

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

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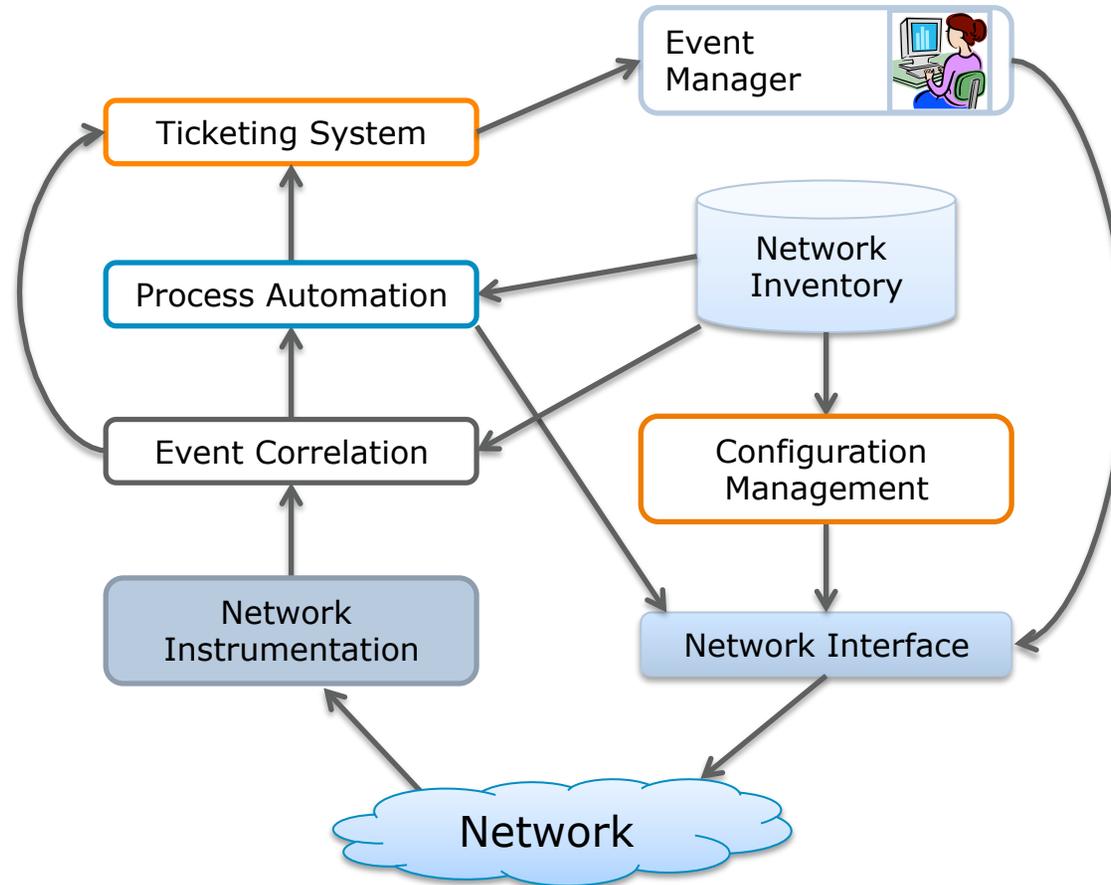


What is Network Management?

