GeneRic Autonomic Signaling Protocol
IETF109 RTGWG
An overview

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draft-ietf-anima-grasp (RFC Editor)
draft-ietf-anima-grasp-api (IESG agenda)

TCP/IP and automation… great start, but then…

- Dark ages (PSTN): hierarchically centralized management and control of network functions including traffic path selection
- 1969 ARPANET – distributed, self-optimizing, self-healing traffic path selection (‘routing’).
- 1990’th TCP/IP routers/networks starting to grow into their role of “nerd knob heaven”. Nothing beyond 1960th design components is self-{building,healing,optimizing}
- 2010’ SDN for TCP/IP evolves. *SS7 rises from the Ashes.*

- 1980’th ? Device-level plug&play networks (e.g.: appletalk).
  Distributed routing, Auto-addressing, auto-naming, …
- 2000’th notion of autonomous networks becomes more formalized (IBM et. all).

- How could we bring more distributed automation / self-x to TCP/IP ?
  - IRTF NMRG -> IETG ANIMA WG

Pragmatic automation

- Routers of many vendors had “scripting” for automation often since 2000’th
  - First language: TCL – vendors C, H, J, probably more. Now many more languages
  - Widely used (before SDN) to provide device-local automation:
  - Script uses router internal CLI to poll/monitor some router behavior and trigger actions (CLI configs, logging, … from it)

- Scripting ~=
  - Runs on the router itself
  - Can be built not only vendor (e.g.: also customer)
  - Can have its own lifecycle independent of “router OS”

Pragmatic automation – limitations

- How to build LAN or network wide coordinated automation (scripts) ?
  - ANIMA calls them “Autonomic Service Agents” (ASA)
- Examples: automate setup & securing routing protocols:
  - Negotiate session key with possible peers, auto-configure routing protocols security.
  - Auto-configure IPsec SA for routing protocol packet
    ... when routing protocol does not support security itself (e.g.: PIM)
  - L2: auto-configuring MacSec.
  - Non-security automation:
    - Distributed elect “most central router in network” and configure it as multicast RP (multicast server)...
  - Negotiate various service parameters (QoS – class weights)
  - Operational scripts, ...
  - **Gee... Communications is very hard to script...**
    ... And repetitiously requires common components

What common components would we need for such distributed automation ?

- (Routing) protocol / use-case independent:
  - Mutual keying material to authenticate peers,
    Confidentiality for communication between peers
    - Even if you do not like security: When everything is meant to run automatic, you removed the implicit security stemming from the human operator – security is a big MUST!
  - Common, easily extensible negotiation protocol
  - Peer discovery mechanism – link-local and network wide

- For communication between non-L2 adjacent candidate peers:
  - Routing protocol independent L3 reachability
    - *routing protocol may first need to be auto-configured*

GRASP step by step

- Preconditions for peer-to-peer communication:
  - Assume one peer knows another peers ip-address
    - And has network layer connectivity to it
  - Assume both peers have mutually trusted keying material
- **Use TLS connections** – authentication, confidentiality

- What else is needed ? Learn from application/”web” layer protocols !!!
  - Limited set of reused ‘common’ protocols, quite successful, our inspirations:
- JSON (‘data encoding’/ ‘presentation layer’)
  - Native from Javascript: **easy and flexible use of arbitrary data structures**
- REST via HTTP/URLs (‘communication primitives’ / ‘session layer’)
  - **Few communication primitives** – everything else left up to ‘application’ definitions

GRASP step by step

- So.. Why not just use what app layer does (HTTP, JSON, URLs) ?

- Want more compact encoding that supports binary
  - But without "ASCII-Art" one-off protocol / application specification
- GRASP uses **CBOR (RFC7049) for application payload encoding**
  - CBOR =~ binary encoding of 'almost' JSON data structures (support text & binary data)
  - CDDL = schema description for CBOR =~ formal language replacement for ASCII art specs.

