

ChoiceNet

Enabling new applications and business models through
choice and competition

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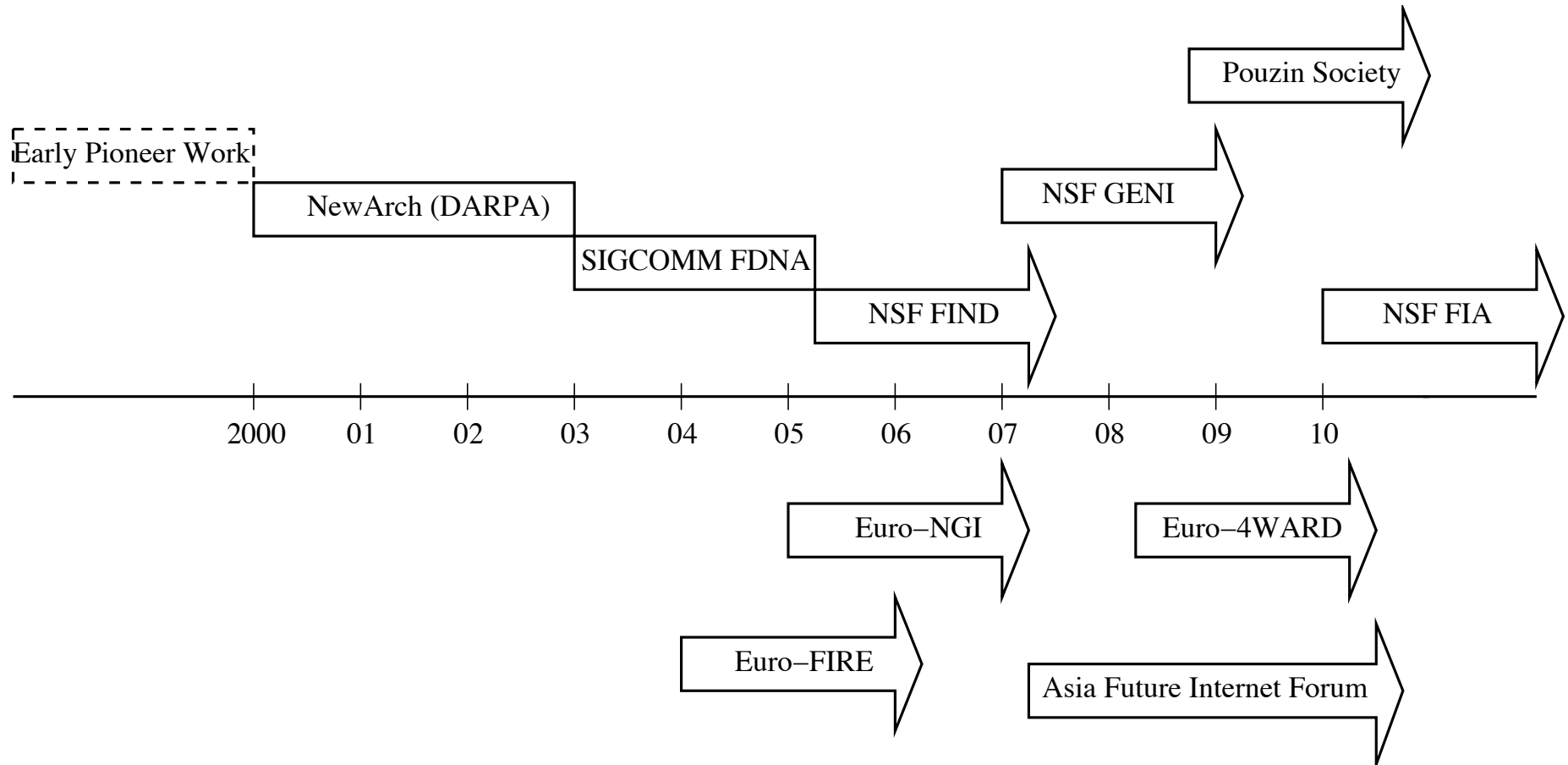
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ChoiceNet

- NSF NeTS Large project
 - Started September 2011
 - Assigned “FIA status” in 2012
- Team:
 - University of Kentucky:
Jim Griffioen, Ken Calvert
 - North Carolina State University:
Rudra Dutta, George Rouskas
 - RENCI:
Ilia Baldine
 - University of Massachusetts:
Tilman Wolf, Anna Nagurney



Historical Perspective



USA FIA Projects

- Named Data Networking (NDN) - UCLA (lead)
 - Content-centric, focus on “what” not “where”
- MobilityFirst – Rutgers (lead)
 - Cellular convergence (4-5B devices), interconnected vehicles
- NEBULA – Upenn (lead)
 - Reliable, high-speed core interconnecting data centers
- eXpressive Internet Arch. (XIA) – CMU (lead)
 - Rich set of communication entities as network principals
- ChoiceNet