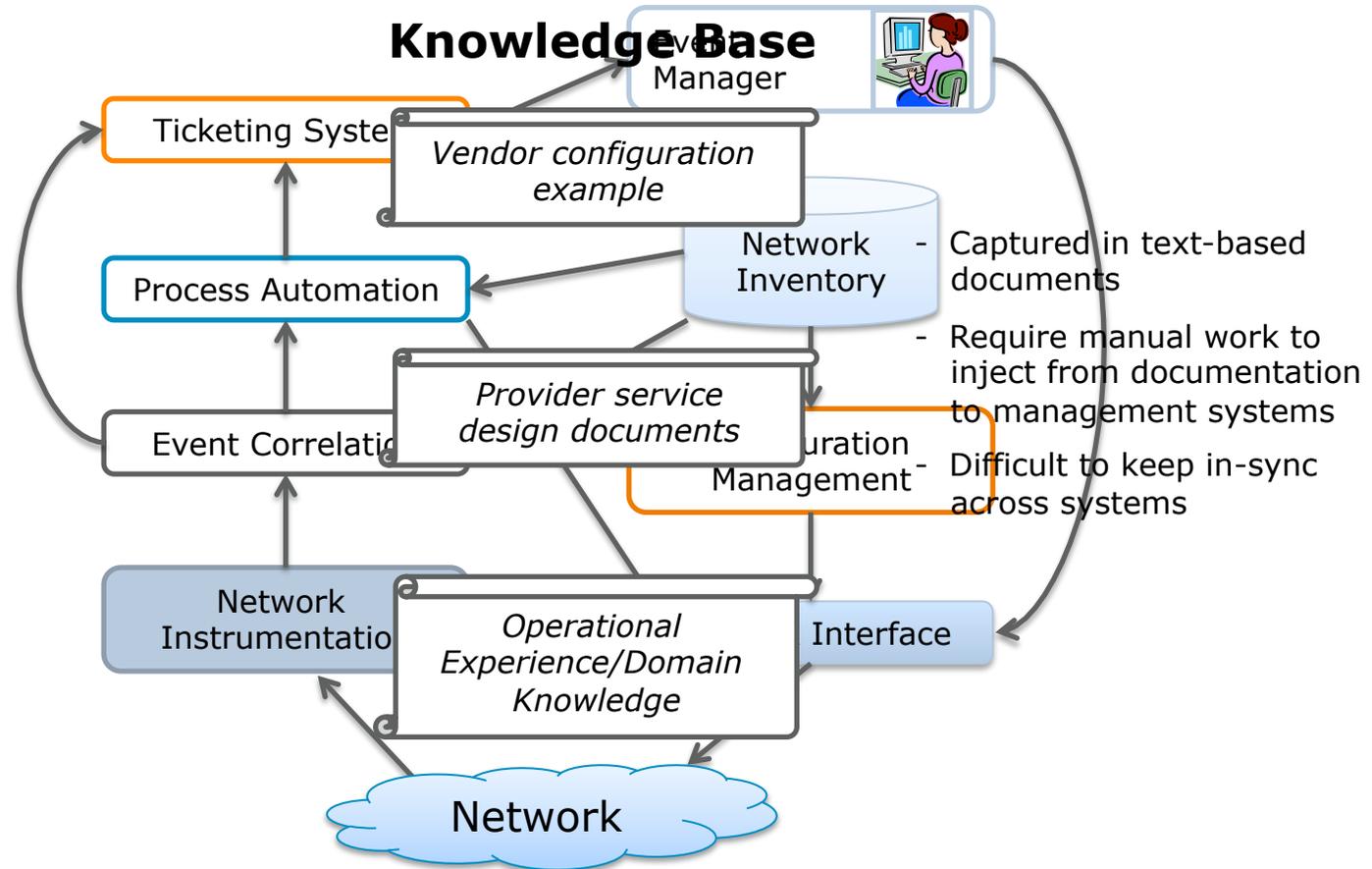
- In short
 - Keep the network in a “healthy” state
 - Deliver SLA-compliant services for customers

- Not so short
 - Planned maintenance/upgrade
 - Fault management
 - Configuration management
 - Traffic/performance management
 - Security management
 - ...

