Ariba: A Framework for Developing Decentralized Services

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NGN Service Delivery Platforms and Service Overlays, 13. November 2009, Berlin

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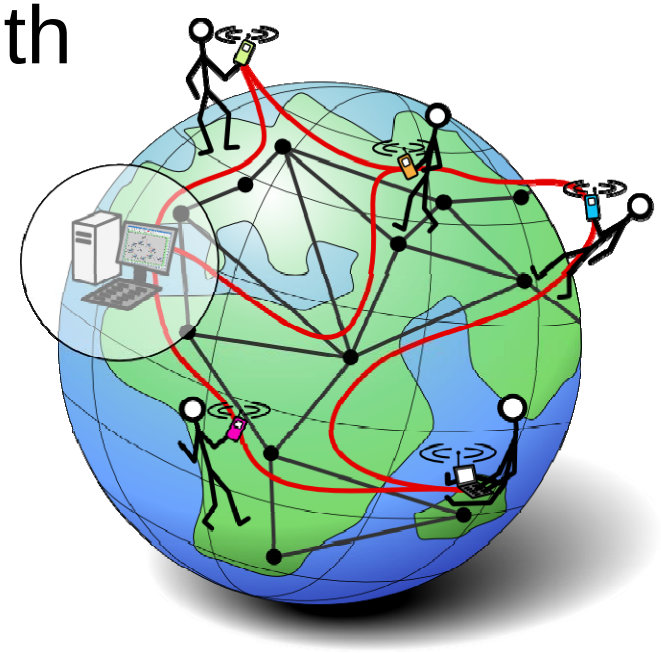
Internet from the Service Perspective

not-Facebook-but-Network



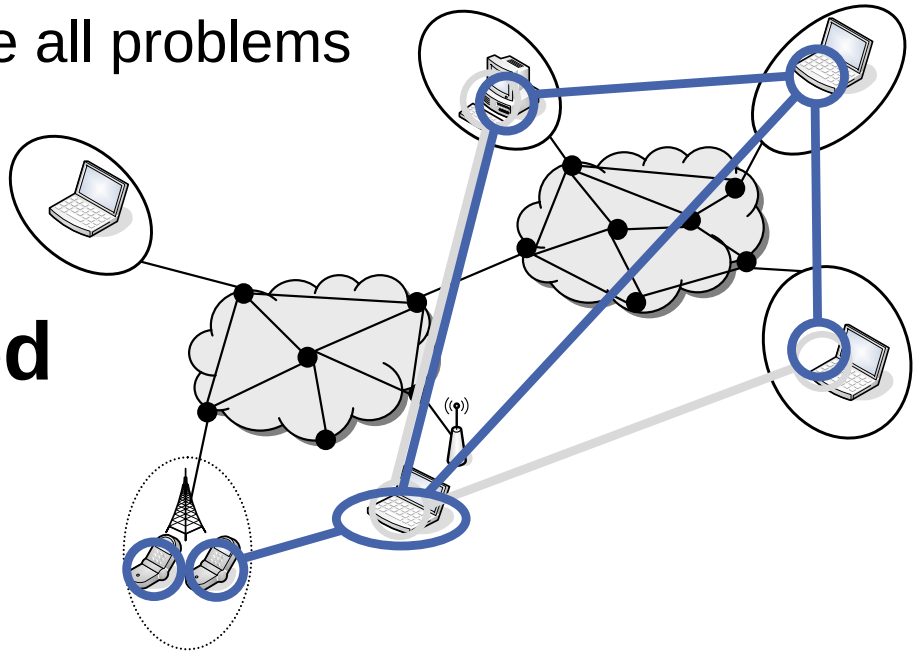
- Today's services need to cope with
  - middleboxes
  - mobility and multihoming
  - growing heterogeneity
- Resulting in
  - incompatibilities, **complexity**
    - e.g. Skype employs large set of mechanisms to 'just work'
  - services reside to web-based technology
    - the Internet can provide more than just web
  - applications use **contradictive paradigms**
    - p2p uses client/server, group communication uses unicast

Existing Solutions are …

- **not autonomous**
  - require infrastructure support (e.g., agents, rendezvous/directory server, gateways, etc.)
- **not self-organizing**
  - need manual configuration
  - not automatically reconnecting
  - assume end-to-end connectivity
- **not dynamically dealing with protocol and network heterogeneity**
  - do not work across different protocol domains (e.g. IPv6/IPv4)
  - do not adapt to network reconfiguration
- **very costly** due to servers, infrastructure, bandwidth
  - fair for large companies, what about user-provided services?

Opportunities through decentralization?

- Today's services are mainly centralized
  - low complexity, **high cost for infrastructure and bandwidth**
- Can decentralized services provide new opportunities?
  - lowered cost for infrastructure and bandwidth
  - service overlays more flexible and spontaneous
  - decentralized services can't solve all problems