Software Defined Networking (SDN)

- Decouples control and data planes
- Control plane SW runs on general purpose HW
 - Decouple from specific networking HW
 - Use commodity servers
- Data plane is programmable
 - Maintain, control, program from central entity
- Architecture to control entire network

Internet Economics

- Market forces have shaped services and applications at the edge
- Wealth of studies explore:
 - Economic issues arising in the Internet
 - Economic effects of existing networking technology

Network Economy Conundrum

- New architectures:
 - Focus on networking technology, not economic interactions
 - Do not provide mechanisms to introduce competition and market forces
- Existing economic models cannot be deployed in today's Internet: No mechanisms to:
 - Discover/create contracts with any provider
 - Doing so on short time scales

ChoiceNet Goals

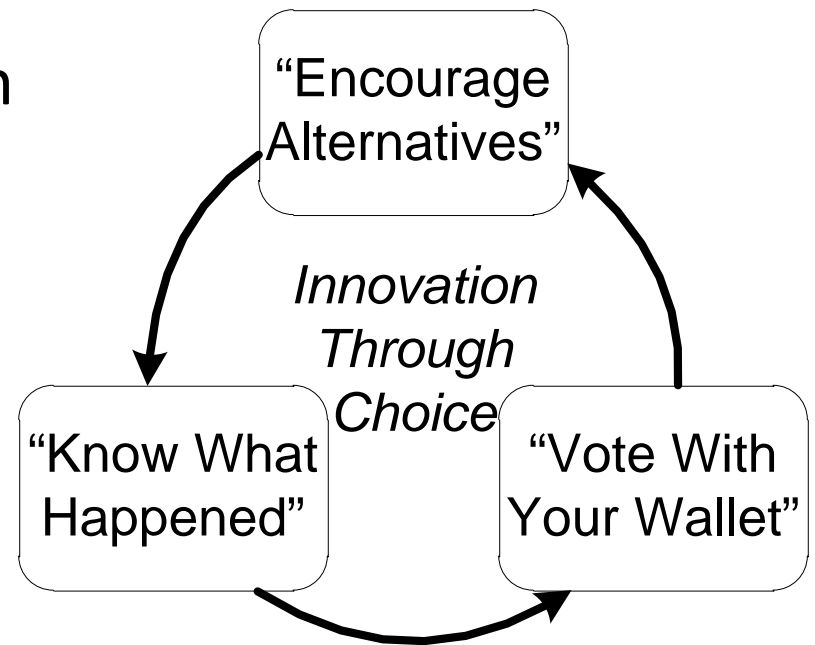
- Expose choices throughout network
 - Network no longer a “black box”
- Interactions between technological alternatives and economic relationships
 - Introduction of dynamic “economy plane”
 - Money as driver to overcome inertia by providers
 - Market forces can play out within the network itself
- Services are at core of ChoiceNet (“everything is a service”)
 - Services provide a benefit, have a cost
 - Services are created, composed, sold, verified, etc.