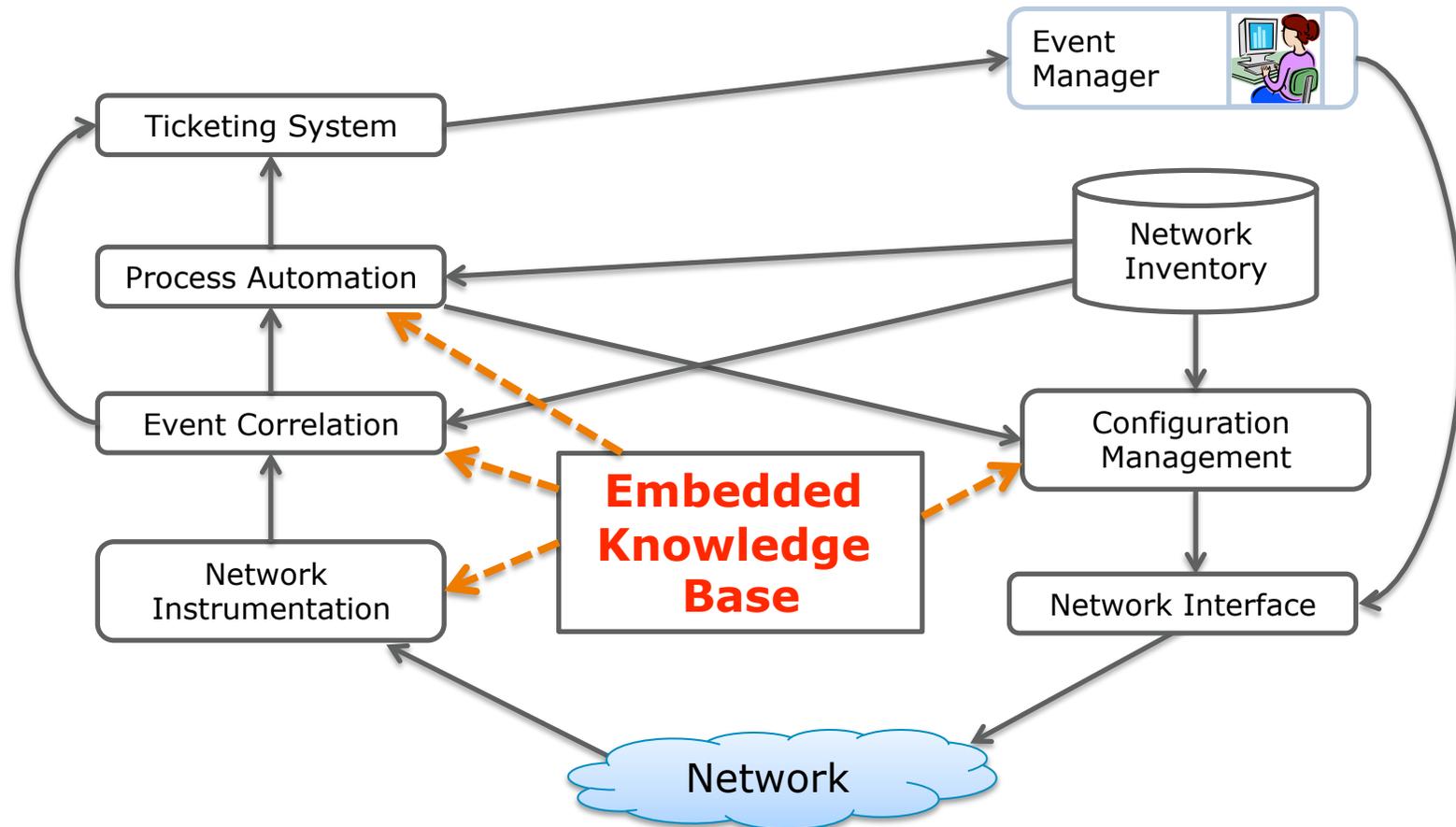
Simplified View of Network Management Systems



