Declarative DSL: A Declarative Networking Perspective

Boon Thau Loo
Introduction

• Declarative framework for specifying and implementing network protocols
• Utilizes a distributed recursive query language (Network Datalog)
• Use cases to date:
  – Routing protocols, distributed hash tables, sensor networks protocols, replication, resilient overlay network, indirection (i3), mobile networks, ....
Main Selling Points

• Ease of Programming
  – Compact specifications, orders of magnitude reduction in code sizes
  – Routing protocols (few lines of code), Chord DHT in 47 lines
  – Many routing protocols are minor variants of one another
  – Group of trial users outside of core research group

• Protocol analysis:
  – Protocol convergence = query safety
  – Other efforts: Meta-Routing [SIGCOMM ’05], Mace [NSDI 07]

• Optimizations
  – Magic sets rewrite: Wired to wireless protocol, hybrid protocols
  – Multi-query optimizations
Shortcomings

• Ease of programming:
  – Learning curve for network programmers
    • Event-condition-action vs Database views
  – Network churn handling and optimized link-state protocol
  – User-defined functions (path computation, Chord identifiers, etc?)

• Protocol analysis work on declarative protocols is preliminary

• Limited optimizations to-date:
  – Magic sets + predicate reordering for reachability queries
  – Multi-query optimizations
  – Need to generalize beyond simple examples
Ongoing Efforts

• Overlay network selection and composition
  – Users supply high-level declarative requirements
  – System composes new networks from component networks
• Declarative trust management + networks
  – Unify logic-based access control languages and declarative networks
• Declarative MANET protocols:
  – WNaN (Wireless Network After Next) DARPA program
  – Proliferation of wireless protocols (DSR, AODV, LS, HSLS, OLSR, DTN, APLS), yet no one-size-fits-all
  – Policy-driven protocol switching (e.g. reactive/proactive/epidemic)
Declarative Languages in Industry

• SPINDLE Delay Tolerant Networking (BBN)
  – XSB and Flora-2 for decision plane policies
  – Integrated with DTN reference implementation

  – Dynamic Spectrum Access (DSA) policies for smart software-defined radios
  – Utilize OWL language

• LogicBlox ([http://www.logicblox.com](http://www.logicblox.com))
  – Datalog engine for enterprise software for data manipulation, spreadsheeting, business logic, etc.