ChoiceNet

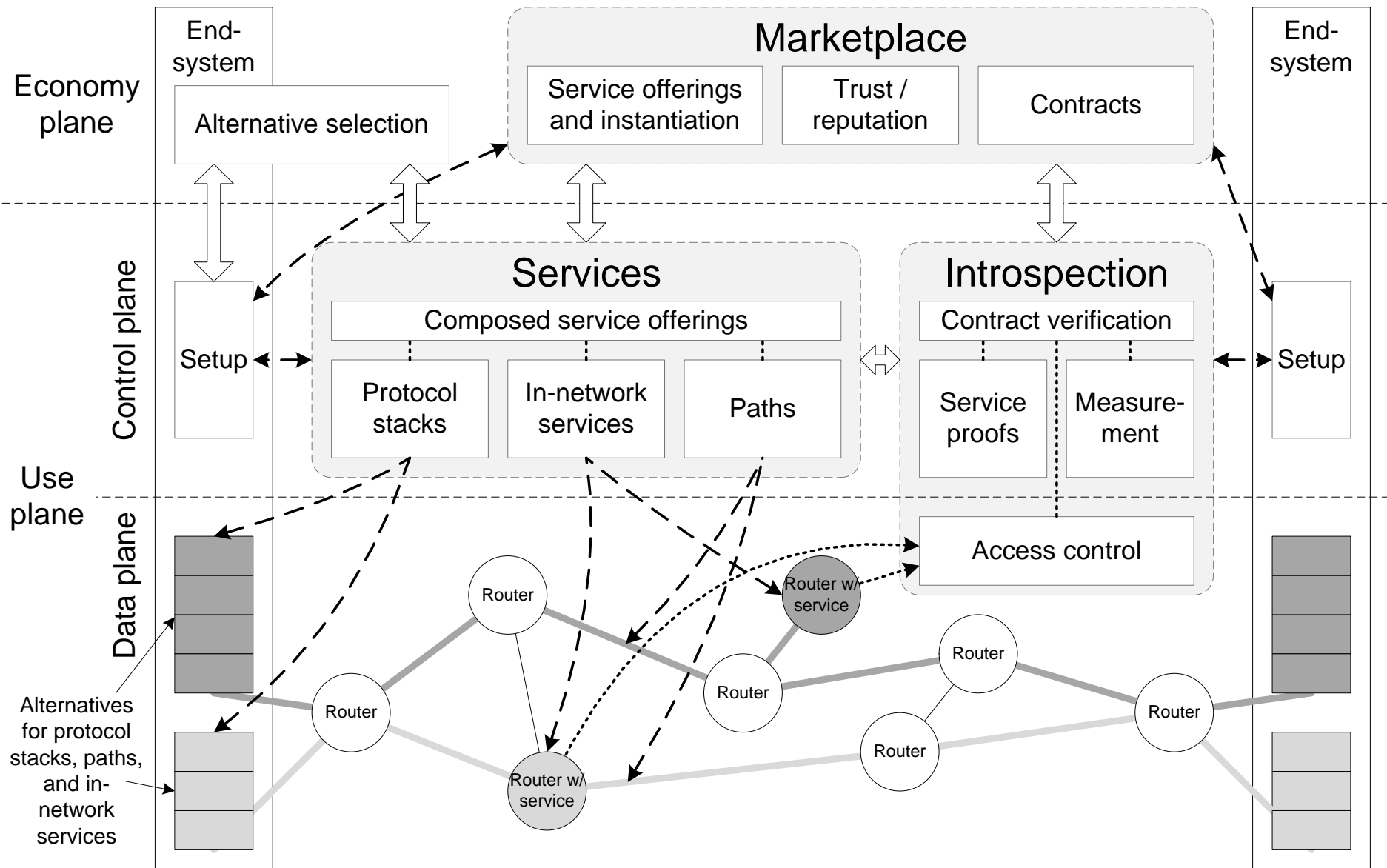
- “Network architecture” with a grain of salt
 - Possibly not a complete architecture
 - Requires redesign of data and control plane
 - Aim to fit with existing and future architectures
 - Based on IPv6, but others possible

ChoiceNet Principles

- Competition drives innovation
- “Encourage alternatives”
 - Provide building blocks for different types of services
- “Know what happened”
 - Ability to evaluate services
- “Vote with your wallet”
 - Reward good services
- Principles and technology can be applied to most network architectures
 - Services and service composition
 - Economic contracts and enforcement

