Autonomic Networking Retrospective

42nd NMRG - IETF 98

Jéferson Campos Nobre

Outline

Introduction

Autonomic Networking @ NMRG

ANIMA WG

Outlook

Introduction

- Minimum set of properties of an Autonomic System (AS)
  - Automatic, i.e. it can "self-control its internal functions and operations"
  - Adaptive, i.e. it can change its "configuration, state and functions"
  - Aware, i.e. it can "monitor its operational context"
- Different set of definitions for an AS
  - E.g., self-CHOP, MAPE-K
- Application to the complete network lifecycle (e.g. installation, commissioning, operating) → Autonomic Networking (AN)

Introduction

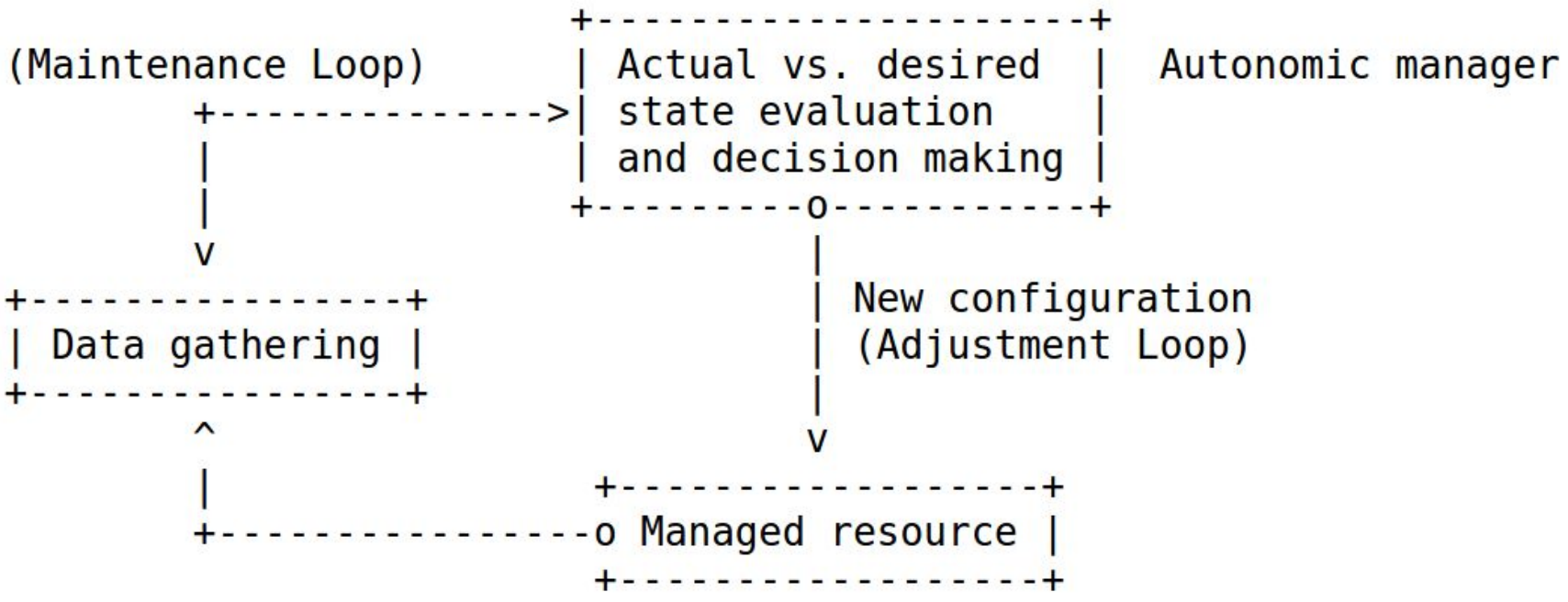

Figure 1: Simple sketch of an autonomic networking control loop

1 - Strassner, J., Agoulmine, N., and E. Lehtihet (2006) *FOCALE: A novel autonomic networking architecture*. Proc. Latin American Autonomic Computing Symposium (LAACS), Brazil

Introduction

- Autonomic Networking (AN) → focus of several research projects over the last decade
  - AN Architecture (ANA), Unified Management Framework (UMF), Generic ANA (GANA), etc
- Recent related efforts in the IETF/IRTF
  - SUPA, HOMENET, SDNRG, NFVRG, I2RS
- AN usually addressed by the Network Management Community (IM, NOMS, CNSM) → NMRG

Autonomic Networking @ NMRG

- 32nd NMRG Meeting (Vancouver, November 2013) - Autonomics for Network Management (Part I)
  - Definition of autonomic networking terms
  - Autonomic networking frameworks and architectures
  - Network configuration negotiation problem statement
  - Peer-to-peer detection of service level agreement violations
  - Bootstrapping trust on a homenet
- 33rd NMRG Meeting (London, March 2014) - Autonomics for Network Management (Part II)
  - Definition of autonomic networking terms (continuation)
  - Proactive self-healing mechanisms for IP networks
  - Gap analysis for autonomous networking

