Grid programming with components:
an advanced ***COMP***onent platform
for an effective invisible grid

WP3

Update on non functional Features

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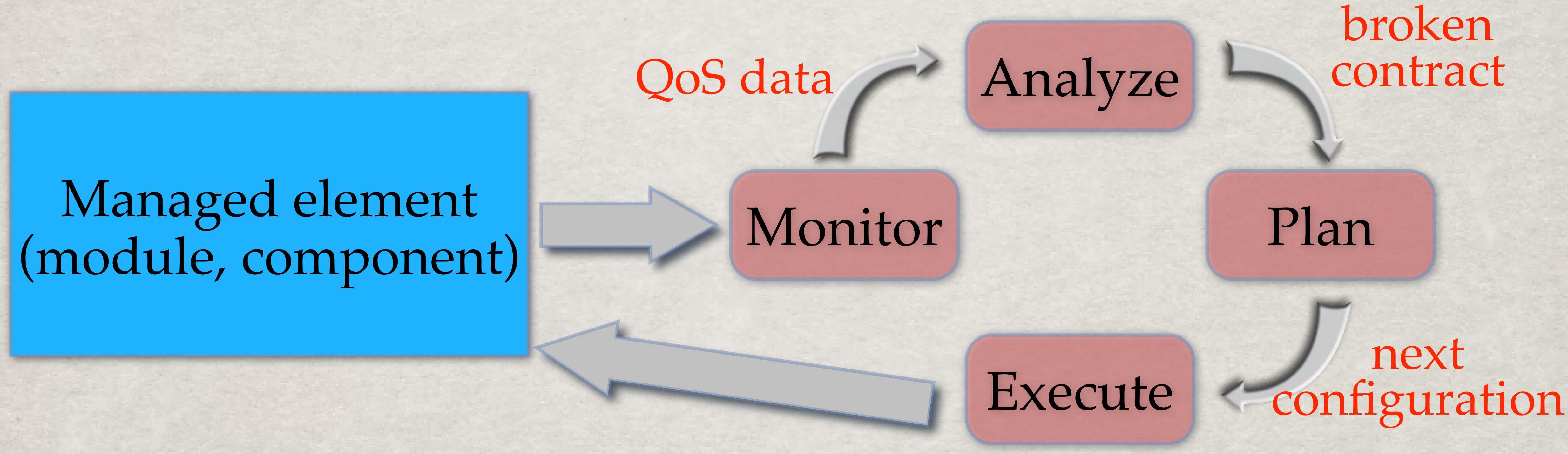
CoreGRID GCM NF features

- Autonomic behavior
  - EU 7 FP, NGG3, blah blah ...
- Renewed proposal based on:
  - Fractal style level of compliance
  - Passive or active vertical interaction

Insulated AC Element Cycle



- **Monitor**: collect execution stats: machine load, service time, input/output queues lengths, ...
- **Analyze**: instantiate performance models with monitored data, detect broken contract, in and in the case try to individuate the problem
- **Plan**: select a (predefined or user defined) strategy to re-convey the contract to valid status. The strategy is actually a list of mechanism to apply.
- **Execute**: leverage on mechanism to apply the plan

Fractal Conformance levels

Minor (κ)		1		1		1		1	2	3
Major (Θ)	0	0	1	1	2	2	3	3	3	3
Component			✓	✓	✓	✓	✓	✓	✓	✓
Interface					✓	✓	✓	✓	✓	✓
Component Type Interface Type							✓	✓	✓	✓
Attribute, Content, Binding LifeCycle Controller		✓		✓		✓		✓	✓	✓
Factory									✓	✓
Template										✓

Conformance level Θ.κ

Fractal Conformance levels Rephrased and GCM

- Major (Θ) ≥ 1 ⇔ “it is a component”
  - Minor (κ) ≥ 1 ⇔ “it exhibits AC, CC, BC, LC”
    - Minor (κ) =2&3 have a bit uneven meaning (F, T)
- Add another counter describing NF behavior $\Theta.\kappa.\alpha$ (as partial function)
  - $\alpha=0$ $\perp$, only if ($\Theta<1$ or $\kappa<1$) (observationally undecidable)
  - $\alpha=1$ No autonomicity
  - $\alpha=2$ Passive autonomicity (low-level, server only NF intf)
  - $\alpha=3$ Active autonomicity (high-level, client/server NF intf)

