Recursive Monitoring Language in Network Function Virtualization (NFV) Infrastructure

draft-cai-nfvrg-recursive-monitor-00

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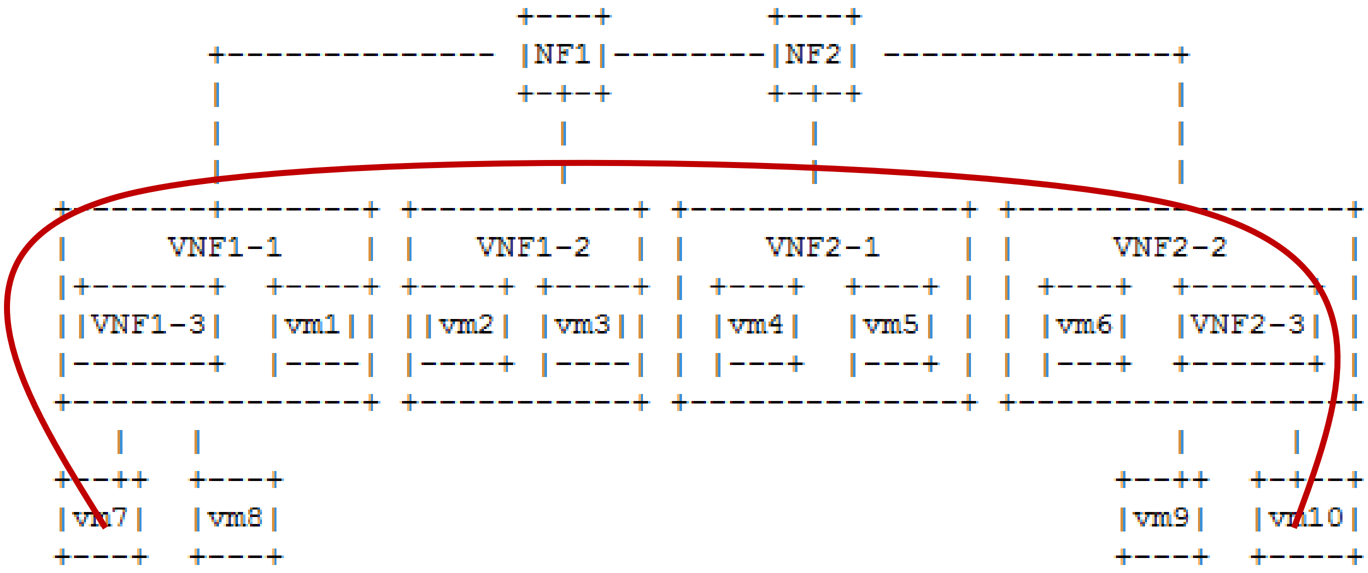
Motivation

