A User-centric Privacy Manager for Future Energy Systems

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Overview of Presentation

- Introduction
- Problems and Motivation
- Background (Trusted Computing and Virtualization)
- Proposed Solution
- Conclusion
- My Assessment
- References

Introduction

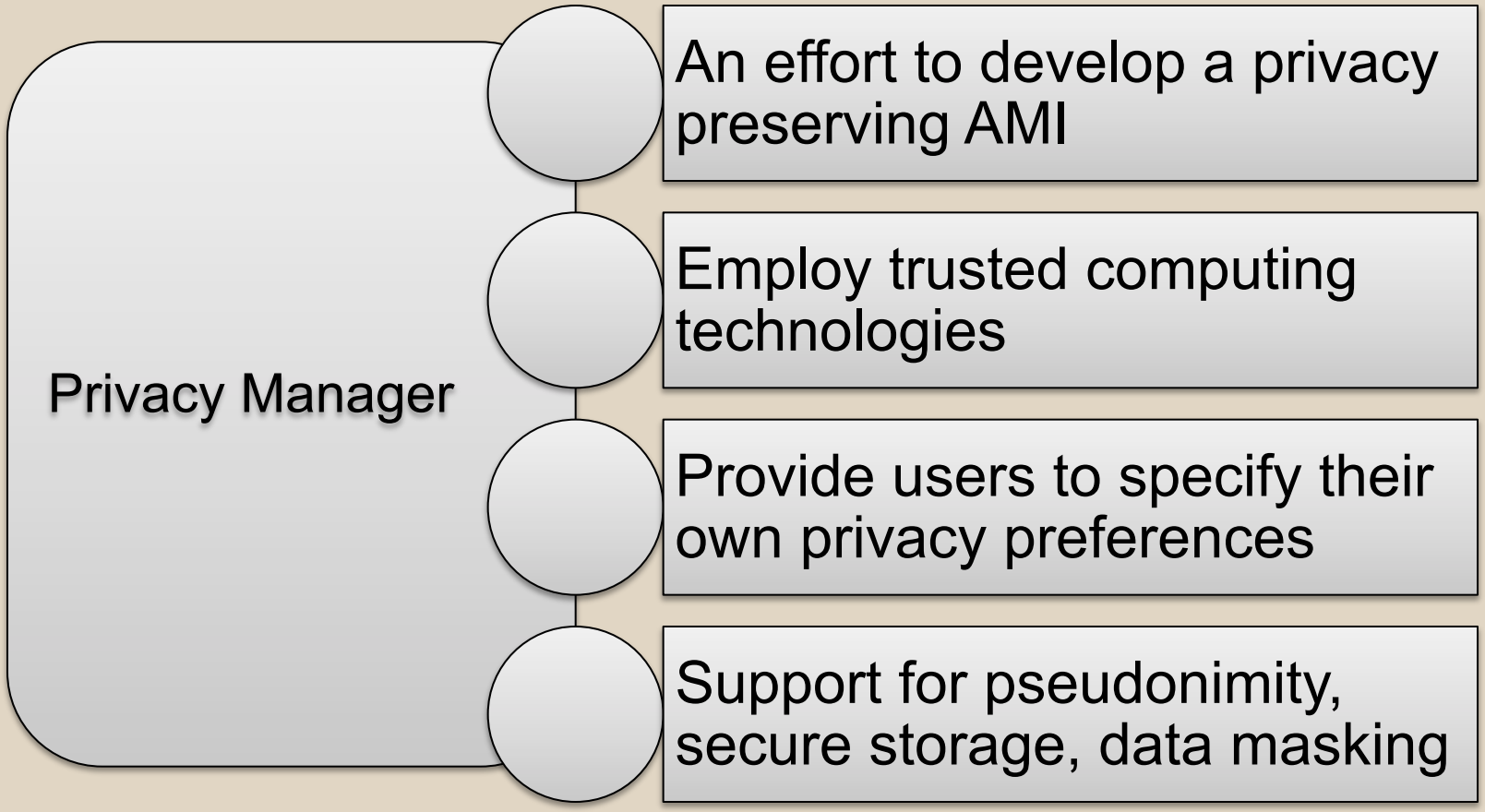
Information

(Ex.: energy usage)

Communication Technologies

Need for Strong User Centric Privacy Protection

Introduction (Continue)



Motivations And Background

- A) Two problem scenarios that motivate the authors:
  - 1) Dynamic metering and pricing schemes for Distributed Energy Resource
  - 2) Remote reinitialization for new customers
- Related privacy concerns.
- B) Key privacy requirements.
- C) Trusted computing.
- D) Platform Virtualization.

