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SEcure DIstributed IoT ManagemENT (SEDIMENT) for OPS-5G

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Outline

- SEDIMENT Remote Attestation (RA)
- SEDIMENT RA protocol framework
- IETF Remote ATtestation procedureS (RATS) Architecture
- SEDIMENT transition to a Linux Foundation project
- Engagement with LF 5G Super Blueprint
  - Use case #1
  - Use case #2
- Next steps
- Q/A

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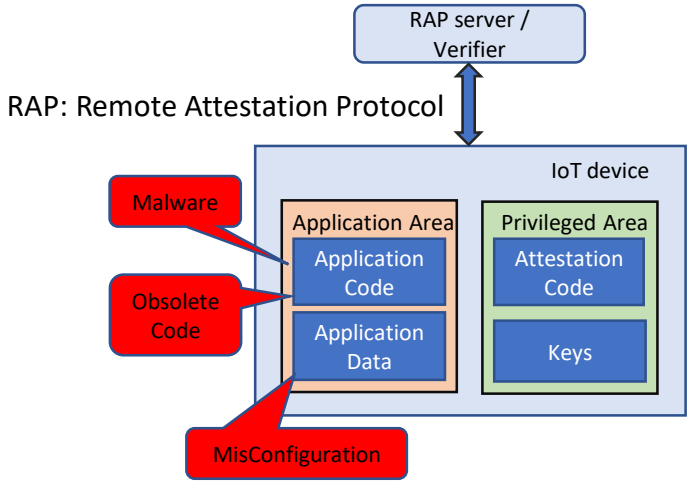
SEDIMENT Remote Attestation (RA)

- RA goals
  - Detect presence of malware and software tampering
  - Verify IOT device configuration integrity
  - Authenticate
  - Operate across the entire scale of devices on a 5G network



- Key RA components
  - A protocol (cf. next slide) that supports
    - Authentication and authorization among communicating entities
    - Flexibility in requesting various types of evidences for attestation
      - E.g., firmware fingerprint; process status
  - Hardware/software/hybrid Root of Trust (RoT) that ensures the integrity of RA protocol execution [1]
    - Protection of attestation credentials
      - Exclusive access
      - No leaks
    - Safe execution in a protected region
      - Execution atomicity (cannot be interrupted)
      - Immutability (attestation code and everything it depends on cannot be altered after being loaded)
      - Controlled invocation (run attestation code in its entirety)

[1] Karim Eldefrawy, Norrathep Rattanavipanon, and Gene Tsudik. 2017. HYDRA: HYbrid Design for Remote Attestation (Using a Formally Verified Microkernel). *WiSec '17*.