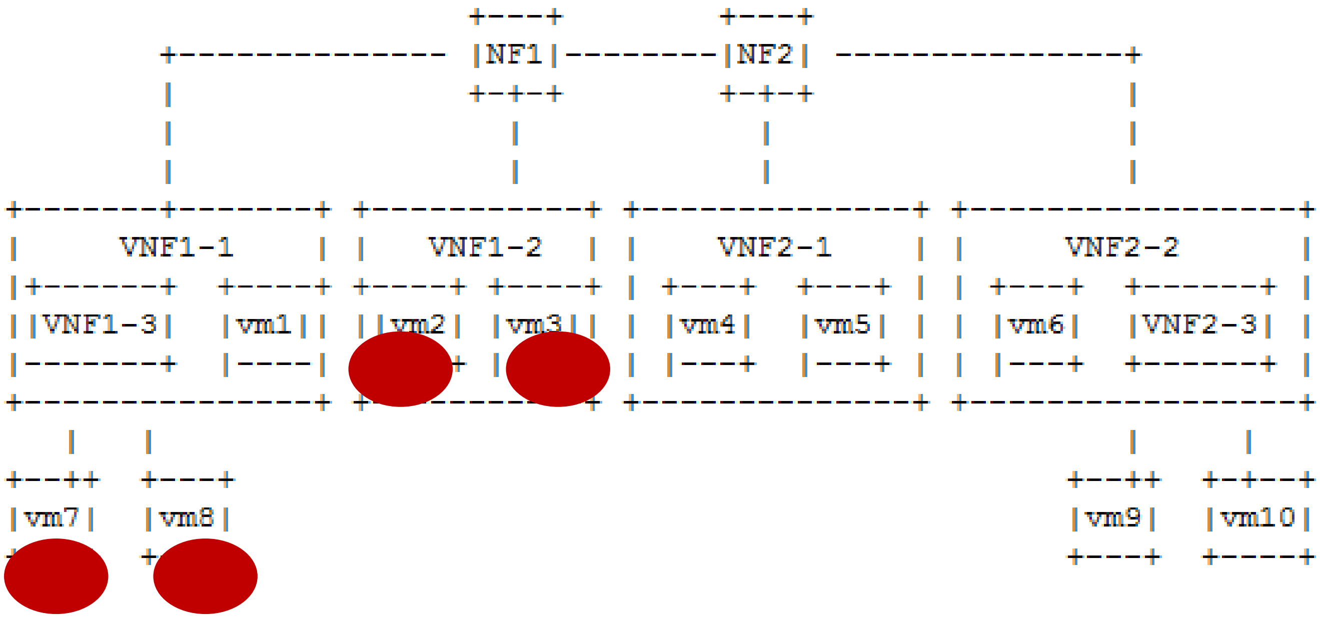
- provide an automatic way to decompose/aggregate monitoring data in different infrastructure layers
- provide a way for developers and operators to easily access monitoring data collected from resources in a software-defined telecom infrastructure that contains a hierarchy of abstraction levels
  - several NFVRG drafts describe such infrastructure

Example – e2e delay



```
                        +---+        +---+
        +-------------- |NF1|--------|NF2| ---------------+
        |               +-+-+        +-+-+                |
        |                 |            |                  |
        |                 |            |                  |
+-------+-------+ +-----------+ +---------------+ +--------+--------+
|     VNF1-1    | |  VNF1-2   | |    VNF2-1     | |     VNF2-2      |
|+-------+  +---+ +----+ +----+ | +---+   +---+ | | +---+  +-------+ |
||VNF1-3|   |vm1|| |vm2| |vm3|| | |vm4|   |vm5| | | |vm6|  |VNF2-3| |
|--------+  |---| |----+ |----| | |---+   |---+ | | |---+  +-------+ |
+---------------+ +-----------+ +---------------+ +-----------------+
   |   |                                                  |     |
+--++ +---+                                            +--++ +-+--+
|vm7| |vm8|                                            |vm9| |vm10|
+---+ +---+                                            +---+ +-----+
```

Example – aggregated CPU usage



Datalog – brief intro

- Subset of Prolog
- A program consists of declarative rules and a query
  - Rules: h <= p1, p2, ..., pn
    - p(x1, ..., xi, ..., xn)" are either predicates applied to arguments "xi" (variables and constants), or function symbols applied to arguments
  - Queries: q (m, y1, ..., yn)“
    - "q" is a predicate, contains arguments "m" (a function) and "yi" (arguments for that function)

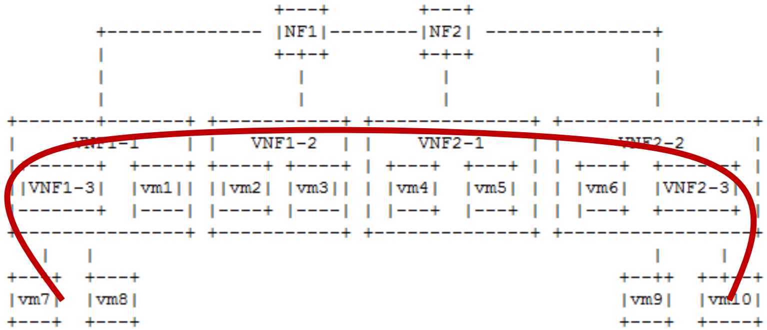
Simple NF-FG representation

- sub(x, y): 'y' is an element of the directly descend sub-layer of 'x';
- link(x, y): direct link between elements 'x' and 'y';
- node(z): node in NF-FG
- The NF-FG representation is “ground facts” for Datalog

Requirements for a query engine

- MUST provide the capability to parse and interpret the query scripts which are written with the language
- MUST be able to retrieve the NF-FG created by NFV infrastructure and translate them into Datalog based ground facts
- MUST be able to query the database in which the monitoring results of primitive metric are stored
- An interface between query engine and the users of the language (e.g., developer or network service operator) MUST be defined to exchange the query scripts and query results.

