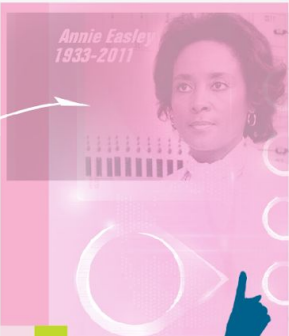Grace Hopper
1906-1992

Annie Easley
1933-2011

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Rethinking Service Systems:
A Path Towards Secure and Equitable Resource Markets

Ghada Almashaqbeh
UConn
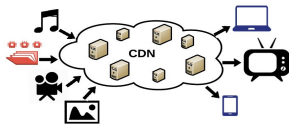
Traditional Service Systems

Central Management

Services

File Storage

Content Distribution

Computing

# Traditional Service Systems

Central Management

- **Drawbacks:**

  - Costly and complex business relationships.

  - Over-provisioning service needs.

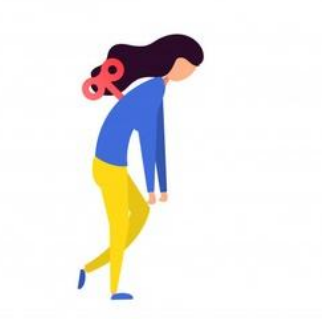 - Issues related to reachability, visibility, flexibility, etc.

Decentralized Services

- Utilize P2P-based models to build dynamic systems.

- **Advantages:**
  - Flexible services.
  - Easier to scale with demand.
  - Extended reachability and lower latency.
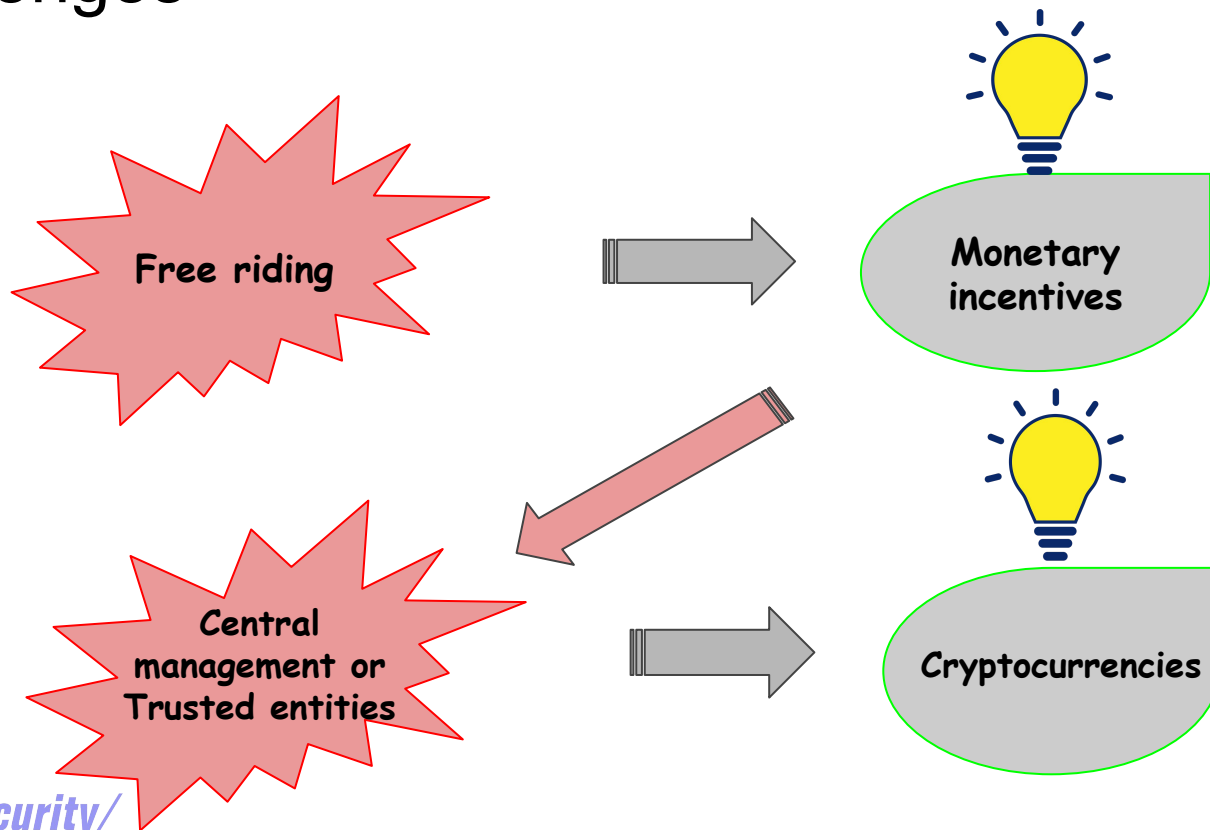 - Democratized and transparent ecosystems.
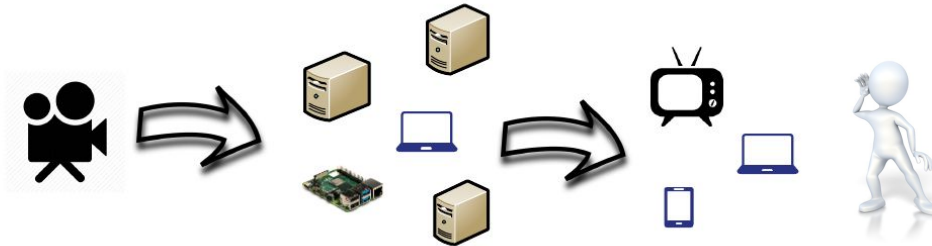
Equitability and Flexibility

