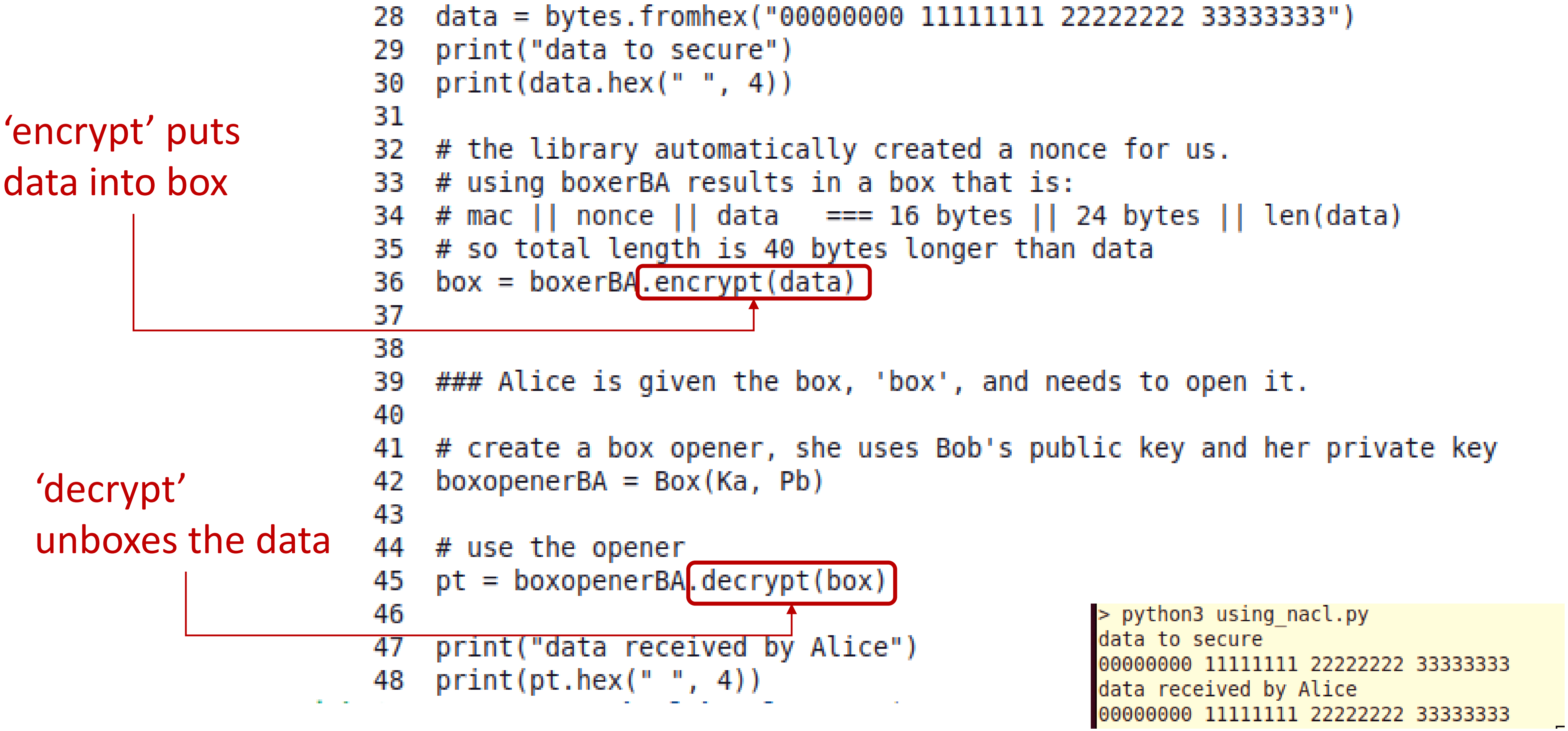
Notes



```
> cat -n using_nacl.py
     1	#
     2	# reference:
     3	# https://pynacl.readthedocs.io/en/latest/public/#nacl-public-box
     4	
     5	import nacl.utils
     6	from nacl.public import PrivateKey, Box
     7	
     8	# notes on key naming
     9	# P/Kx  -- Public/Private keypair for entity x
    10	# Sx    -- Symmetric key for entity x
    11	
    12	# Generate Bob's private key (!! keep this secret !!)
    13	Kb = PrivateKey.generate()
    14	
    15	# Use the private key to create the public key -- this must be shared
    16	Pb = Kb.public_key
    17	
    18	# Alice does the same thing
    19	Ka = PrivateKey.generate()
    20	Pa = Ka.public_key
    21	
    22	# <here Alice and Bob exchange public keys>
    23	
    24	# Bob wants to box some data for Alice;
    25	# He needs his private key and Alice's public key
    26	boxerBA = Box(Kb, Pa)
    27	
```

Used to put data into box and get it out.