Example – e2e delay



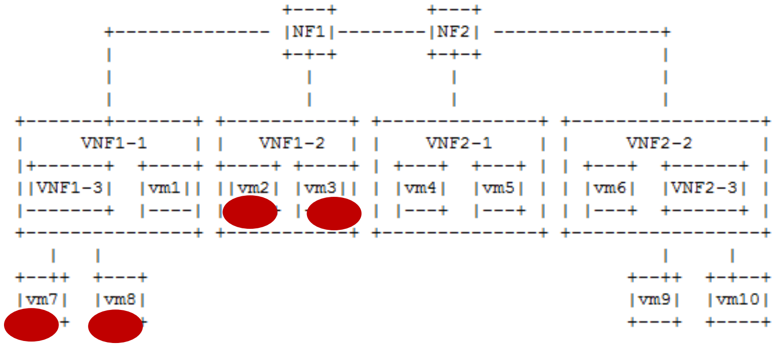
Ground rules

```
F1: sub(NF1, VNF1-3, vm1, vm2, vm3), sub(NF2, vm4, vm5, vm6, VNF1-3),
sub(VNF1-3, vm7, vm8), sub(VNF1-3, vm9, vm10)
F2: node(NF1, NF2, VNF1-3, vm1, vm2, vm3, vm4, vm5, vm6, VNF1-3,
vm7, vm8, vm9, vm10)
F3: link(NF1, NF2), link (VNF1-3, vm1), link(vm2, vm3), link(vm3, vm4),
link(vm4,vm5), link(vm5,vm6), link(vm6, VNF1-3), link(vm7, vm8),
link(vm9, vm10)
R1: child(X,Y) <= sub(X,Z), child(Z,Y)
R2: child(X,Y) <= sub(X,Y)
R3: leaf(X,Y) <= child(X,Y), ~sub(Y,Z)
R4: in_leaf(X, Y) <= leaf(X, Y) & ~link(M, Y)
R5: out_leaf(X, Y) <= leaf(X, Y) & ~link(Y, M)
R6: e2e_delay(S,D,P) <= link(S,D), P == f_e2e_delay(in_leaf(S,Y),
out_leaf(D,Z))
query(e2e_delay, NF1, NF2)
```

Rule template(s)

Query

Example – e2e delay



Ground rules

```
F1: sub(NF1, VNF1-3, vm1, vm2, vm3), sub(NF2, vm4, vm5, vm6, VNF1-3),
sub(VNF1-3, vm7, vm8), sub(VNF1-3, vm9, vm10)
F2: node(NF1, NF2, VNF1-3, vm1, vm2, vm3, vm4, vm5, vm6, VNF1-3, vm7,
vm8, vm9, vm10)
R1: child(X,Y) <= sub(X,Z), child(Z,Y)
R2: child(X,Y) <= sub(X,Y)
R3: leaf(X,Y) <= child(X,Y), ~sub(Y,Z)
R4: max_cpu(X,C) <= leaf(X,Y), C == f_max_cpu(leaf(X,Y))
R5: mean_cpu (X,C) <= leaf(X, Y), C == f_mean_cpu(leaf(X,Y))
Query(max_cpu, NF1)
```

Rule template(s)

Query

Conclusion

- We presented a proposal on using a Datalog-derived language for automatically aggregating monitoring data in NFV environments
- Next steps:
  - Receive feedback from the community
  - Provide additional templates
  - Enhance the NF-FG description to align with NFVRG drafts evolution