CSE 350/550 Network Security; Assignment No. 3, due Friday, March 29, 2024

Listed below, you will find brief description of 2 projects, numbered 0 through 1. In groups of 2, you are required to pick one (see algorithm below), complete that project and submit a report (with a working system) on or before Friday, March 29, 2024 midnight.

The algorithm to pick a project: pick project numbered 0 or 1 as determined by k = A1+A2 mod 2, where

A1 = last_4_digits_of_roll_no_of_first_student, and

A2 = last_4_digits_of_roll_no_of_second_student.

The submission will consist of three parts:

1. 2 to 4 page document describing the system you have designed (including all assumptions you have made),
2. the code as a separate file, and
3. 5 to 8 slides that you will use to present your work.

In both these projects, you are to setup an RSA based public-key crypto system, complete with selection of p & q, computation of n & Φ, selection of encryption key, e, computation of corresponding public key, and (finally) algorithms for encryption & decryption.

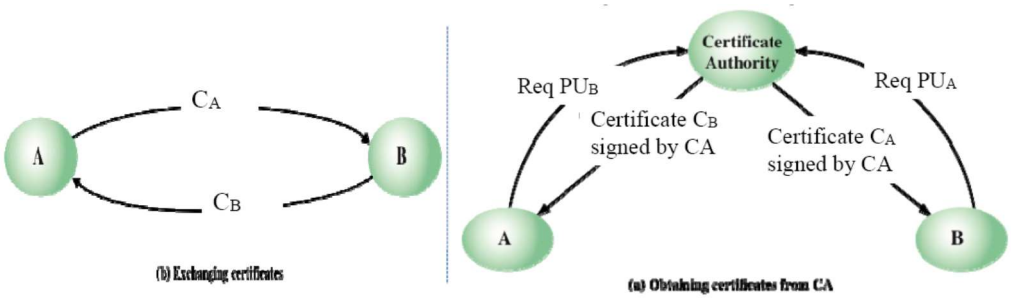
Project no. 0: RSA-based Public-key Certification Authority (CA)

You are required to

a. build a public-key CA, that responds to requests from clients that seek their own RSA-based public-key certificates OR that of other clients, and
b. build 2 clients that:
   - send requests to the CA for their own public-key certificates OR that of other clients, and
   - exchange messages with each other in a confidential manner, suitably encrypted with public key of receiver, but only after they know the other client's public key in a secure manner.

There are two ways for client A to know the public key of another client, B:

a. Receive a "certificate" from B itself, or
b. Get it from CA – this is the scheme we shall follow.



We will presently limit the fields in the "certificate" to the following:

$CERT_A = [(ID_A, PU_A, T_A, DUR_A, ID_{CA}) \,||\, ENC_{PR\text{-}CA}(ID_A, PU_A, T_A, DUR_A, ID_{CA})]$,

where (you decide the format for each of these):

- PR-CA is private key of certification authority (PU-CA is public key of certification authority)
- ID_A is user ID of A, ID_{CA} is the ID of the CA,
- PU_A is the public key of A,
- T_A is time of issuance of certificate, and DUR_A is the duration for which the certificate is valid.

To do so, you will need to use method (b) above to obtain each other's public key:

- Assume:

a. that clients already (somehow) know their own [private-key, public-key], but do not have their own certificates or that of others,
b. that clients already (somehow) know the public key of the certification authority,
c. that CA has the public keys of all the clients.

- Decide that messages *from* CA *to* clients are encrypted using RSA algorithm and CA's private key,
- Encrypted messages are sent/received between clients once they have each other client's public key, and
- Find a way to generate and encode "current time", and "duration".

Above you need to think hard as to who generates the pair of keys for a given client, viz. [private-key, public-key], and how do the CA and/or client itself get to know it.

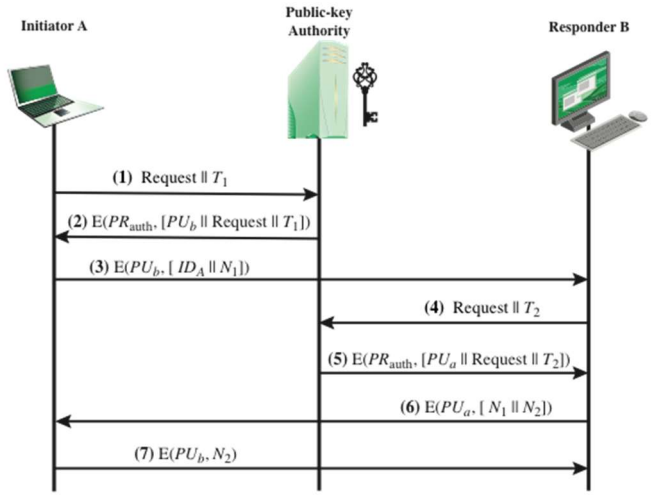
As a test, use the above to determine each other's public key, and then ensure client A can send 3 messages to B, viz. Hello1, Hello2, and Hello3. Client B in turn responds with ACK1, ACK2, and ACK3 to messages received from A.

Project no. 1: RSA-based Public Key Distribution Authority (PKDA)

You are required to:

a. build a PKDA, that responds to clients that seek their own public-keys OR that of other clients, and
c. build 2 clients that:
   - send requests to the PKDA for public-keys of themselves or that of other clients, and
   - exchange messages with each other in a confidential manner, viz. suitably encrypted with public key of receiver, but only after they know the other client's public key in a secure manner.

Specifically, use the scheme described (below) for a client to request public-key of another client (and for PKDA to respond to the request). Since not all parameters are shown below, add parameters such as IDs of initiator & responder, time of day, duration, nonces, etc. to the messages between clients and between clients and PKDA.



To do so, you will need to:

- Assume:
  a. that clients already (somehow) know the public key of the distribution authority, PKDA,
  b. that clients already know their own [private-key, public-key], but do not have the public-keys of other clients,
  c. that PKDA has the public keys of all the clients,
- Messages *from* PKDA to clients are encrypted using RSA algorithm and PKDA's private key,
- Encrypted messages are sent/received between clients once they have each other's public key, and finally
- Find a way to generate and encode "current time" and "nonces".

Above you need to think hard as to who generates the pair of keys for a given client, viz. [private-key, public-key], and how do the PKDA and/or client get to know it.

As a test, use the above to determine each other's public key, and then ensure client A can send 3 messages to B, viz. Hi1, Hi2, and Hi3. Client B in turn responds with Got-it1, Got-it2, etc. to messages received from A.