Several Aspect still not Clear

- Relation between Fractal and GCM
  - Conformance levels, Sharing, Client NF ports
- Introspection & Intercession
  - Intercession is mentioned just in the intro of Fractal specification, not sure the concept has been correctly interpreted in GCM
  - Life cycle too restrictive
    - Why require to stop all components to change bindings?
- Membrane, what is?
  - Is group communication sem implemented by controllers?
  - Are controllers components? *(No, if possible)*
  - How controllers interoperate and how are programmed?
  - Has it a distributed implementation? *(Yes, if possible)*

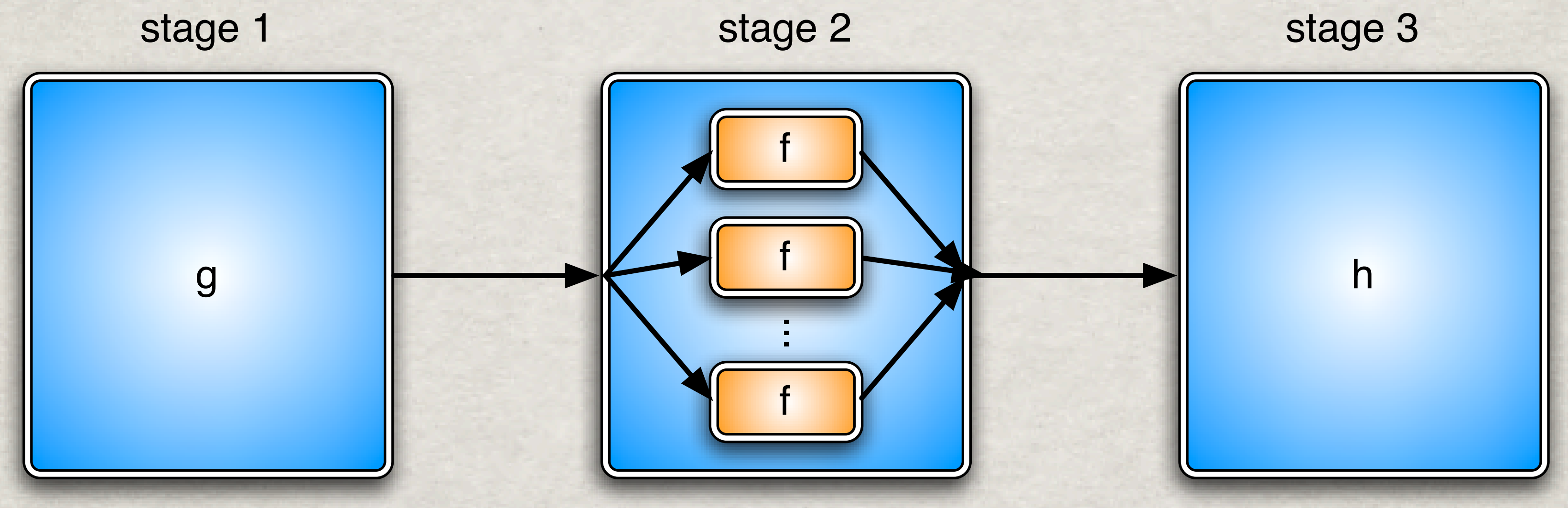
Partial Conclusions (GCM)

- On going refinement
  - Avoid choices that make implementation too complex, or inefficient
  - Personally, not really liking Fractal approach on “everything is optional and can be under-specified”
    - What is a cat? A thing, at level 0, an animal at level 1, a feline at level 2 ....
- Early experimentation in GridCOMP is important
  - Usability feedback
  - Performance feedback

Our Fractal/ProActive experience (First 6 months)

- Understanding
  - Install, learn, understand Fractal & ProActive
  - Understand Fractal/Proactive architecture
    - Documentation; not layered architecture
  - Fractal interoperability
    - Proactive vs Julia implementations
    - AOP with Fractlet
- Case study
  - Self-optimizing only (performance)
  - pipe(S1, Farm(S2), S3)
  - Fractal/ProActive features to support NF control