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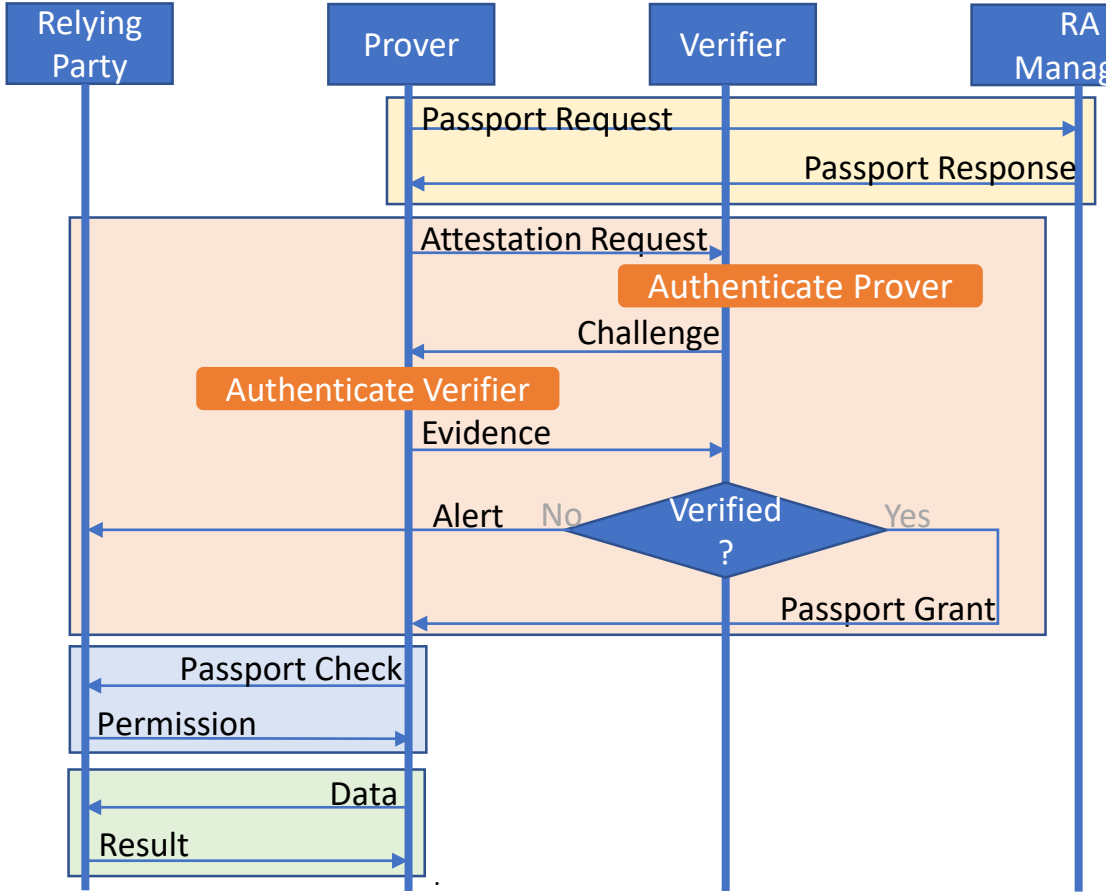
Remote Attestation Protocol Framework



Pairing:

- Prover authenticates itself to Relying Party and acquires Verifier connection information

Attestation:

- Prover initiates attestation, *instead of continuously keeping a communication channel open waiting to be attested, with significant energy savings*.
- Verifier can issue a variety of challenges to request Prover to produce evidences.
- Authentication digests signed with the shared key enables both parties to authenticate.
- Verifier evaluates evidence. Either grants a passport to Prover or sends an Alert to Relying Party. Prover must restart the procedure after some time if it does not get expected positive response from Verifier.

Join:

- Prover submits granted passport to the Relying Party to gain permission to communicate.

Report:

- IoT device sends application data after Passport has been accepted.

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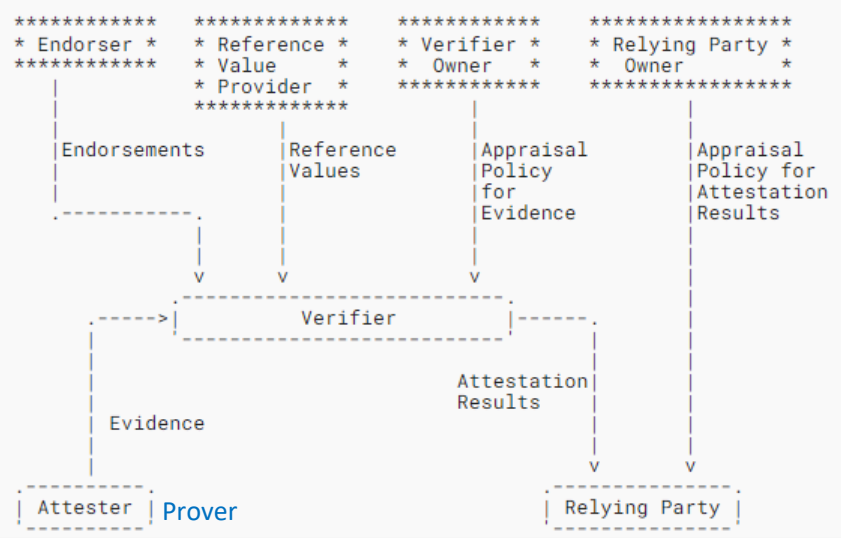
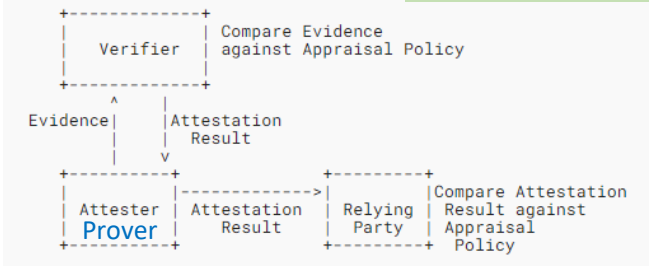
IETF RATS WG Architecture