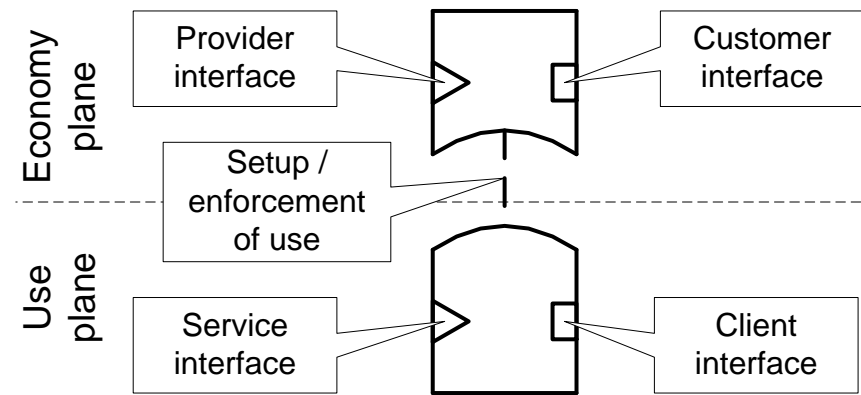


ChoiceNet Architecture

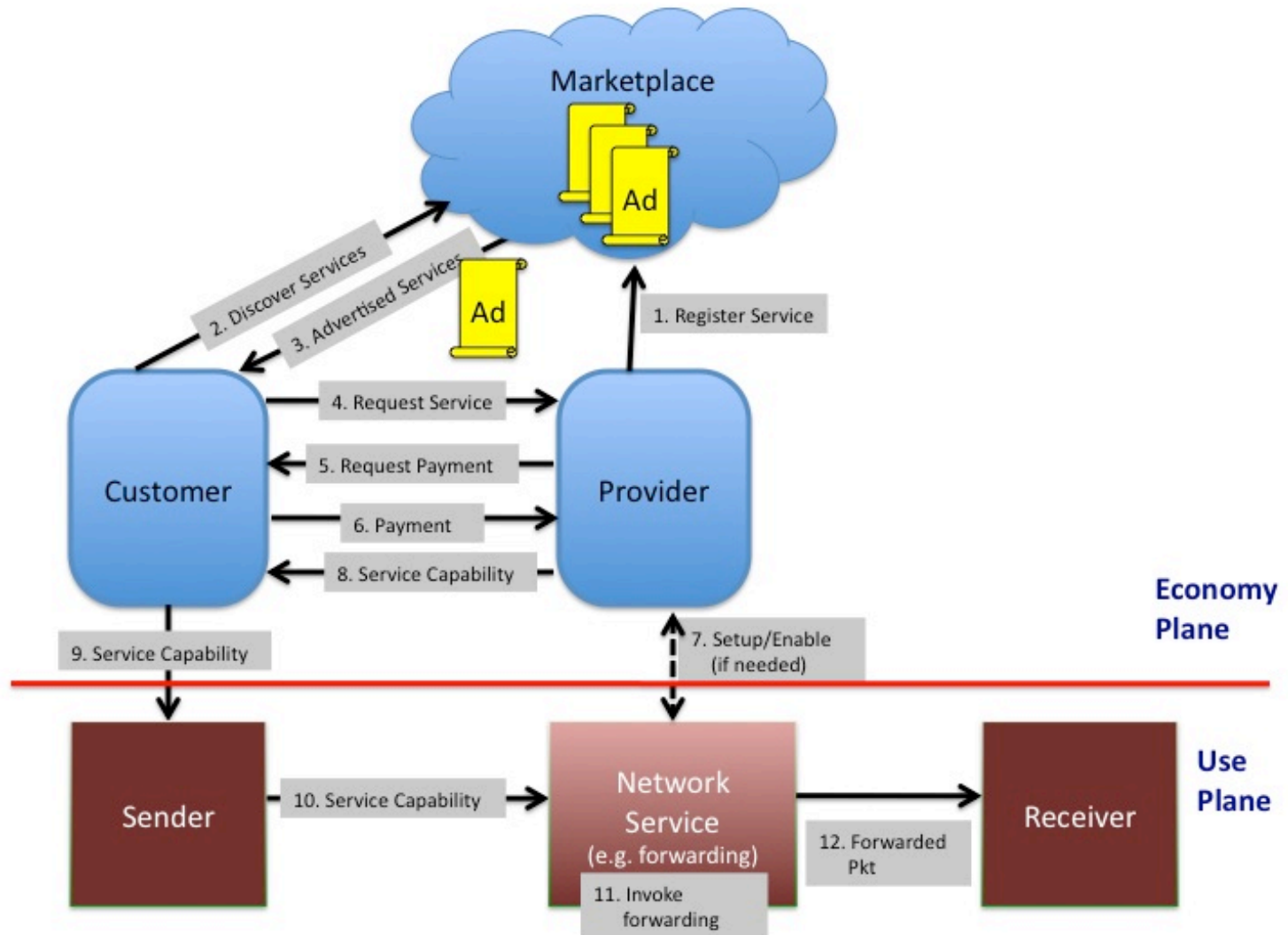


Entities in ChoiceNet

- ChoiceNet enables composition of services and economic relationship
 - Economy plane: customer-provider relation
 - Use plane: client-service relation
 - Strength is ability to reflect real-world relations

