QUANTUM SAFE AUTHENTICATED GROUP KEY ESTABLISHMENT

NATO SPS programme- Project Number: G5448

Project Meeting, April 2nd, 2019

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URJC team- Spain

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TOWARDS SECURE POST-QUANTUM GROUP KEE AGREEMENT

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PROGRESS REPORT: ACTIVITIES IN SPAIN

- Research work in progress
  - Model for secure PQ-GKE (main part of this presentation)
- Dissemination effords

- Involvement of students
  - Report on attacks on post-quantum proposals (WalnutDSA)

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POST-QUANTUM GROUP KEY ESTABLISHMET

Main focus for the Spanish team

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GKE: THE STARTING POINT FOR ENABLING SECURE COMMUNICATION

A priori-shared secrets are needed for many cryptographic tasks

"start up a secure session"
"stablish a secure channel "

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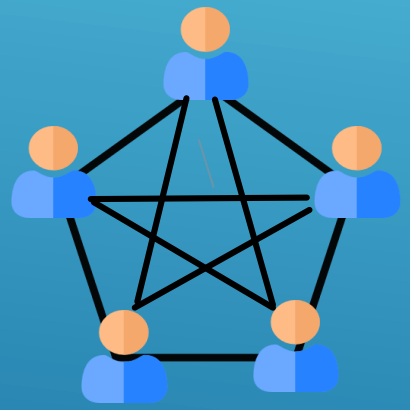
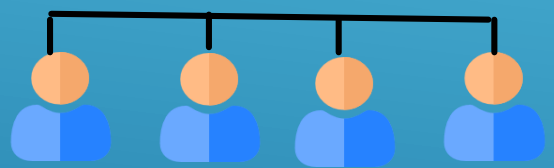
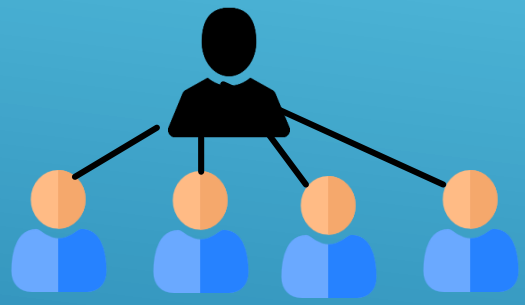
GKE: DIFFERENT SCENARIOS







- User roles (identical, jerarchical, etc.)
- Communication network (peer-to-peer, broadcast,..)

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PROJECT STEP 1-A :

Choice/Design of security model form GKE capturing post-quantum attacks

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GENERIC GOALS (FOR GROUP APPLICATIONS)

- Correctness
- Availability
- Efficiency
- Security : confidenciality, authentication, access control, anonymity

→ all can be attained through GKE

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GKE: SECURITY GOALS

- Key confidenciality/key secrecy: (secrecy, freshness, Independence, randomness, indistinguishability…)
- Authentication
- Key confirmation/Key integrity

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GKE: SECURITY MODEL

Formal description of adversarial capacities:

- Can they inject messages, or just eavesdropp?
- Can they corrupt group members? In what sense?
- Can they attack different (concurrent) sessions?
- Can they obtain previously agreed keys?

Further, in a post-quantum scenario we need to describe the adversarial access to quantum technologies (channels, computing, storage..)

Typical modelling of adversarial capacities is done through Oracle formulation

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THIS PROJECT: MODELLING SCENARIO

- Security model: Quantum-Future
  - During the protocol execution: classical adversaries
  - After the protocol execution: quantum adversaries
  - Users are always classical

- Advantages: modelling quantum attacks in a non-restrictive way, to be able to derive efficient solutions

- Rationale:

  - Quantum attacks are not considered at the execution time → standard (not post-quantum) authentication means can be used (thus we avoid"expensive" PQ signatures)
  - The resulting keys will remain secure once quantum adversaries are present, if forward security is attained by our design

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FOCUSING ON GKE: SECURITY GOALS

- We will use Oracle-modelling to capture adversarial capacities, focusing on attaining two properties:
  - Key secrecy (defined in a *real-or random* fashion: adversaries should not be able to tell apart a real key from one chosen at random from the key space)
  - Forward security (leakage of authentication keys has no inpact in previously agreed session keys)

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FURTHER : AUTHENTICATION

- Authentication;
  - Group: messages are recognized as sent by someone from the group
    → attained typically through passwords
  - User: messages are recognized as sent by a specific user inside the group
    → attained typically through digital signatures

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TOWARDS PROJECT STEP 2-A :

Design Tools :

- Classical authentication methods (MACs, digital signatures)
- Post-quantum tools (KEMs)

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EXPECTED OUTCOME (D3)
2ND YR, 4TH QR (JULY/SEPT 2020)

- Detailed security model
- High level description of a generic protocol
- Detailed constructions (based on different primitives)
- Security analysis (theoretical/practical/using run-time verification techniques)
- Implementation guidance

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THANK YOU