KnowOps: Towards an Embedded Knowledge Base for Network Management and Operations

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What is Network Management?

• In short
  – Keep the network in a “healthy” state
  – Deliver SLA-compliant services for customers

• Not so short
  – Planned maintenance/upgrade
  – Fault management
  – Configuration management
  – Traffic/performance management
  – Security management
  – ...
Simplified View of Network Management Systems

- Ticketing System
- Process Automation
- Event Correlation
- Network Instrumentation
- Network Interface
- Configuration Management
- Network Inventory
- Event Manager
Simplified View of Network Management Systems

- Network Instrumentation
- Event Correlation
- Process Automation
- Ticketing System
- Vendor configuration example
- Provider service design documents
- Operational Experience/Domain Knowledge
- Network Inventory
- Configuration Management
- Interface

Knowledge Base

- Captured in text-based documents
- Require manual work to inject from documentation to management systems
- Difficult to keep in-sync across systems

Network
KnowOps: Using Shared and Machine-readable Knowledge Base

- Ticketing System
- Process Automation
- Event Correlation
- Network Instrumentation
- Embedded Knowledge Base
- Event Manager
- Network Inventory
- Configuration Management
- Network Interface
- Network
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- Capture domain knowledge in a declarative language
  - Vendors: protocol mechanisms, dependencies
  - Service providers: service realizations, misconfigurations
- Automated reasoning mechanisms *decoupled* from the rules
  - Bottom-up reasoning
  - Top-down reasoning
Shared Knowledge Base in KnowOps

- What to do?
- What should be avoided?

- What events should be correlated?
- What time windows should be used?

- What to monitor?
- What to alarm?

- What to do?
- What should be avoided?

Process Automation
Event Correlation
Network Instrumentation

Service Requirements
Vendor Rules
Service Provider Rules
Network Configuration

Network
Preliminary Experience

• DROOLS: open-source business logic
  – Rule engine
  – Process automation
  – Event correlation
  – Optimization/Planning
Example VPLS

MPLS, RSVP, OSPF

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BGP Session

LSP Connection

VPLS Connection

Site1

Site2
Example: VPLS

Graph:
- VPLS
  - LSP
  - MPLS
  - BGP
  - RSVP
  - OSPF
- Interface Configuration
Rules for OSPF

Rule 1

Dependency on interface configuration

rule "ospf_local"

dialect "mvel"

dialect "mvel"

dialect "mvel"

when

$int : interface( ospfarea != "", adminEnabled == true, &r : router)
$router : Router( this == $r )
$pre : InterfacePrefixConfig( interface == $int )
	hen

OspfRoute fact0 = nf.createOspfRoute();
fact0.setArea( $int ospfarea ); fact0.setRouter( $router );
fact0.setPrefix( $pre.prefix ); fact0.setNexthop "local" |

insertLogical( fact0 );

end

Rule 2

rule "ospf_remote"

dialect "mvel"

dialect "mvel"

when

$route: OspfRoute( $pre : prefix, $r1 : router, $area : area )
$int1: Interface( router -- $r1, adminEnabled -- true, ospfarea -- $area )
$int2: Interface( adminEnabled -- true, ospfarea -- $area )
$link0: Link( interfaces[0] == $int1 && interfaces[1] == $int2 ) |

not (exists |OspfRoute( area == $area, prefix == $pre, router == $r2, metric <= (route.metric + $int1 ospfMetric)) )

then

OspfRoute fact0 = nf.createOspfRoute();
fact0.setArea( $area ); fact0.setRouter( $r2 ) ;
fact0.setPrefix( $pre ); fact0.setNexthop( $int1.name );
fact0.setMetric( $route.metric + $int1 ospfMetric )
insertLogical( fact0 );

end
Planned Maintenance Example

Automation Process

Pre-maintenance check

Disable related alarms

Shut down interface

Device Vendor Rules

Service Provider Rules

“Disrupting VPLS service should raise a warning.”
Conclusions

• Take-aways
  – Knowledge transfer in current management systems are mostly text-based, thus costly and error-prone to build and maintain
  – We should build management systems based on a machine-readable, shared, and embedded knowledge base

• Challenges
  – What does the knowledge base really look like
  – Better integrate different contributors
  – Migrate from existing systems

• Future (on-going) work
  – Drools-based implementation
  – Application to mobility management tasks
Questions? Comments?

- Thanks!