Autonomic Networking @ NMRG

- 34th NMRG Meeting (Toronto, July 2014) - Autonomics for Network Management (Part III)
  - Definition of autonomic networking terms (continuation)
  - Gap analysis for autonomous networking (continuation)
  - Lessons learned on using autonomics for network management
  - Real world experiences on using autonomic principles in network management
- 35th NMRG Meeting (Rio de Janeiro, November 2014)
  - 2 presentations on AN
  - Autonomic Networking Definitions Revisited
  - Autonomic Networking Use Case for Distributed Detection of SLA Violations

Autonomic Networking @ NMRG

- Focus on the definition of autonomic networking terms
- Internet-Drafts and RFC
  - Set of design goals and non-goals for AN [irtf-nmrg-autonomic-network-definitions] → **RFC 7575**
  - Standardization →open question and deployment limited to specific mechanisms [irtf-nmrg-an-gap-analysis] → **RFC 7576**

UCAN BoF

- Important outcome of the NMRG work
- Good popularity of the BoF (IETF 90)
- UCAN docs
  - Background
    - http://tools.ietf.org/html/draft-irtf-nmrg-an-gap-analysis
    - http://tools.ietf.org/html/draft-irtf-nmrg-autonomic-network-definitions
  - Use Cases
    - http://tools.ietf.org/html/draft-carpenter-nmrg-homenet-an-use-case
    - http://tools.ietf.org/html/draft-jiang-auto-addr-management
    - http://tools.ietf.org/html/draft-behringer-autonomic-bootstrap
    - http://tools.ietf.org/html/draft-irtf-nmrg-autonomic-sla-violation-detection
    - http://tools.ietf.org/html/draft-bogdanovic-nmrg-mobile-backhaul-use-case
  - Solution space
    - http://tools.ietf.org/html/draft-jiang-config-negotiation-ps
    - http://tools.ietf.org/html/draft-jiang-config-negotiation-protocol
    - http://tools.ietf.org/html/draft-pritikin-bootstrapping-keyinfrastructures
    - http://tools.ietf.org/html/draft-behringer-autonomic-control-plane

ANIMA WG

- Definition → “a system of autonomic functions that carry out the intentions of the network operator without the need for detailed low-level management of individual devices”
- Goal → “complete solution for full autonomic networking is an ambitious goal” → the specification of a min set of reusable infrastructure components to support autonomic interactions and use cases
- Focus → professionally-managed networks

ANIMA WG

- Development of protocol specifications (or extensions)
  - Discovery for autonomic nodes
    - GRASP [draft-ietf-anima-grasp-10]
  - Negotiation for autonomic nodes
    - GRASP [draft-ietf-anima-grasp-10]
  - Bootstrapping a trust infrastructure
    - BRSKI [draft-ietf-anima-bootstrapping-keyinfra-05]
  - Separated Autonomic Control Plane
    - ACP [draft-ietf-anima-autonomic-control-plane-06]

ANIMA WG

- Limited initial set of work items → avoid "boiling the ocean"
- Additional (“unchartered”) docs
  - E.g., policy intent, use cases, Autonomic Service Agents (ASAs)
  - Encouraged as individual submissions or **NMRG submissions**

AN @ NMRG *post* ANIMA

- Some unchartered work remains in ANIMA → waiting for new phases/recharter
  - E.g., coordination, intent format and distribution, etc
- Internet-Drafts and RFC
  - AN Use Case for Distributed Detection of SLA Violations [draft-irtf-nmrg-autonomic-sla-violation-detection] → WGLC

Outlook

- AN definitions, goals and gap analysis within the context of IETF → more consideration
- NMRG possible a home for the discussion (?)
  - Goal of Autonomic Networking Definitions Revisited [draft-pentikousis-nmrg-andr] → active (?)
    - New contributors are welcome :)

Outlook

- Machine Learning (ML)
  - NMLRG <> AN
  - AN formulations seem to precede current ML development → room for investigations
- Intents
  - Controversial topic
  - Currently out of scope of ANIMA
  - E.g., SUPA [pentikousis-supa-mapping] (inactive) → infrastructures which are managed through intents

Outlook

- Fully programmable network elements and functions interesting for AN
- SDN and NFV principles ⟶ wider audience of researchers and practitioners
  - E.g., lots of interest on SDNRG and NFVRG
    - Desirable: programmability communities to think in terms of control, management, and operational planes (e.g., RFC 7426)

Outlook

- Deployment of new network technologies → typically a time-consuming and labour-intensive task
- A way forward → AN in NMRG in the context of programmable networks and through a more comprehensive manner

Thank you.

Questions?