- More opportunities to access services at lower cost.

- More opportunities for additional income sources by providing services.

- Insensitive to who you are or where you reside.

Challenges

Free riding

→

Monetary incentives

Central management or Trusted entities

→

Cryptocurrencies

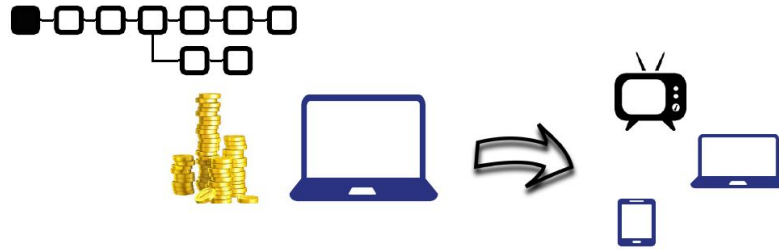together we build

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Cryptocurrencies and Blockchain Technology

- An emerging economic force with a huge interest.

- Early systems focused on providing a currency exchange medium.

- Newer systems provide a service on top of this medium.

  - Create **distributed resource markets**.

  - E.g., Filecoin, Livepeer, NuCypher.
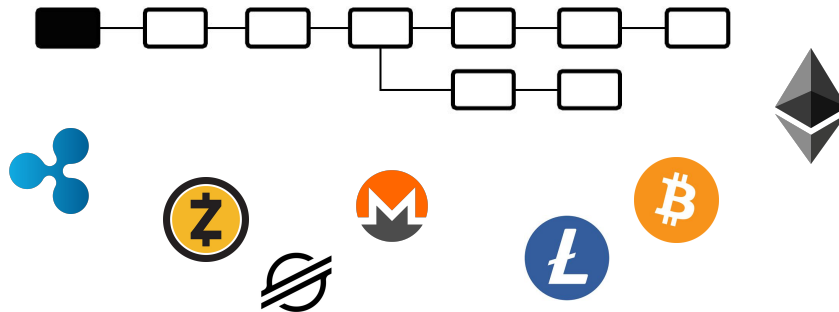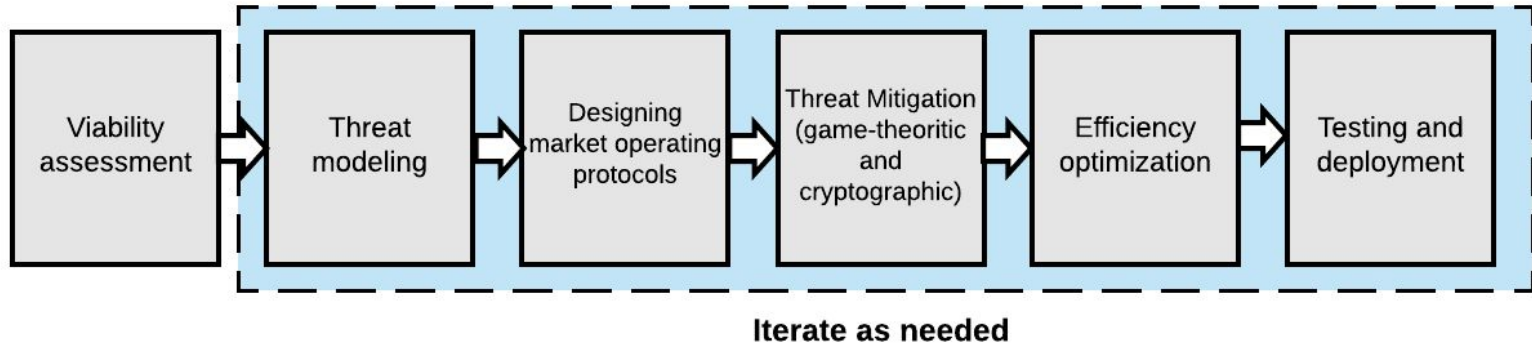
Problem solved?!