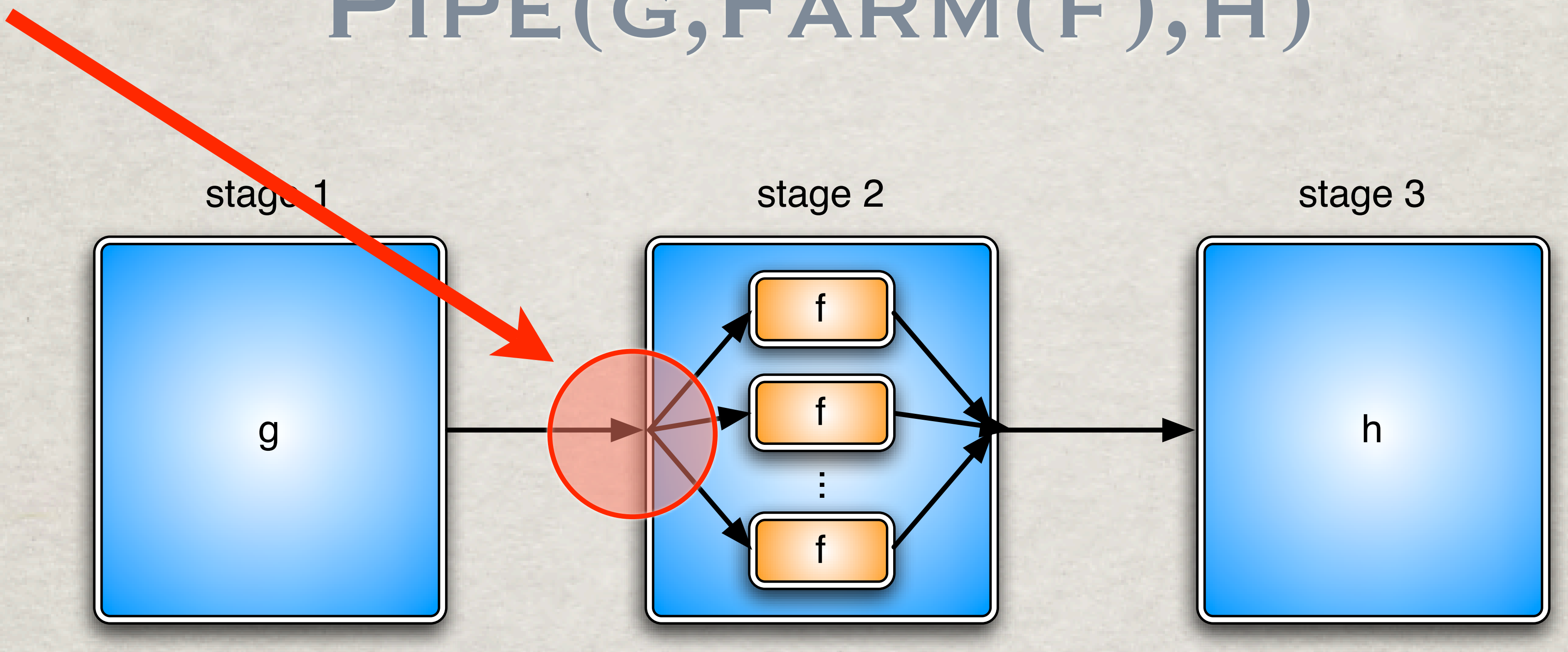
SELF-OPTIMIZING PIPE(G,FARM(F),H)



- A simple three stages application, working on a data stream (e.g. video frames)
  - pipe performance max(Tg,Tfarm(f),Th)
  - farm performance Tf/#n, n variable along run
- Self-optimizing w.r.t. nodes power along time

Self-optimizing Pipe(g,Farm(f),h)