- HTTP also has too much overhead (text format), REST via URLs too.
- **GRASP itself built solely with CBOR**
  - Few primitives: For P2P: Request Negotiate/Sync, Negotiate,/End , Synchronize

GRASP step by step

Simple “Synchronization” request/reply example (from GRASP section D.3):

CBOR encoded messages via a GRASP TLS connection:

Initiator to Responder:

GRASP header

GRASP objective
Application function name

[M_REQ_SYN, 4038926, ["EX2", F_SYNCH_bits, 5, 0]]

On the wire encoded: h'83041a003da10e8463455832050500'

Responders reply to initiator:

CBOR encoded application reply

[M_SYNCH, 4038926, ["EX2", F_SYNCH_bits, 5, ["Example 2 value=", 200]]]

On the wire encoded:
h'83081a003da10e846345583205058270457861 6d706c6520322076616c75653d18c8'

GRASP step by step

- Discovering GRASP peers (for a specific ‘objective’)

- GRASP can use L2 multicast to announce or request objectives
  - Specified / standardized with IPv6 link-local multicast

- GRASP can do L3 domain wide multicast announce or request objectives
  - Not requiring any L3 connectivity (unicast or multicast routing)
  - Instead relying on GRASP per-L3-hop GRASP message propagation
    - GRASP forwarding agent:
Flooding of messages with loop detection/breaking (per-message unique identifiers).

- GRASP discovery communication primitives: Flood, Discover

How to use / deploy GRASP – many options

- Minimum: With just peer-to-peer unicast and L2 multicast
  - Dependency: Keying material for TLS authentication / confidentiality
  - This is an IETF standardization requirement (security). *Of course GRASP could equally run solely over TCP*
  - Requires just pre-existing L3 unicast reachability between only L3 reachable peers
    - Aka: not sufficient to use GRASP to e.g.: autoconfigure routing protocols to establish L3 routing
- Add GRASP forwarding agent:
  - Adds ability to do GRASP discovery across L3
- Add ANIMA “Autonomic Control Plane” (ACP)
  - ACP: Hop-by-hop automatically built “virtual out-of-band-management network (VRF”)”
  - Comes with GRASP forwarding agent and automatic L3 unicast connectivity (prior to any routing config)
- Add ANIMA Bootstrap Remote Key Infra (BRSKI)
  - Depends on ACP
  - Provides “zero-touch” bootstrap of keying material for all nodes/routers in a domain.

GRASP Prototype

- A Python 3 implementation of GRASP as a module **`grasp.py`**
- About 2400 lines of code
- A test suite to exercise as many code paths as possible
- Various toy ASAs to test "real" operation across the network
  - bank/client negotiation
  - model of secure bootstrap process
  - model of IPv6 prefix management
  - bulk transfer using GRASP
- Some documentation

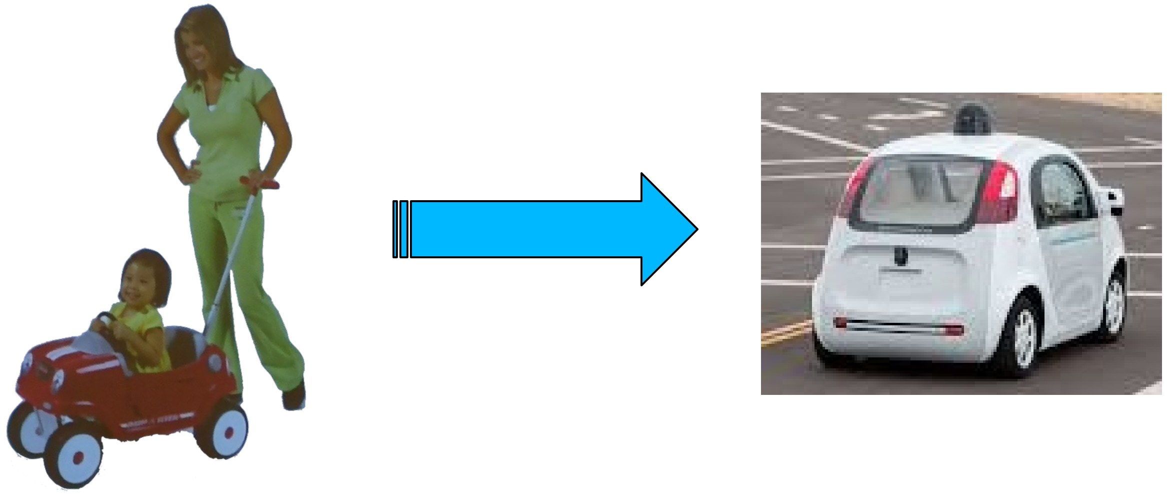
Summary, outlook, Questions ?