https://datatracker.ietf.org/doc/rfc9334/

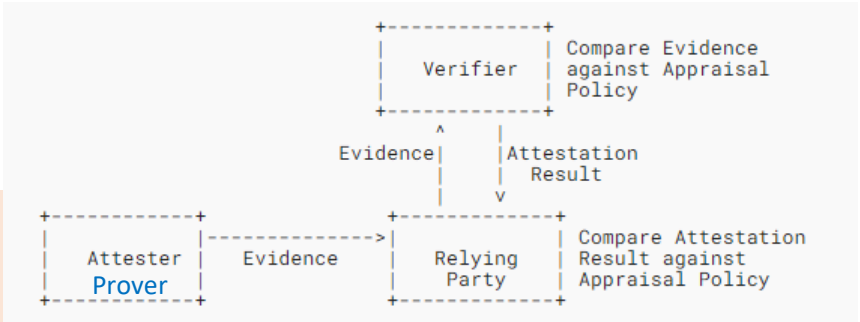


Conceptual Information Flow

SEDIEMENT RA is being aligned with RATS, following Passport model



Passport Model



Background Check Model

Relying Party:	Network equipment for network access admission; Server holding confidential data for release; Entity that needs trustworthiness of remote elements
Evidence:	Claims about the target environment
Reference Values:	Values used in appraising evidences
Endorsements:	Statements that help authenticating device info

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SEDIMENT Transition: Linux Foundation Project

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- "SEDIMENT, a Series of LF Projects" has been set up with the following mission statement:
  - "to provide open-source software implementing a distributed and scalable security architecture with remote attestation for networked IoT devices"
- Documents have been adopted/executed by LF and Peraton Labs:
  - Technical Charter, Series Agreement, and Contributor's Agreement (word mark transfer)
- Project supporters including one LF member:
  - NIWC (LF member), DARPA, Peraton Labs, UCI, Kryptowire Labs, Aarno Labs, USC/ISI
- Apache v2.0 License for code and CC-BY-4.0 for documentation chosen
- Code and documentation released by DARPA DISTAR and Peraton
- Repositories for code and webpages: https://github.com/sediment-lfproject
- LF Project public announcement on February 22nd, 2023

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Engagement with LF 5G SBP

- Develop use cases for RA in collaboration with Muddasar Ahmed and Ranny Haiby
  - Ensure that IoT devices on a network are authentic and have not been tampered with
  - Ensure that IoT devices can be seamlessly maintained and securely updated
- Develop and integrate SEDIMENT RA onto existing 5G SBP lab infrastructure as proof of concept of ways to realizing 5G SBP use cases

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Use Case #1

- Insure that IoT devices on a network are authentic and have not been tampered with. This is particularly sensitive in remote areas that are not often frequented by people.

- How would remote attestation help?
  - RA Verifier is set to periodically "inspect" remote cameras by checking their firmware fingerprint.
    1. RA Verifier confirms that the firmware fingerprint of Remote Camera A is authentic and permits/allows the camera to stay on the network.
    2. RA Verifier determines that the firmware fingerprint of Remote Camera B is not authentic. RA Verifier then alerts Relying Party (e.g., firewall) to deny Remote Camera B access on the network.

5G SBP Use Case - Remote Attestation Use Case 1- IoT Device Security and Authentication

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Use Case #2

- Ensure that firmware of IoT devices can be seamlessly maintained and securely updated, especially when IoT devices are deployed at scale.

- How would remote attestation help?
  - With a hardware/software co-design, RA Prover enforces software immutability and prevents unauthorized updates.
    1. Unauthorized software updates on Remote Camera C triggers its MCU reset.
    2. Secure updates issued by RA Verifier to Remote Camera D as the sole means of software updates.

5G SBP Use Case - Remote Attestation Use Case 2- IoT Device Onboarding & Maintenance

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Next Steps

- Continue use case refinement with the working group and update draft on the LF 5G SBP site.

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