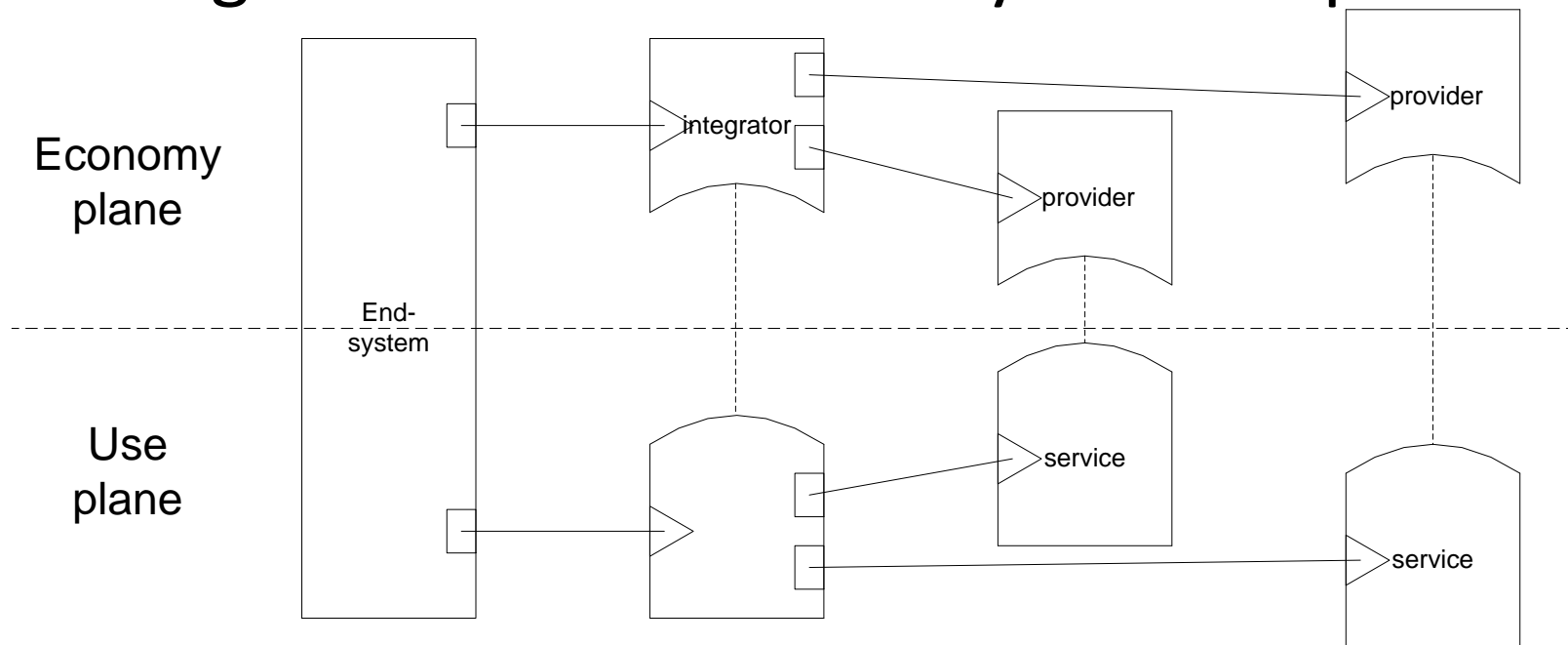


Entities and Interactions



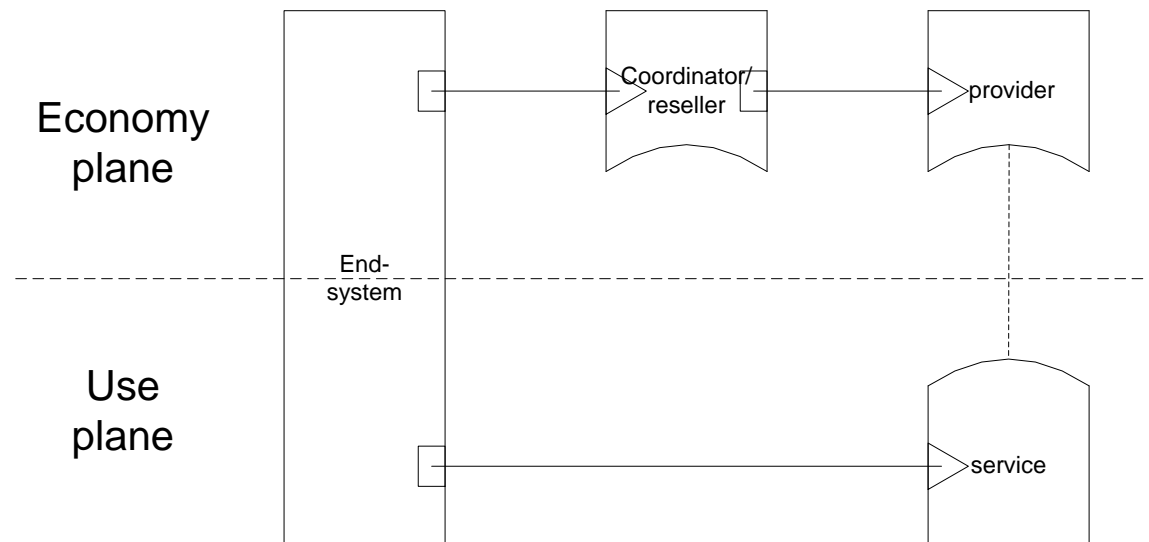
Composed Services

- Service author/developer creates new services
 - Composition from other service offerings
- “Integrator” acts in economy and use plane



Composed Services

- “Reseller” only acts in economy plane
 - Separation of hosting allows for such entities



- Many research questions
 - Composition of services
 - Design of enforcement across providers

Provider Ecosystem

- Incentives for actors to participate?
 - Everyone can be rewarded (authors, host, integrator, verifier)
 - Good and innovative services get rewarded
- Payments among actors to sustain viability
 - Economy plane distributes value (e.g., money)
- Same commercial entities as today?
 - Similar providers, but also finer-grained providers
 - New providers for composition and verification

ChoiceNet Technologies (in progress)