- GRASP ready to use
  - ANIMA WG now working on API, ASA usage guidelines and some key ASA functions
  - Some existing ASA examples (reference one: draft-ietf-anima-prefix-management)

- If you want to automate services, think about defining this as ASA with GRASP
  - ANIMA WG happy to help
    (and dependent on which WG has best use-case expertise also be home for ASA docs

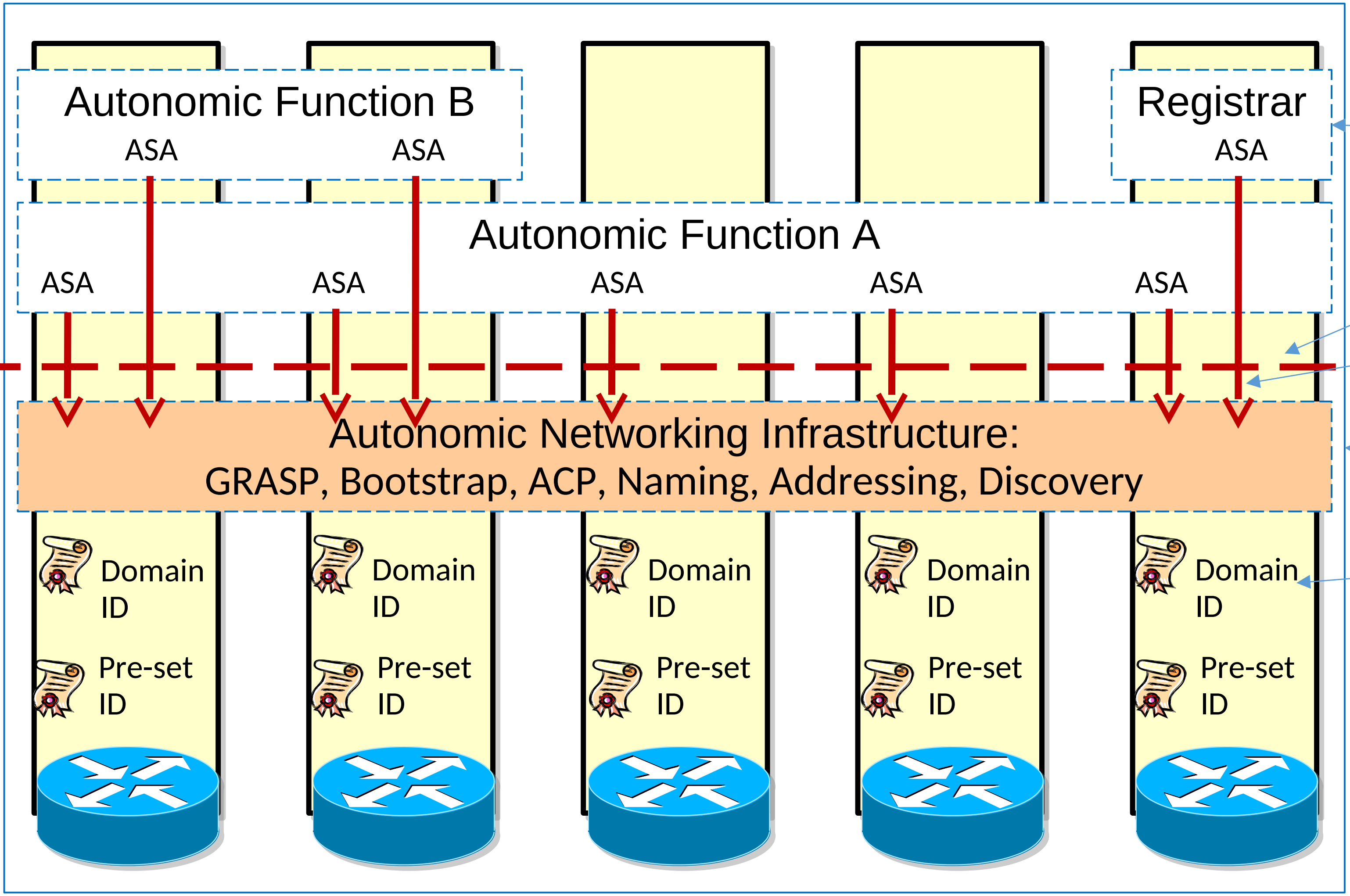
Self driving Networks

without an SDN Controller called “Mom



Backup Slides

Autonomic Network / ASA Reference Model – High Level View



draft-ietf-anima-asa-guidelines *

draft-ietf-anima-bootstrapping-keyinfra

ASAs deployed as needed

draft-ietf-anima-grasp-api

draft-ietf-anima-grasp

Base infra: Every node must support

draft-ietf-anima-autonomic-control-plane

draft-ietf-anima-bootstrapping-keyinfra

* imminent draft

Network with autonomic functions

References…

- RFC 7575
- RFC 7576
- https://datatracker.ietf.org/wg/anima/documents/
- https://github.com/becarpenter/graspy