User programmable unicast



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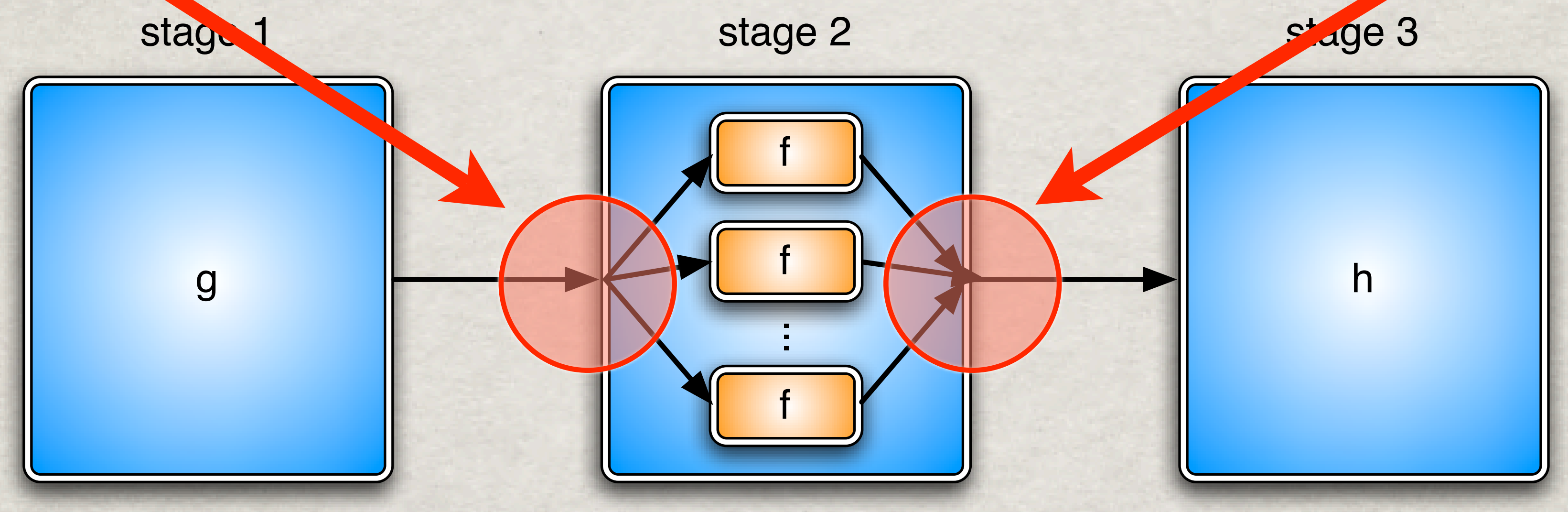
SELF-OPTIMIZING PIPE(G,FARM(F),H)

User programmable unicast

Collects from any



- A simple three stages application, working on a data stream (e.g. video frames)
  - pipe performance max(Tg,Tfarm(f),Th)
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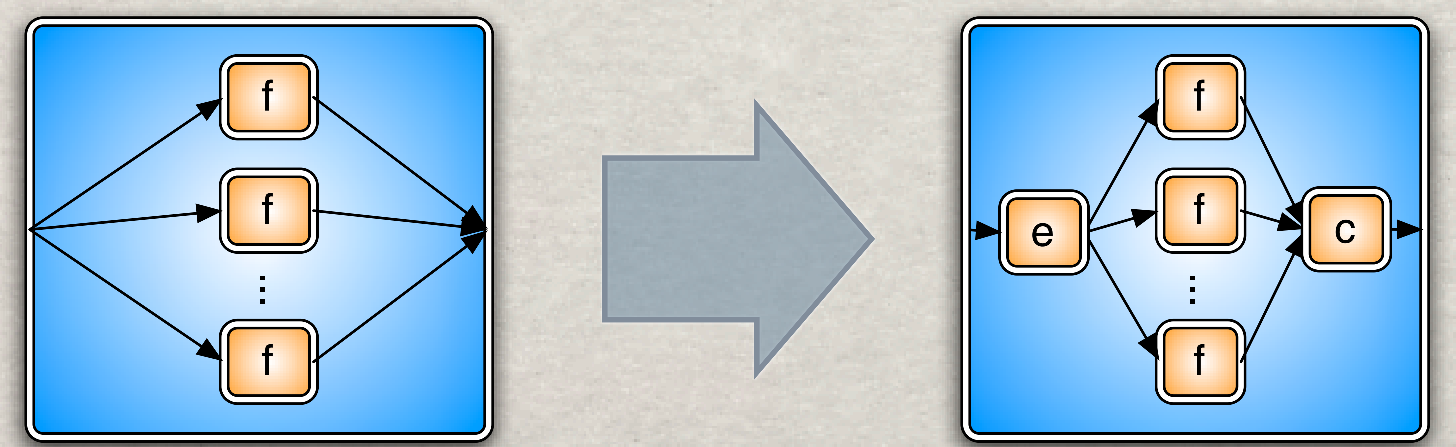
Farm