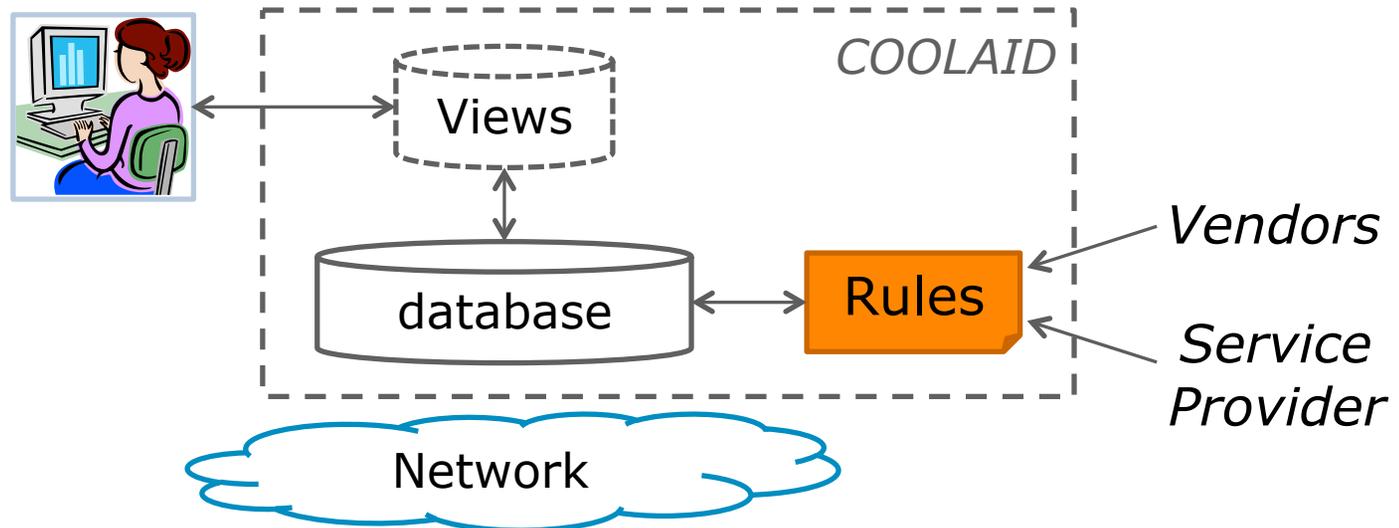
Simplified View of Network Management Systems



KnowOps: Using Shared and Machine-readable Knowledge Base



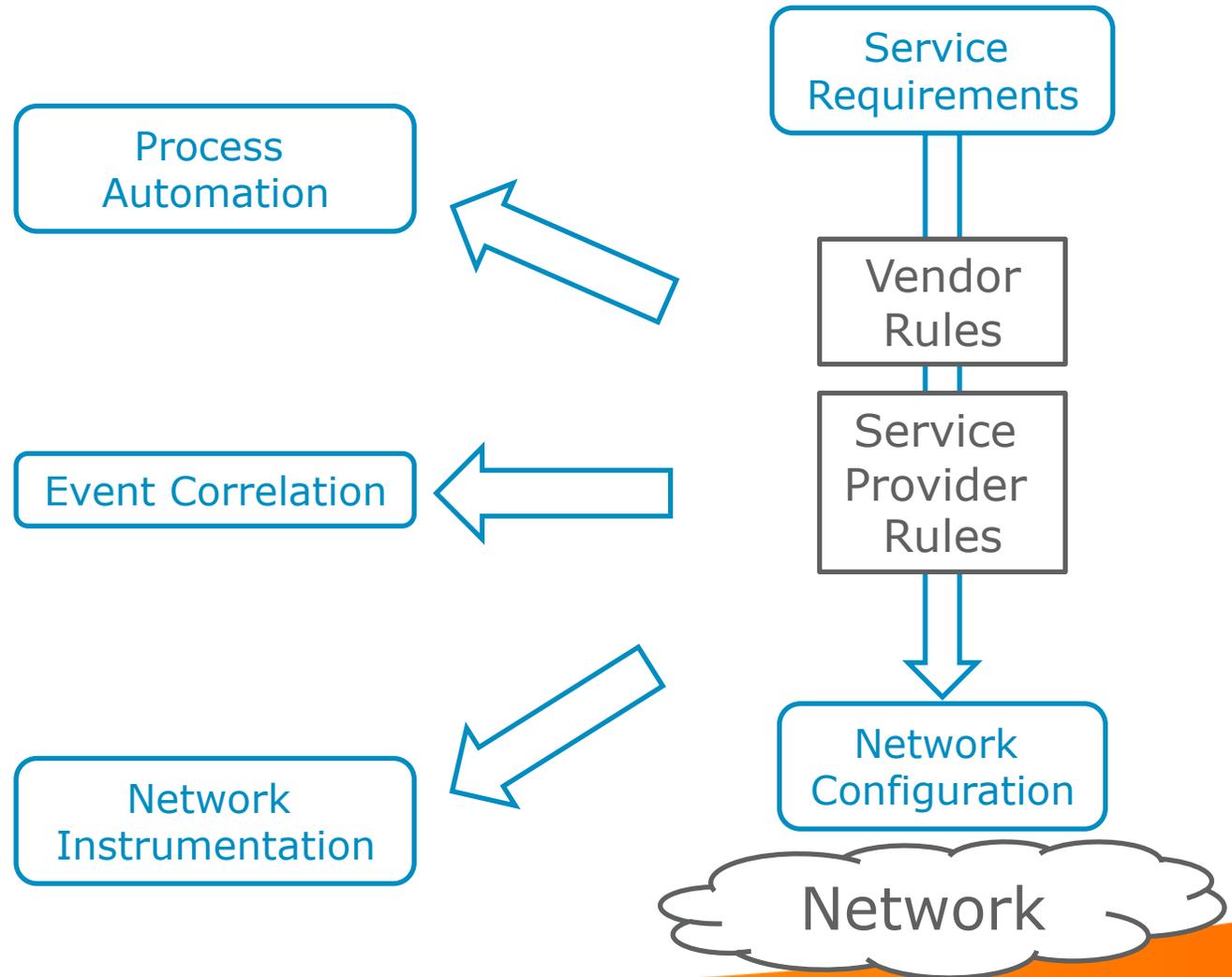
COOLAID [CoNEXT 2010]