Scenario-1

Dynamic metering and pricing schemes for Distributed Energy Resource

- A gateway service provider (utility) provides its customers with SEG.
- Smart Energy Gateway:
  - Displays usage and pricing info
  - Monitors and controls distributed energy generation and consumption.
  - Log transactions.
  - Shared by several stakeholders (grid operator, energy supplier)

Scenario-1 (Continue)

With SEG:

- Customer can monitor its energy consumption and generation capacity.
- Customer can sell the overproduced electricity.
- Utility is able to detect load peaks, and can remotely disconnect a set of customers to reduce load level.
- Third party service providers (billing provider) can retrieve aggregated customer related energy information.

Related Privacy Concerns for Scenario-1

- Customers' usage habits, lifestyle might be deduced.
- Critical business data might be deduced.
- Misuse or uncontrolled disclosure of private data.
- Sharing with a third party without customers' consent and abusive advertisement.
- Combination of electric usage data, vehicle's current position, identity may be used to track the future electric vehicle and its driver.

Scenario-2

Remote reinitialization for new customers

- Smart control devices deployed to remotely capture customer's energy usage information.
- Old customer moves out, new customer moves in.
- As a default policy, energy usage information is needed to be reinitialized.

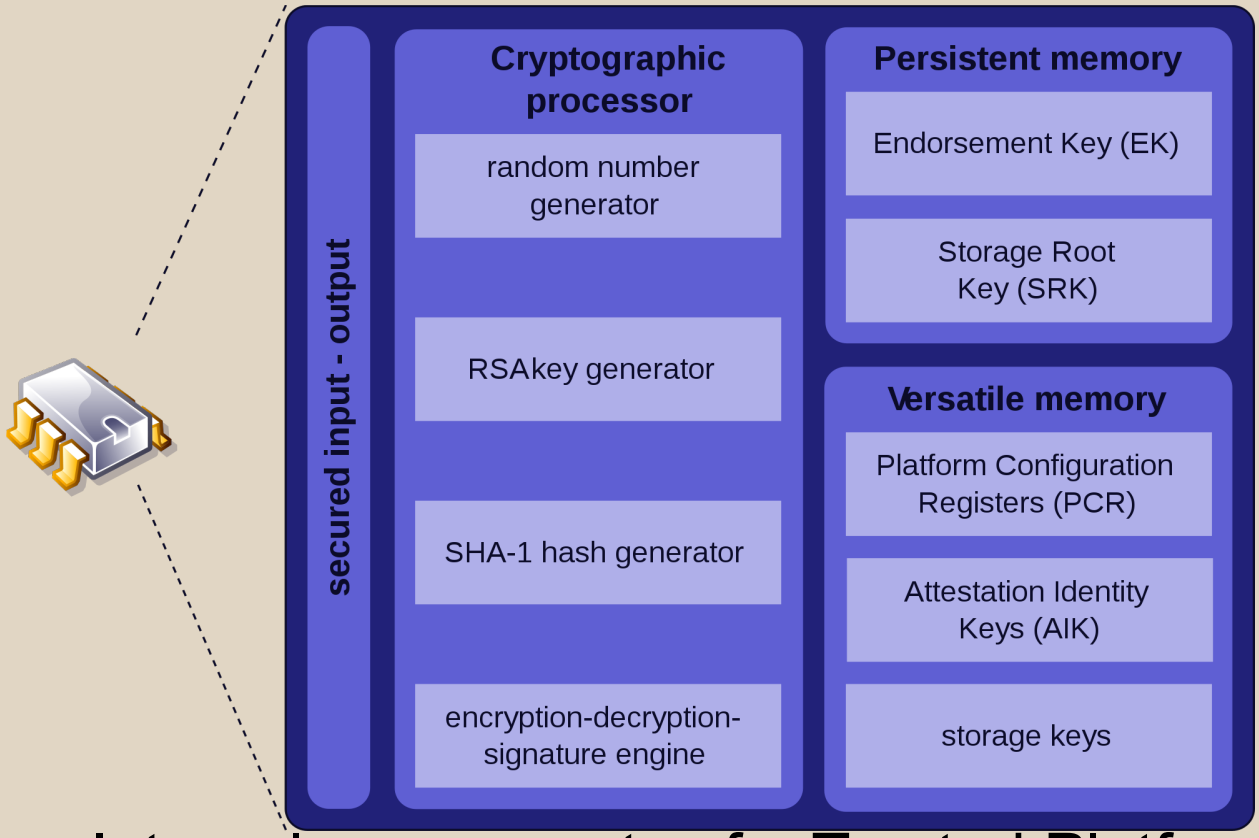
Related Privacy Concerns for Scenario-2

- If energy usage data, which were stored within the SEGs are not fully removed, following information can be deduced:
  - Energy usage patterns.
  - Details about daily routines of old customers.
  - Advanced analysis of metering data could lead to identity theft.

Key Privacy Requirements

- **Requirement-1 (Customer Empowerment):**
  - Notification of Customers.
  - Customer's consent.
  - Setting privacy preferences.
- **Requirement-2 (Data Protection):**
  - Ensure secure storage, transport, process of metered and other sensitive data.
  - Accordance with customer's privacy preferences.
  - Isolation.
  - Secure information flow.
- **Requirment-3 (Data Minimization):**
  - Collect and process when necessary.
  - Using pseudonyms
  - Identity must be hindered.