- Economy plane
 - Methods for describing, composing, and instantiating services
 - Marketplaces for connecting customers and providers (e.g., search for services)
 - IDs associated with entities
- Use plane
 - Verification of economy plane contracts in use plane (e.g., capabilities with delegation)
 - Measurement services to verify offerings

Use Cases Enabled by ChoiceNet

- ChoiceNet / economy plane enables new business models in the Internet
 - Highly dynamic economic relationship possible
 - All entities get rewarded
- Examples
 - Movie streaming
 - Reading NYT in coffee shop (long-term contracts)
 - Reading NYT in coffee shop (short-term contracts)
 - Customers as providers

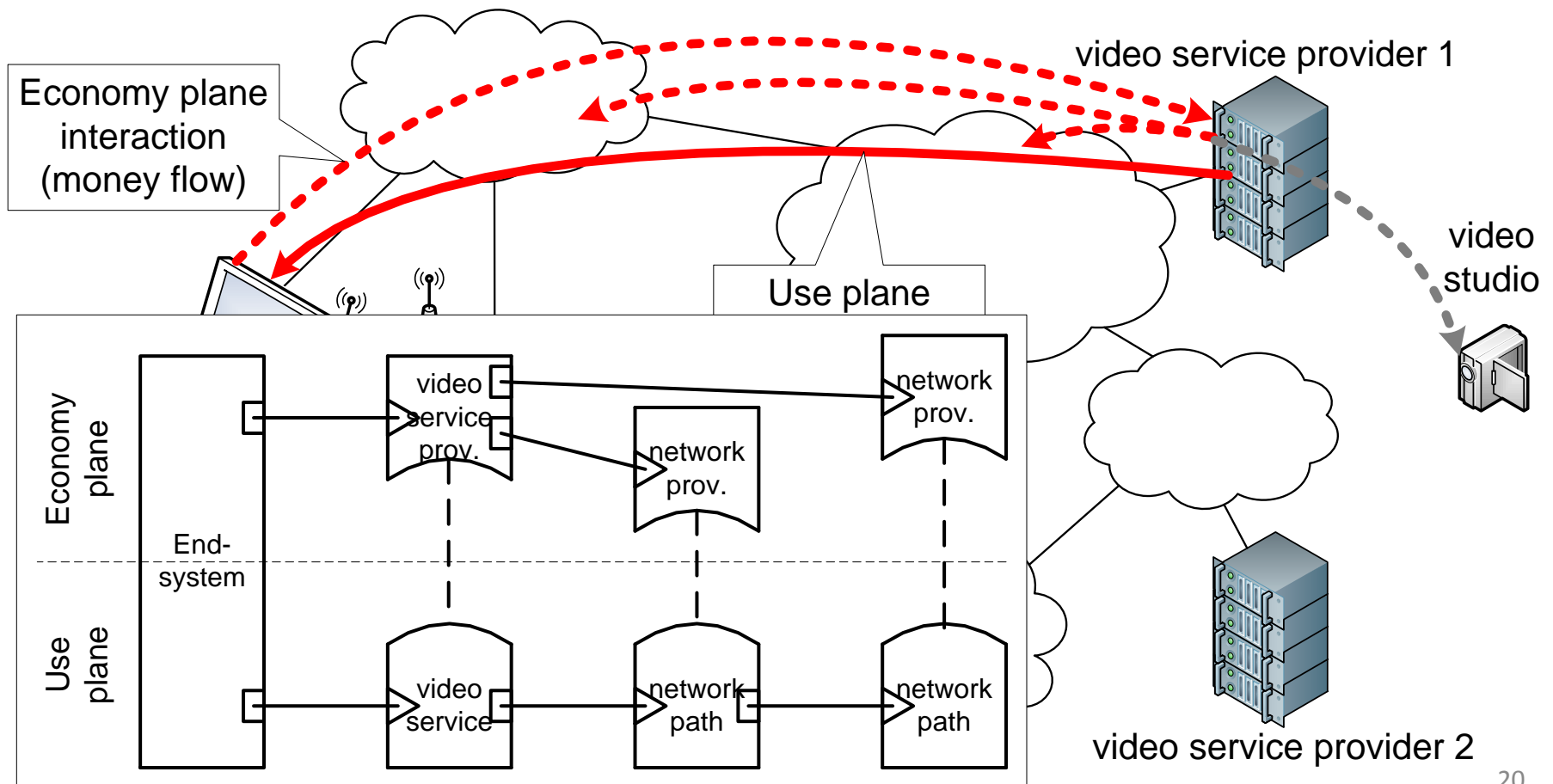
Movie Streaming Example (1)