Notes



‘encrypt’ puts data into box

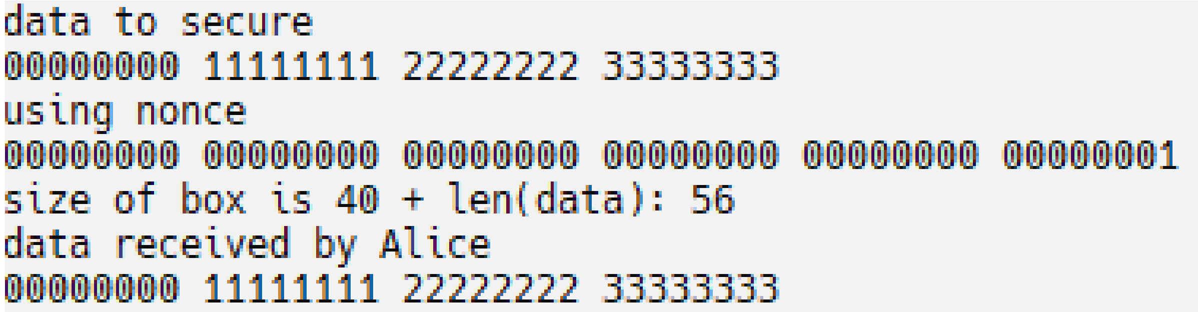
‘decrypt’ unboxes the data

```python
data = bytes.fromhex("00000000 11111111 22222222 33333333")
print("data to secure")
print(data.hex(" ", 4))

# the library automatically created a nonce for us.
# using boxerBA results in a box that is:
# mac || nonce || data   === 16 bytes || 24 bytes || len(data)
# so total length is 40 bytes longer than data
box = boxerBA.encrypt(data)


### Alice is given the box, 'box', and needs to open it.

# create a box opener, she uses Bob's public key and her private key
boxopenerBA = Box(Ka, Pb)

# use the opener
pt = boxopenerBA.decrypt(box)

print("data received by Alice")
print(pt.hex(" ", 4))
```

```
> python3 using_nacl.py
data to secure
00000000 11111111 22222222 33333333
data received by Alice
00000000 11111111 22222222 33333333
```

Notes

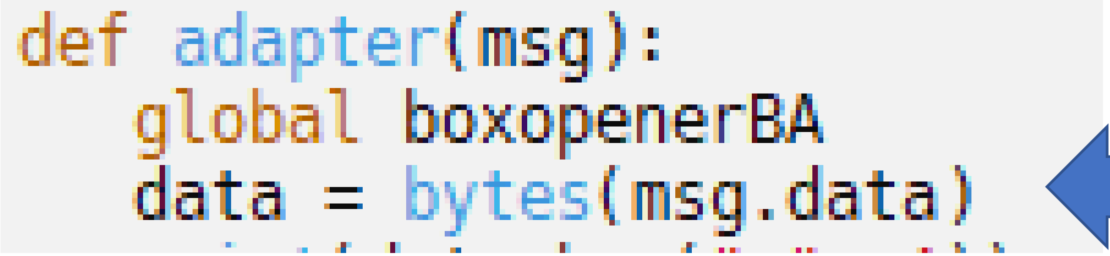
See “classroom/using_nacl_nonce.py” for example setting your own nonce.



```
data to secure
00000000 11111111 22222222 33333333
using nonce
00000000 00000000 00000000 00000000 00000000 00000001
size of box is 40 + len(data): 56
data received by Alice
00000000 11111111 22222222 33333333
```

Notes

Save yourself some headaches and time… it wasn't obvious to me that in **adapterA** we need to convert a 'bytearray' into 'bytes' using bytes() call



```
def adapter(msg):
    global boxopenerBA
    data = bytes(msg.data)
```

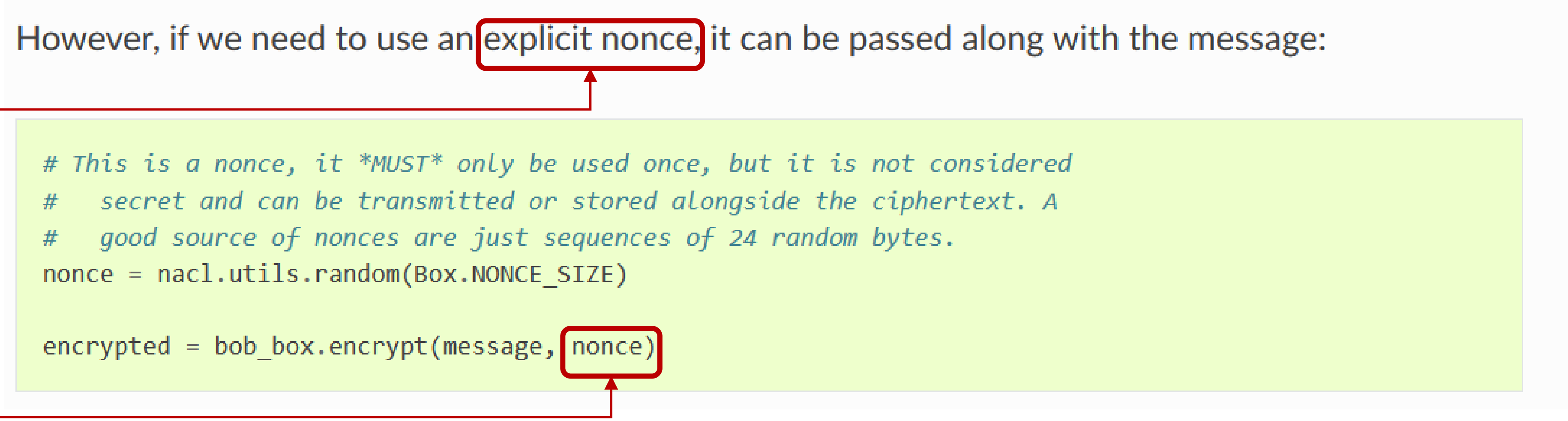
https://stackoverflow.com/questions/46064070/convert-bytearray-to-bytes-like-object

Lab

- The only code required is for:
  - adapterA.py
  - adapterB.py

Lab

nonce



However, if we need to use an explicit nonce, it can be passed along with the message:

```
# This is a nonce, it *MUST* only be used once, but it is not considered
#   secret and can be transmitted or stored alongside the ciphertext. A
#   good source of nonces are just sequences of 24 random bytes.
nonce = nacl.utils.random(Box.NONCE_SIZE)

encrypted = bob_box.encrypt(message, nonce)
```

https://pynacl.readthedocs.io/en/latest/public/#nacl-public-box