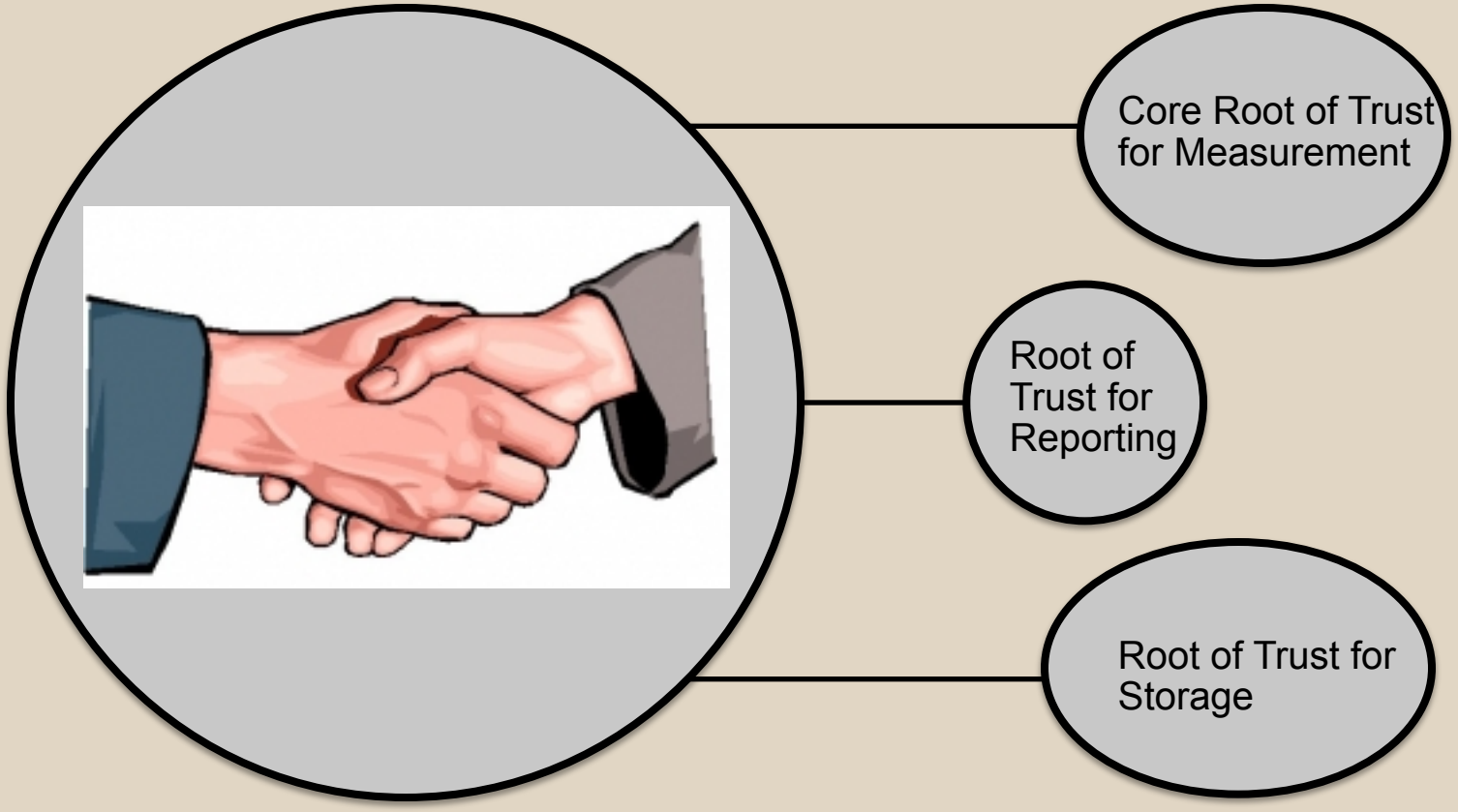
Background-Trusted Computing



Internal components of a Trusted Platform Module
(Figure from http://en.wikipedia.org/wiki/Trusted_Platform_Module)

