Coordinating multiple autonomic functions

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Why we need coordination?

Metric value conflict:
One metric is influenced by parameters of different autonomic functions

Parameter value conflict:
One parameter is modified by different autonomic functions
Why we need coordination?

- a static conflict map…
Interactions types

• Conflict
  – see previous slides

• Cooperation
  – An autonomic function can improve another one

• Dependency
  – An autonomic function cannot work without another one
## Coordination lifecycle

| Specification | - Autonomic function descriptor (metrics, parameters, actions…)  
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<th>- Static map, a priori knowledge</th>
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| Deployment     | - Per instance/resource:  
|               |   • inventory of metrics monitored, of actions performed and computation paths  
|               |   • build connected control loops graphs  
|               |   • Identify conflicting control loops  
|               | - Deployed conflict map |
| Run-time       | - Arbitrate conflict based on coordination strategies and available mechanisms  
|               | - Infer new dependencies  
|               | - Dynamically update interaction groups |
Knowledge-based Conflict Identification

StationEmittingPower_{Cell B} = \text{LoadBalancing}(\text{UserLoadOfStation}_{Cell B},...)

[... in order to perform action]

[takes as input...]

UserLoadOfStation_{Femto B.3} = F(\text{StationEmittingPower}_{Cell B}, \text{Femto B.3},..., ...)

[has impact on...]

set \text{StationEmittingPower on Cell B}
Knowledge-based Conflict Identification

Potential conflict

UserLoadOfStation of Femto B.1

StationEmittingPower of Cell B

set StationEmittingPower on Cell B

set BackhaulRatio of Femto B.3

Backhaul Ratio of Femto B.3

UserLoadOfStation of Femto B.3

Backhaul Optimization NEM

UserLoadOfStation of Cell B

Load Balancing NEM

set BackhaulRatio of Femto B.3
Coordination strategies

- Random, token-based...
- Separation in time
- Hierarchical optimization
- Centralized multi-objective optimization
- Other control theory approaches
Discuss: ANIMA implications

• Coordination:
  – a must-have feature (stability, convergence)
  – cross-autonomic functions (re-usuable component)
  – requires common descriptors, lifecycle (registration/discovery, negotiation…)
  – common representation of information/knowledge (cf. conflict map)
  – common “control/command” interface