- 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?*

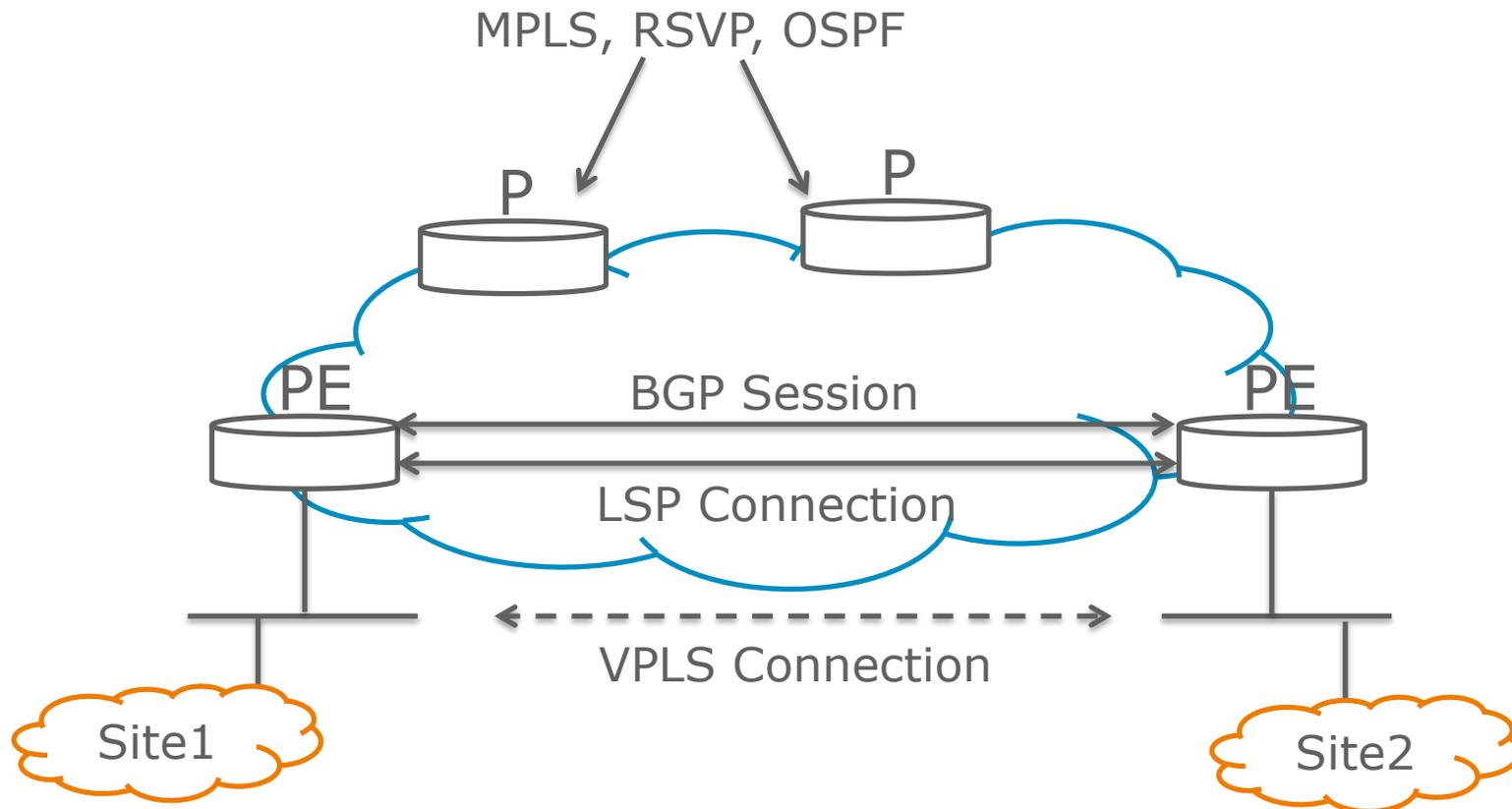


Preliminary Experience