- Choices for movie streaming
 - Technical choices:
 - Different connections, transport, caching, etc.
 - Economic choices:
 - Pay more or less for a particular video experience
 - Technical choices are packaged and sold as experiences
- End-user interactions with ChoiceNet
 - Select, pay for, and expect a certain experience
- Opportunities for developers
 - Novel solutions composed from other services and offered in marketplace
 - Developers without infrastructure can innovate



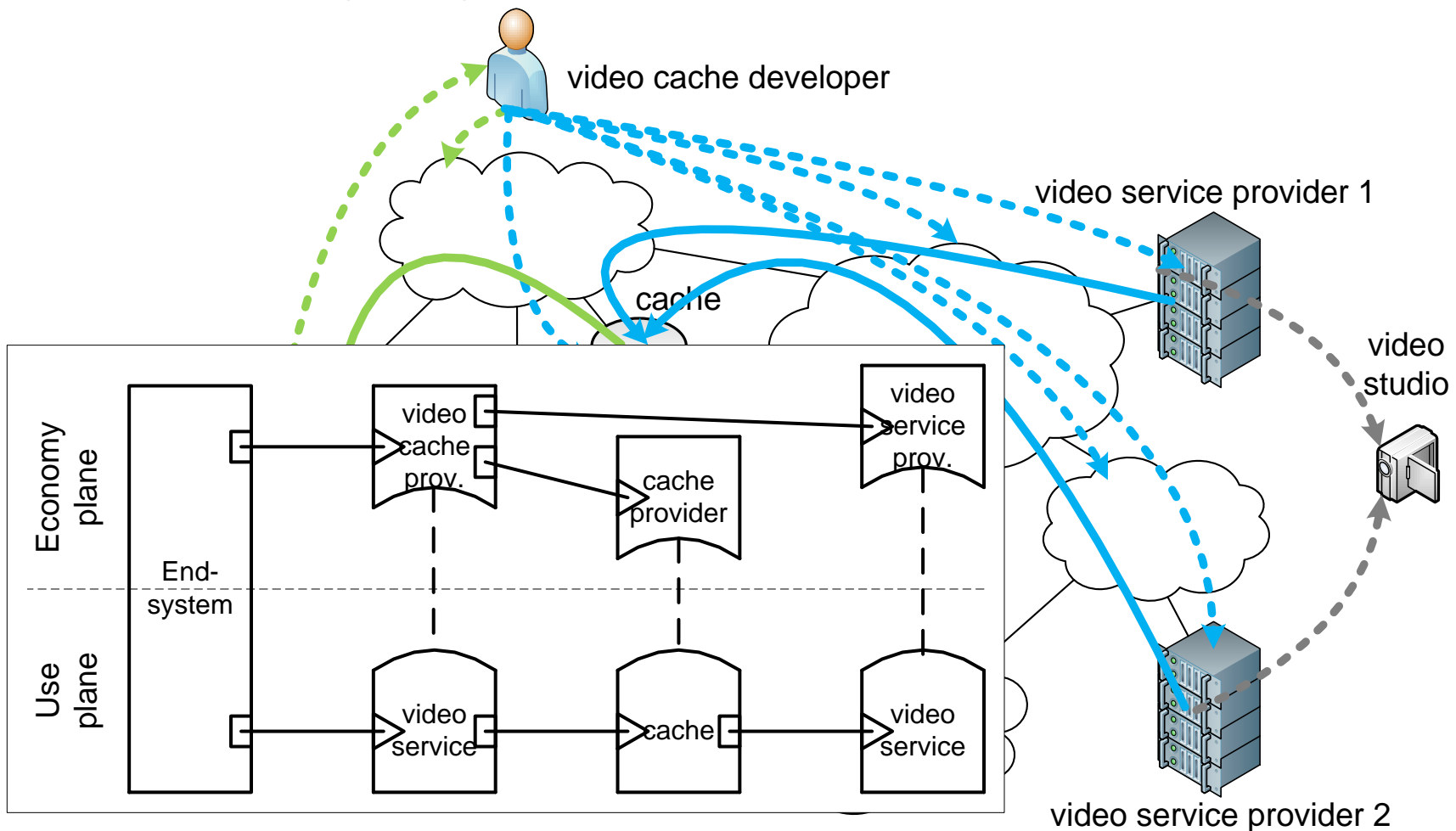
Movie Streaming Example (2)

- User pays video service provider (e.g., Netflix)



