ChoiceNet

Enabling new applications and business models through choice and competition

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ChoiceNet

- NSF NeTS Large project
  - Started September 2011
  - Assigned “FIA status” in 2012

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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
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