(AI) Agents in Network Devices

(Anima's perspective)

2025.7.24

ANIMA overview

ANI – Autonomic Network infrastructure

Control-plane + Forwarding features in network equipment to enable secure, zero-touch automation

Via SDN controlller ... Autonomous (no controller)

BRSKI – zero touch certificate enrollment protocol.

Basis for all communication between automation components (also Controller)

GRASP – signaling protocol

Network wide discovery: For self-orchestration of (de) centralized intelligence (think DNS, but without need for any servers or network IP multicast)

Peer-to-peer communications – like http/CoAP, but kept more simple for new designs. Uses CBOR for binary encodings.

ACP – automatic, inband management fabric (optional)

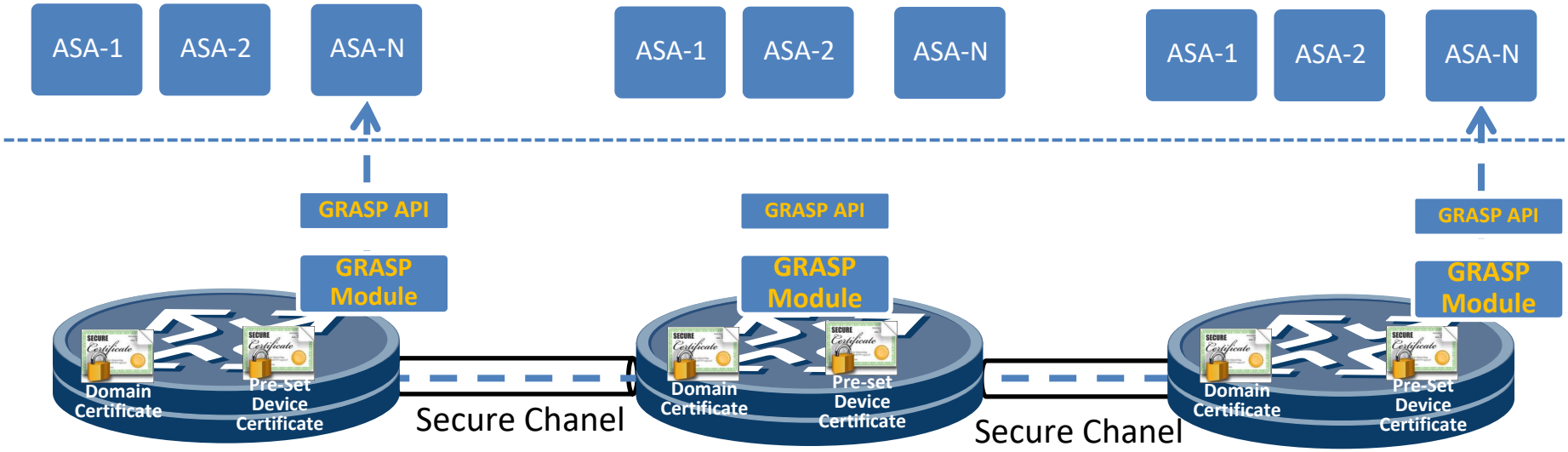
Connectivity/forwarding between all devices without any config, indestructibe by (erroneous!) config.

ASA – Autonomic Service Agents

INTELLIGENCE HIGHLY WELCOME

Regarding to Autonomic Service Agent (ASA)

- Defined in RFC7575: *"An agent implemented on an autonomic node that implements an autonomic function, either in part (in the case of a distributed function) or whole."*
- Could be considered as "Apps" running in network devices to do O&M functions
  - could be simple router scripts to configure network services or secure them
- ASA easy to build because the have connectivity (ACP), security (BRSKI), signaling (GRASP)



Example Intelligence aspects for ASAs

- Better sensing the network
  - ✓ Analytics based on experience (training)
    - ✓ What are specific complex conditions in network that require reactions ?
  - ✓ Network traffic/events etc., to trigger actions autonomically
  - ✓ Device-level status sensing (anomaly detection etc.)
- Better supporting the network administrator's intent
  - ✓ User-friendly interaction (e.g. Natural Language-like command line)
  - ✓ Autonomic intent execution (e.g. policy generation, decision making)
  - ✓ Intelligent distribution of action via ASA / GRASP / ACP

Example Use Case-1: Automatic Network Congestion Relief

(from the presentation of "Automatic Network Congestion Relief" in Anima interim in Feb.2025)