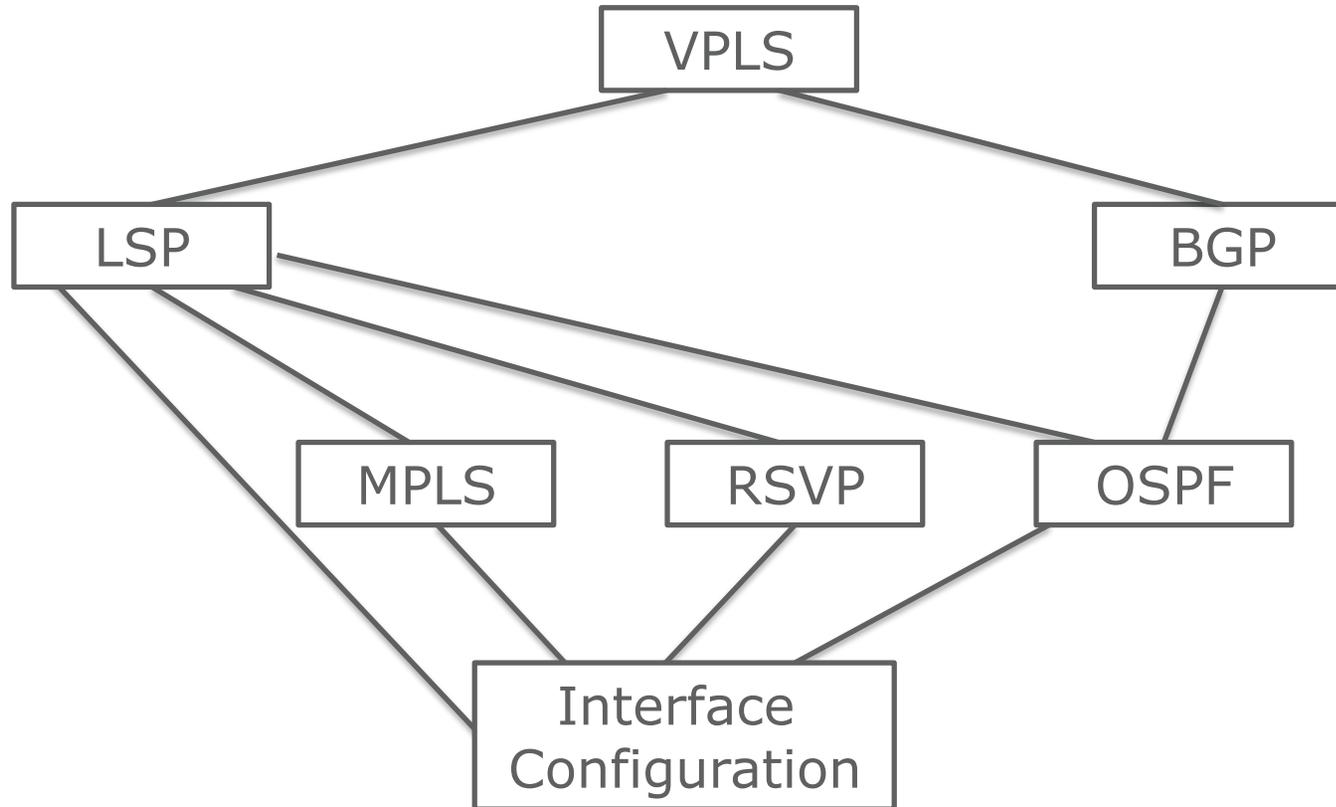
- DROOLS: open-source business logic
 - Rule engine
 - Process automation
 - Event correlation
 - Optimization/Planning