Background-Trusted Computing

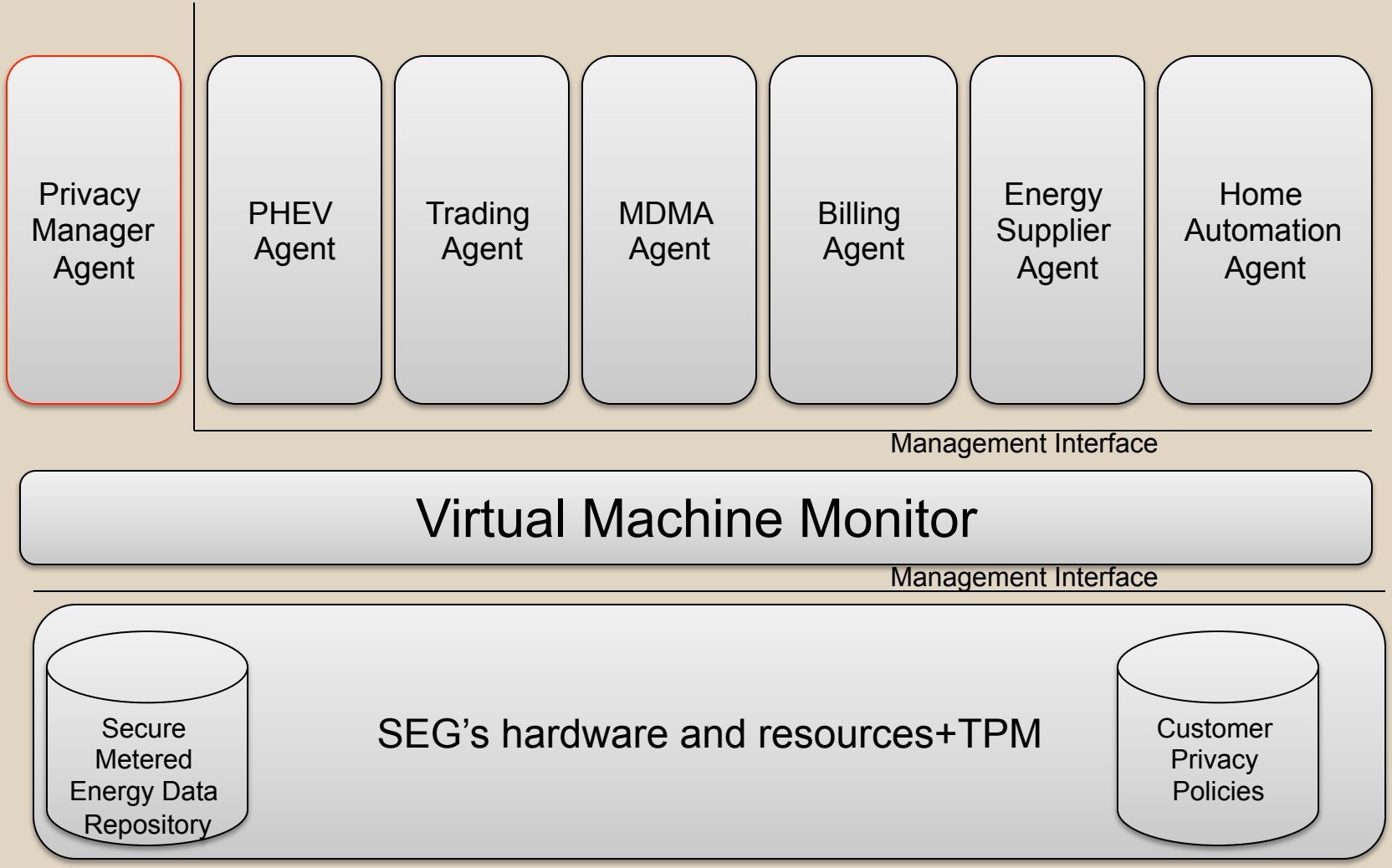
Roots of Trust



Background- Platform Virtualization

- Realizes several runtime environments in parallel but isolates computer platform resources (such as storage, memory, CPU)
- This isolated environment is called VM and provides an interface that is similar to physical shared resource.
- It extends the concepts of TC into virtual machines and provides the illusion of TPM on a VM.

Proposed Framework/Solution



A Trusted Virtualized Multi-Agent SEG Platform

Proposed Framework/Solution

Privacy Manager Agent - Features

1) Privacy Preferences Specification and Enforcement:

- How customer's information will be treated?.
- How revealed personal information should be handled?.
- Secure association between captured data and privacy policies.

2) Privacy Policies Enforcement:

- Validation against the SEG platform integrity policy during installation and runtime.
- Comply with the customer predefined policies whenever the energy usage data are handled.
- Flow of sensitive private.
- Ensure the integrity of VMM and PM.
- Support establishment of trust with the smart grid backend.

Example Policy

<PrivPol PolicyId='SamplePolicy'>

<Subjects> energy supplier; grid operator; utility distributor; end customer **</Subjects>**

<PersonalInformation> vehicle identifiers; serial numbers of in-house smart equipment; account number **</PersonalInformation>**

<AllowedOperations>read, write**</AllowedOperation>**