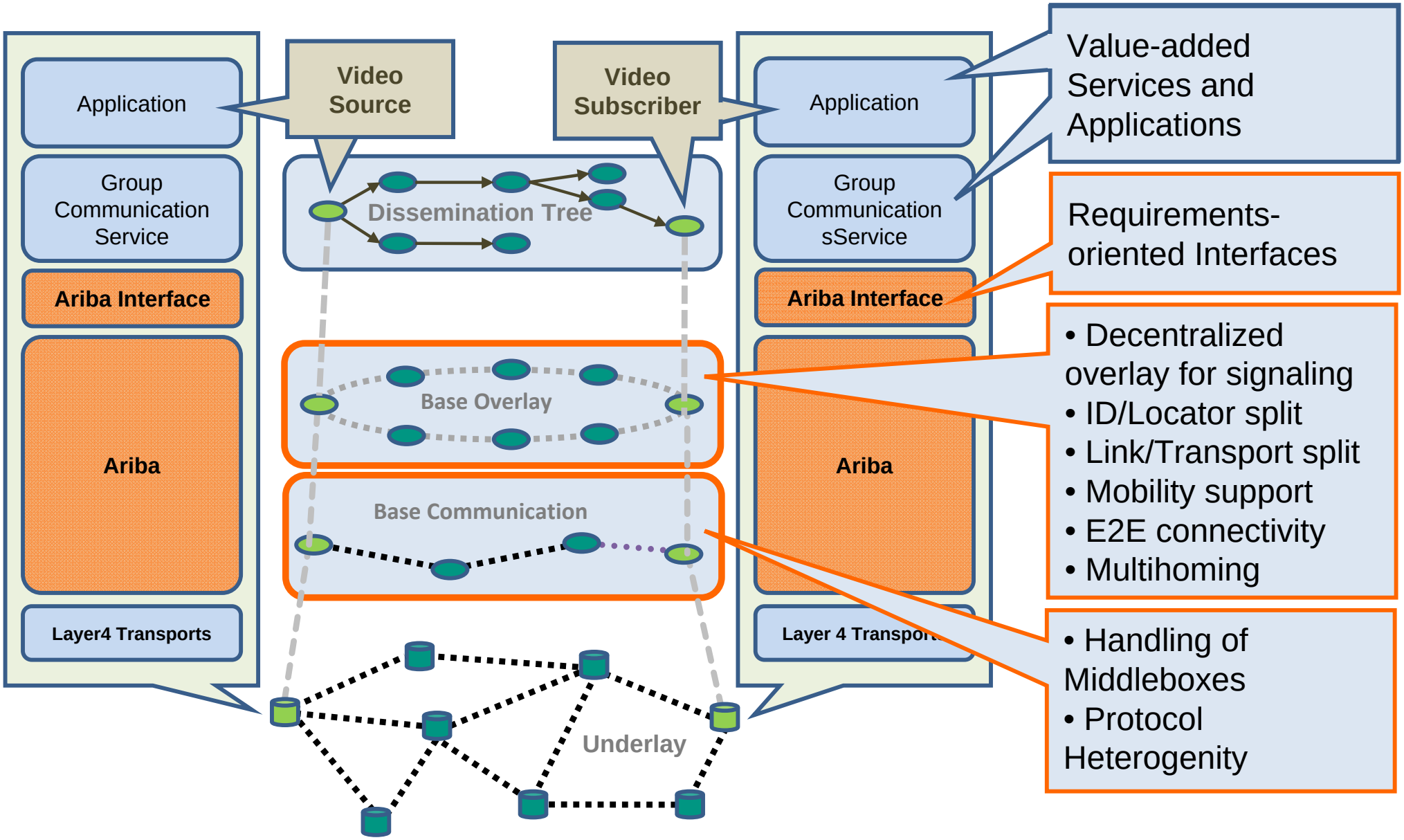
High entrance barrier:
complexity of decentralized services is orders of magnitude higher!

Ariba: Decentralized Service Framework

- **Overlay-based virtual network substrate**
  - self-organizing transport connectivity across heterogeneous networks
  - integrated solution with ID-based addressing, providing a virtual network per application context
  - eases service and application development
  - transparently copes with middleboxes, mobility, protocol heterogeneity

Low cost without the complexity: Ariba hides the complexity of decentralized service development

Architecture of Ariba Network Substrate



Main concepts (1/2)

- **Identifier-based addressing of *Nodes* and *Links***
- Node-Identifiers
  - decouples locators (IPv4, IPv6, UDP, TCP, …) from node identity
  - node identifier is static, locators can change
  - allows for **transparent handling of mobility, multihoming**
  - cryptographic identifiers allow for source authenticity
- Link-Identifiers
  - decouple transport connections from transport context
  - allows for transparent protocol switching during connection lifetime
  - allows for **relaying of links and piecewise transport connections**

Main concepts (2/2)

- Requirements-oriented interfaces
  - **developers state requirements**
  - → decouple developer from specifying mechanisms explicitly
  - link properties can describe reliability, security, …
  - overlay properties can describe *robustness*, *performance*, *cost*, …
- Integrated security
  - a network substrate can integrate security
  - securing links between nodes, handle crypto complexity
  - authenticity of nodes through cryptographic Node-Identifiers
  - → requirements-oriented interface to security

Service Development with Ariba

Ariba provides a two-fold interface: **Node-specific** and **Communication-specific**

- **Node-specific: controlling the overlay**
  - **bootstrapping/joining**
  - **overlay selection, state event callbacks, DHT functionality**
- **Communication-specific: controlling links**
  - **binding services to service-specific IDs**
  - **establishing communication links with requirements**
- **Exemplary services spanning own overlays**
  - **Application-layer multicast (ITM Karlsruhe)**
  - **Event-communication and -correlation (IPVS Stuttgart)**

Open Source efforts

- **Ariba is an Open Source implementation**
  - FreeBSD license model
  - C++ with few library dependencies
  - runs on Linux flavors and Nokia Internet Tablets
  - lightweight to run on mobile devices
  - developed in context of the Spontaneous Virtual Networks project (SpoVNet)

www.ariba-underlay.org

Summary and Outlook

- Ariba
  - **provides an overlay-based, flexible, and low cost solution for service developers**
  - Demo at ACM SIGCOMM09 (*Honorable-Mention Award*)

THE ariba UNDERLAY ABSTRACTION

- Outlook
  - current porting efforts (OpenWRT, Windows, iPhone)
  - bringing Ariba into the network (c.f. B. Davie, PRESTO09)
  - integrating security (e2e link security and cryptographic identifiers)
  - porting applications to Ariba (VLC media player)

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Thank you! Questions?