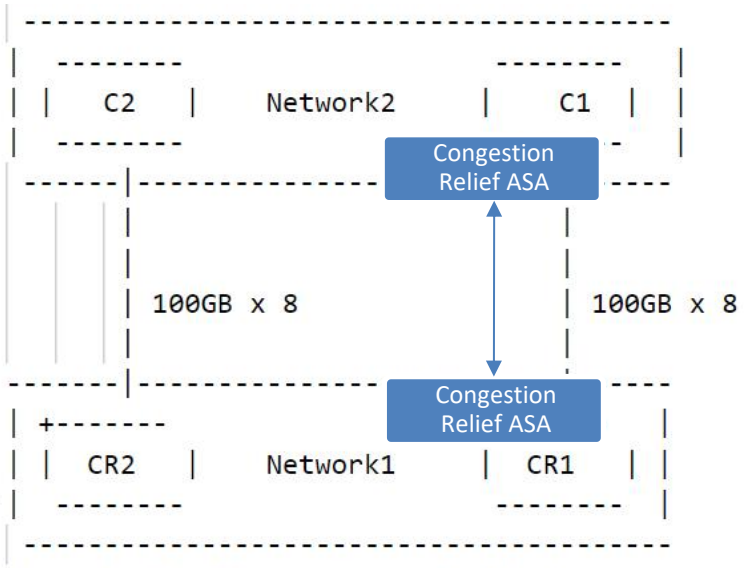


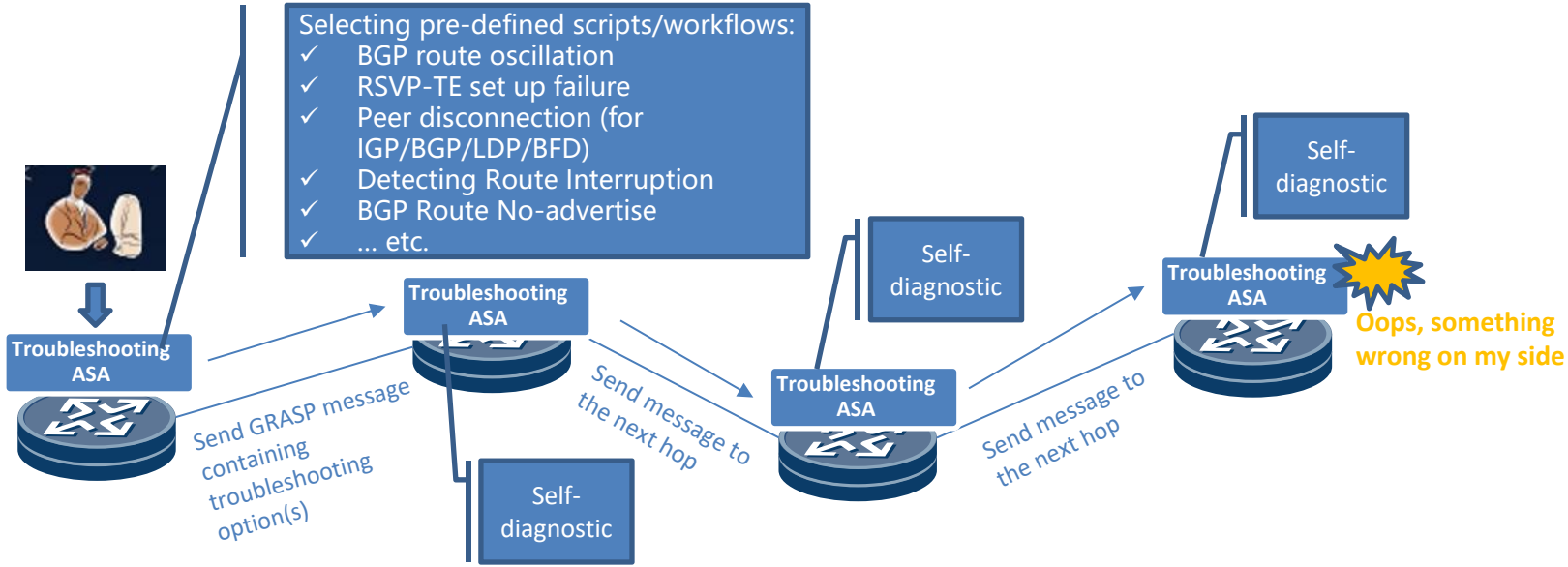
Figure3: Intelligent Decision-Making usecase

- **Step1: Traffic Modeling**
  - Real-time TOP-N traffic modeling with AI computing.
  - 100GB x 8 total bandwidth between CR1-C1 & CR2-C2, 600GB current traffic on each.
- **Step2: Traffic Monitoring**
  - Devices auto-detects CR1-C1 link failures (5 link).
- **Step3: Intelligent Policy Generation**
  - Identifying the TOP-N routing prefixes to be adjusted.
  - The intelligent module of CR1 auto-generates policies.
- **Step4: Policy Propagation**
  - CR1 auto-sends policies to C1.
  - C1 updates the routing. Divert 200G high - priority traffic to CR2 - C2 to ease CR1 - C1 congestion.
  - Result: CR1-C1 down to 300G, CR2-C2 up to 800G, efficient resource use.
- **Step5: Policy Reversion**
  - Device detects CR1-C1 link recovery.
  - Gradually withdraws policies.

Example Use Case-2: Autonomic Distributed Troubleshooting

(based on the presentation of "Autonomic Distributed Troubleshooting" in Anima interim in Feb.2025)

- Challenges of centralized methods
  - Burden of collecting a large amount of data, since there might be too many devices, protocols and data
  - High performance requirements on the Controller/NMS for computing
- User habits
  - It is more convenient/swift for admins to do local configuration and maintenance (e.g. by using CLI interface)
  - Admins need to take time to adapt specific NMS/Controller systems



Next Step

- Encourage to Leverage AI to empower ASA
- To analyze whether there could be new agent communication requirement for GRASP
- To analyze the impact of AI capabilities to the Anima framework

Thank You!