<Purpose>billing; accounting; pricing**</Purpose>**

<Condition> explicit customer consent; erase data after 12 months**</Condition>**

<Obligation> notify **</Obilgvation>**

</PrivPol>

Sample Energy Data Handling Policy

Proposed Framework/Solution

Privacy Manager Agent-Features

3) Secure Storage:

- Secure data repository.
- Allow only trusted and legitimate application to access metered data repository. (Meets R2)
- Sign energy data.

4) Pseudonymity:

Hide customer identity

5) Privacy Feedback:

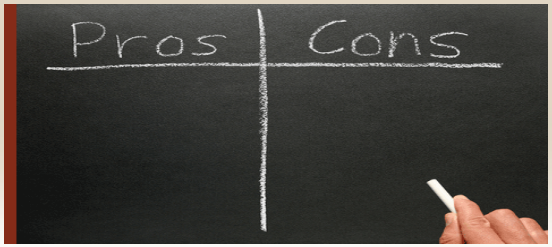
Notify the customer (Meets R1).

Conclusion

Authors proposed a user centric privacy manager which:

- Protects privacy of energy users.
- Helps customers to specify privacy conditions and obligation with respect to handling their private data.
- Provides application isolation, access control, pseudonymity, secure storage, encryption of data before transferring .
- Uses hardware based security (Trusted Computing) combined with virtualization techniques.

My Assessment



Pros:

- Strong privacy protection.
- Secure storage and transfer of energy data.
- Empowers customers
- Provides transparency

Cons:

- Cost of deploying TPM enabled SEGs?
- How to integrate the SEG with current smart meters other devices is not mentioned?
- Recent researches showed that TPM can be hacked. So TPMs are not really that much reliable.
- Very high level picture of their framework.

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Questions?

Thank You!