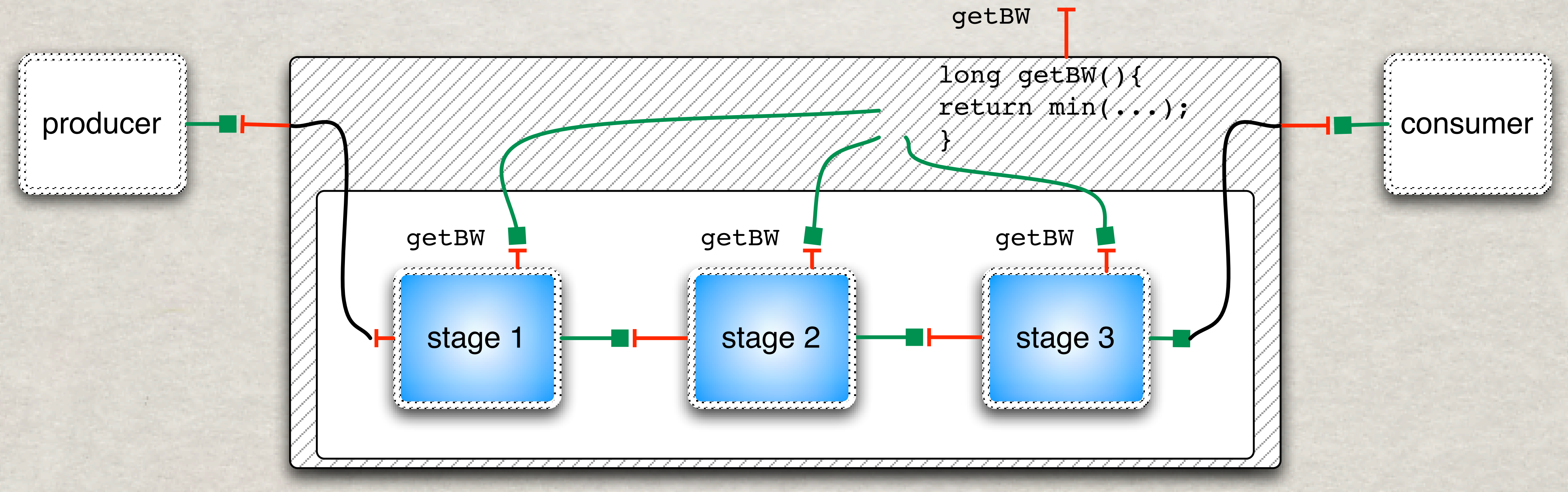
- A clean implementation needs:
  - Unicast "programmable" communications
    - send to a single ID in a set, collect from any (not all)
    - probably not excluded by GCM specification, not clear our to implement in the current version
  - Distributed implementation of the membrane
    - is it a single Active Objects?
- Currently two inner components act as distributor and collector



Pipe

- Two versions
  - Passive inner components
    - Each component exposes server NF interface (GetBandwidth)
    - They are periodically polled from a controller in the membrane, which then expose a GetBandwidth server port for the pipe component
    - Implementation pretty tricky, polling is programmed at hand within the controller
  - Active inner components
    - How to open server ports on the membrane toward the inner part (import-binding)? Is it possible?
    - We simulated with a functional component
  - Both versions expose all ports through a single JVM
    - Membrane and Active Objects