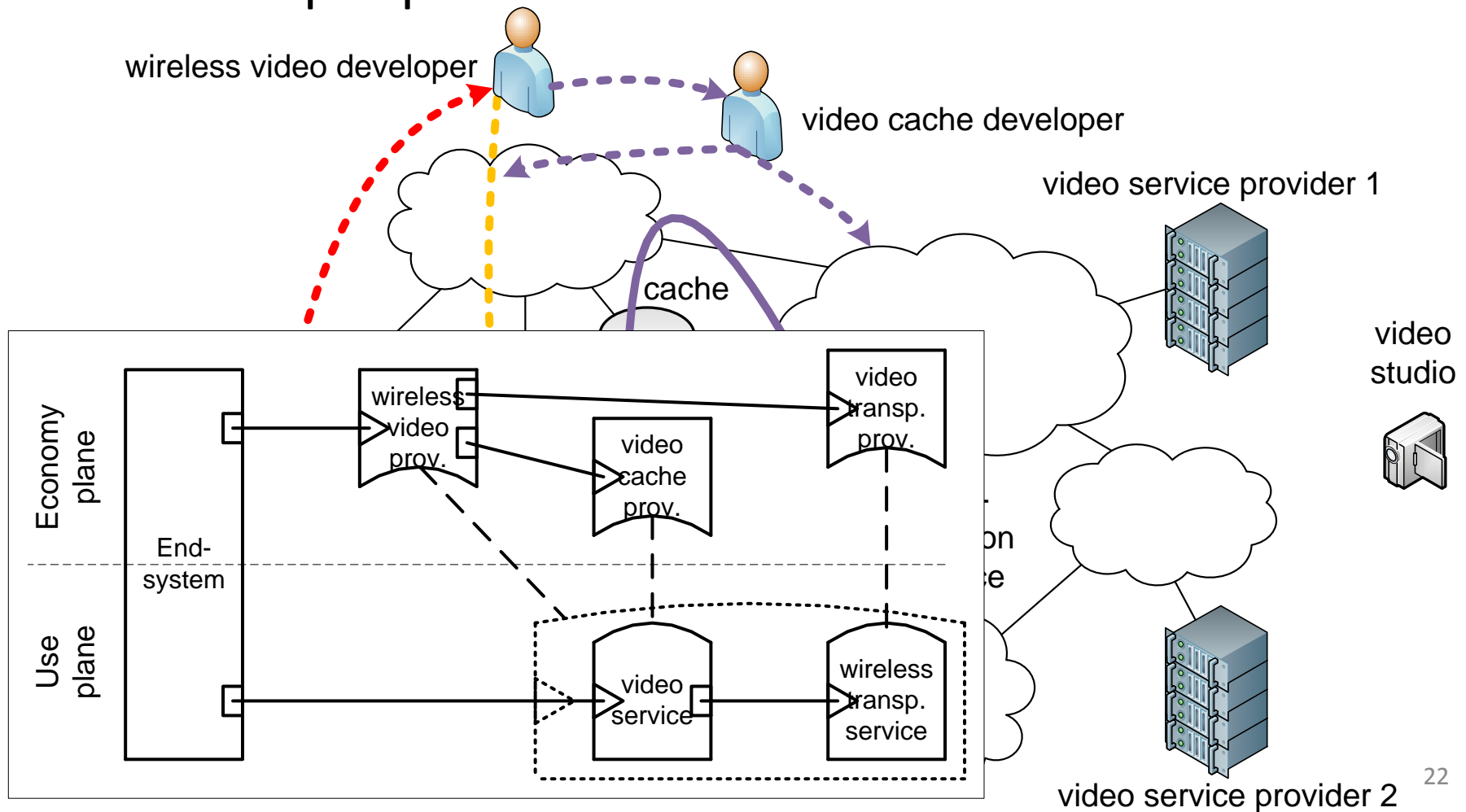
Movie Streaming Example (3)

- Developer provides cached video service



Movie Streaming Example (4)

- Developer provides services without infrastructure



NYT Example

(long-term contracts)

- Alice purchases “access anywhere” service from NYT
- NYT contracts with CDN to distribute its content “anywhere”
- CDN contracts with:
 - Access providers in popular locations (Starbucks)
 - Transit providers to carry content
- ChoiceNet provides credentials that Alice (or her laptop/browser) can present to the WiFi network at Starbucks to access CDN server (only), and to CDN server to access NYT

NYT Example

(fully unbundled, ephemeral contracts)

- Alice (or her ChoiceNet agent) pays for 1-time, limited use of the Wi-Fi network in Starbucks
 - Includes access to marketplace(s)
- Alice searches marketplace for “paths to NYT content service”, receives offers, buys one(+)
- Alice uses path to connect to NYT service, purchases access to current issue, downloads NYT content

Customers as Providers

- Line between providers and customers blurs
 - Everybody can offer services
 - Services can be based on purchased services
- Example
 - Resell network access that I buy from provider
 - Similar to small-scale Mobile Virtual Network Operator (MVNO)
- Number of provider choices can be large
 - Large-scale competition and innovation

Conclusion

- ChoiceNet makes economic relationships explicit through the economy plane
 - Everything is a service
 - Choices drive competition and innovation
- Democratization of network operation
 - Entities without infrastructure can participate
- ChoiceNet fits with any network architecture