Open access work model, large scale system with monetary incentives ...

A Design Framework for Distributed Resource Markets

Viability assessment → Threat modeling → Designing market operating protocols → Threat Mitigation (game-theoritic and cryptographic) → Efficiency optimization → Testing and deployment

Iterate as needed

Viability Assessment

- An important step to assess the potential for practical adoption.

- Two sides of the equation:

    ○ Service demand.

    ○ Service supply.

DEMAND

**SUPPLY**

Threat Modeling

- An essential step to investigate all potential security risks.

  - A guiding design map, as well as a tool for assessing security.

- Requires frameworks capable of:

  - Dealing with large scale systems.

  - Explicitly account for financial motivations of attackers.
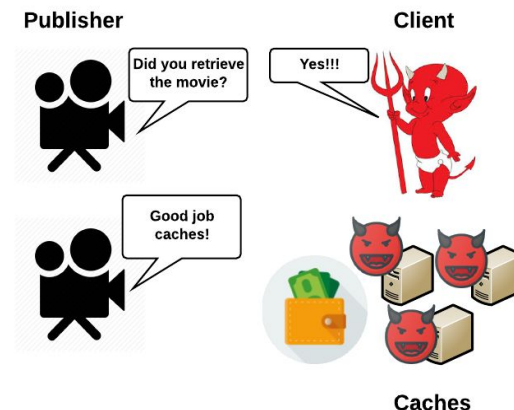
Unique Issues in Distributed Resource Markets

- **Fair-service exchange is impossible**.
  - Pay first or serve first?
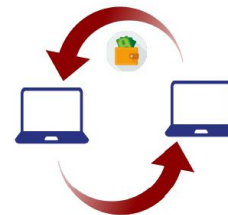
- **Accounting attacks**.
  - Do servers earn their payments?

Cryptographic and Economic Security Measures

- Dealing with monetary incentives is challenging!

- Financially-motivated threats require economic mitigation techniques.

  - E.g., Detect and punish, service pricing.

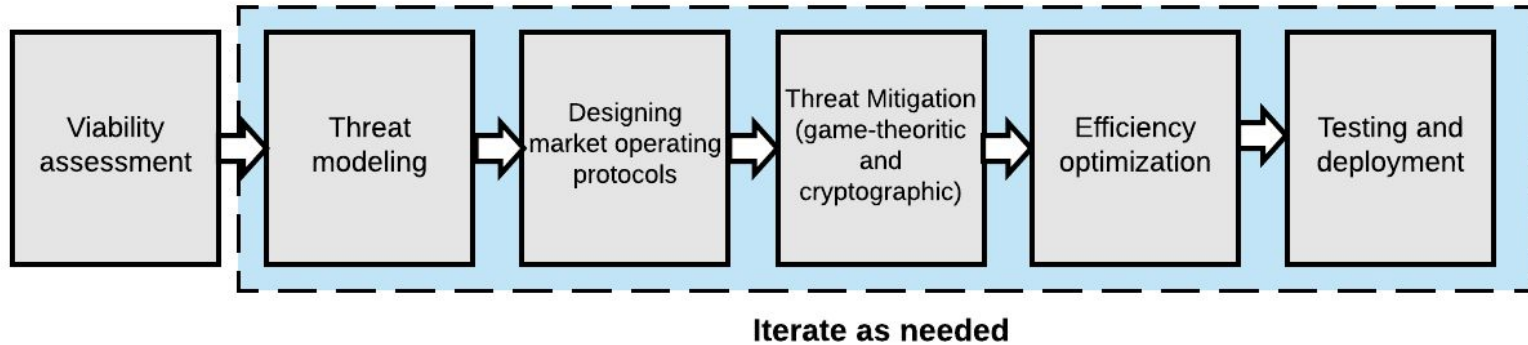- Usually rely on assuming rational players.

Optimize for Efficiency

- Seeking a practical adoption?

  - Testing and deployment.

  - Exploit every opportunity to boost system's performance.

  - Look for the right trade-off between security and efficiency.

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Iterate as Needed!

Viability assessment → Threat modeling → Designing market operating protocols → Threat Mitigation (game-theoritic and cryptographic) → Efficiency optimization → Testing and deployment

Iterate as needed

Thank You!

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