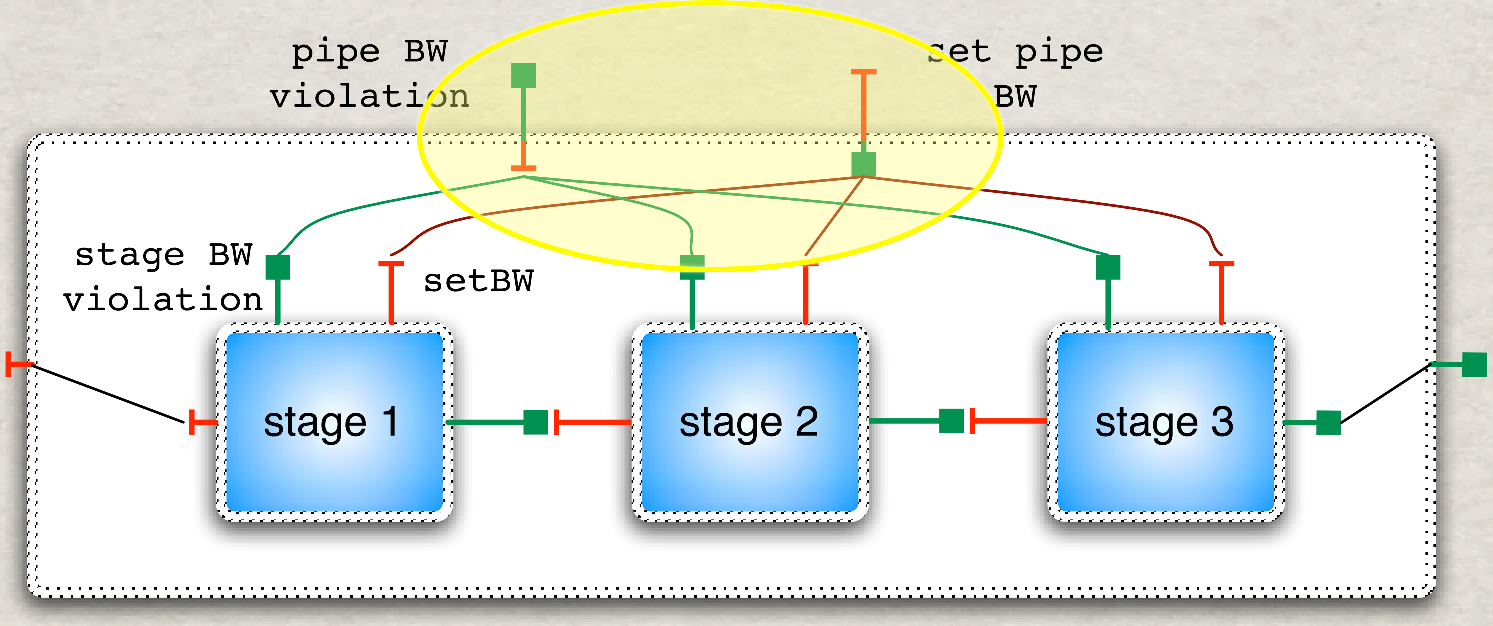
Pipe with Passive NF stages



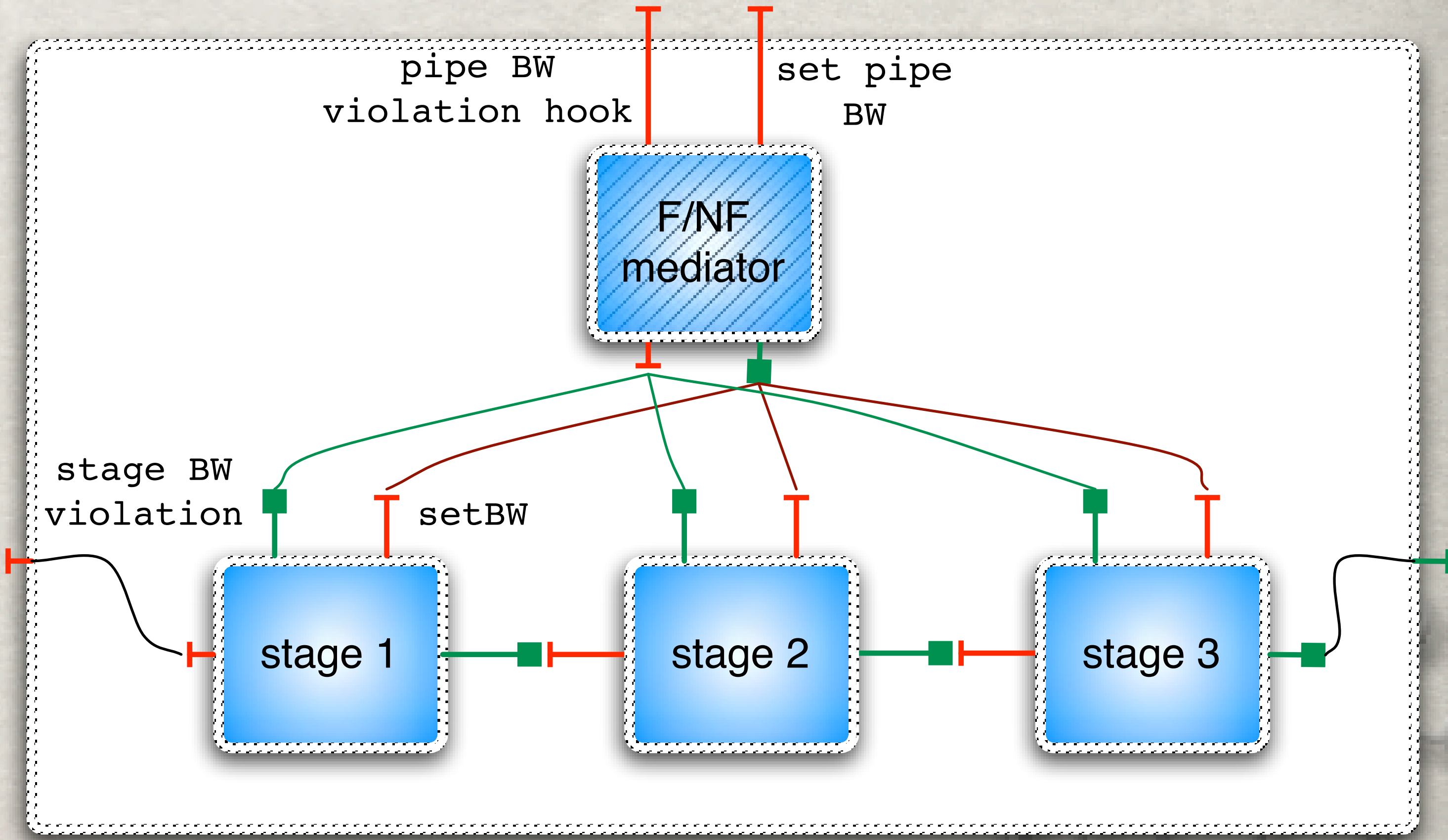
```
long getBW(){
return min(...);
}
```

- Implemented, works
  - Overheads not yet measured
- Managing code completely up to the user
  - NF binding programmatically described

Pipe with Active NF Stages



- Not succeed to express this
  - Maybe not impossible, but we don't succeeded in several weeks
  - Can be simulated by inserting an functional component (explicit manager)
  - Import/export bindings for NF controllers appears under-specified (-studied, -implemented



Points needing further investigation

- Programming controllers
  - GCM specification should be refined
- Interactions among controllers
  - Ports exposed by controllers, toward in and out
  - Interaction among ports
- Mapping membrane & controllers
  - VN, ActiveObjects, JVM, nodes, ...
- Low-level points
  - Sent to Proactive Q&A

Conclusion

- High-level research issues
  - Formalization of QoS property ongoing
  - Interaction among managers is still a black hole
- Implementation issues
  - Middleware expressiveness/effectiveness tradeoff can (should?) be improved
  - Low-level issues submitted to Proactive Q&A
  - Layering of features
    - In our idea, some of middleware features may require a promotion to QoS features (e.g. load balancing, communication synchronicity, group communication semantics, security ...) because they are supposed to be dependent by semantics of GCM application not on ProActive