Example VPLS



Example: VPLS



Rules for OSPF

```
rule "ospf_local"      Dependency on
salience 10           interface configuration
dialect "mvel"
when
  $int : Interface( ospfarea != "" , adminEnabled == true , $r : router)
  $router : Router( this == $r )
  $pre : InterfacePrefixConfig( interface == $int )
then
  OspfRoute fact0 = nf.createOspfRoute();
  fact0.setArea( $int.ospfarea ); fact0.setRouter( $router );
  fact0.setPrefix( $pre.prefix ); fact0.setNextHop( "local" );
  fact0.setMetric( 0 );
  insertLogical( fact0 );
end
```

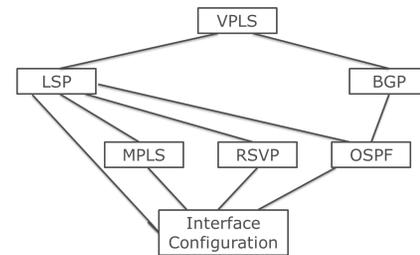
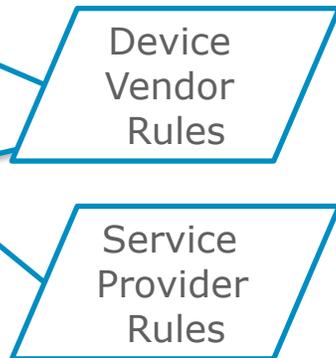
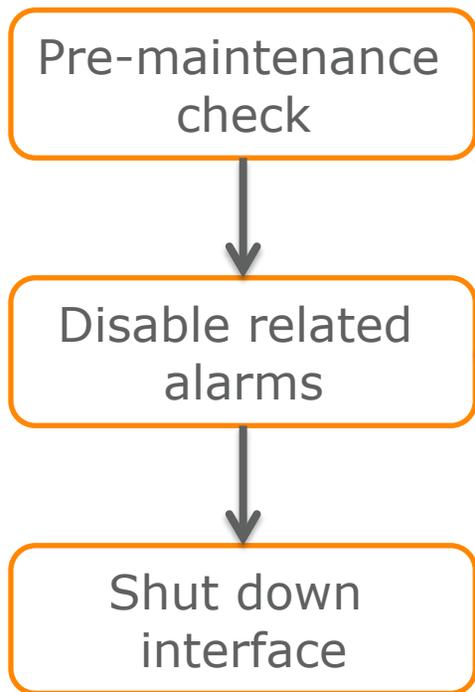
Rule 1

```
rule "ospf_remote"
salience 5
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 )
  $link: Link( (interfaces[0] == $int1 && interfaces[1] == $int2) ||
              (interfaces[1] == $int1 && interfaces[0] == $int2))
  $r2: Router( this == $int2.router)
  not (exists (OspfRoute( area==$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
```

Rule 2

Planned Maintenance Example

Automation
Process



"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!

