Transformations of Attributed Structures with Cloning

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MATHÉMATIQUES APPLIQUÉES - INFORMATIQUE

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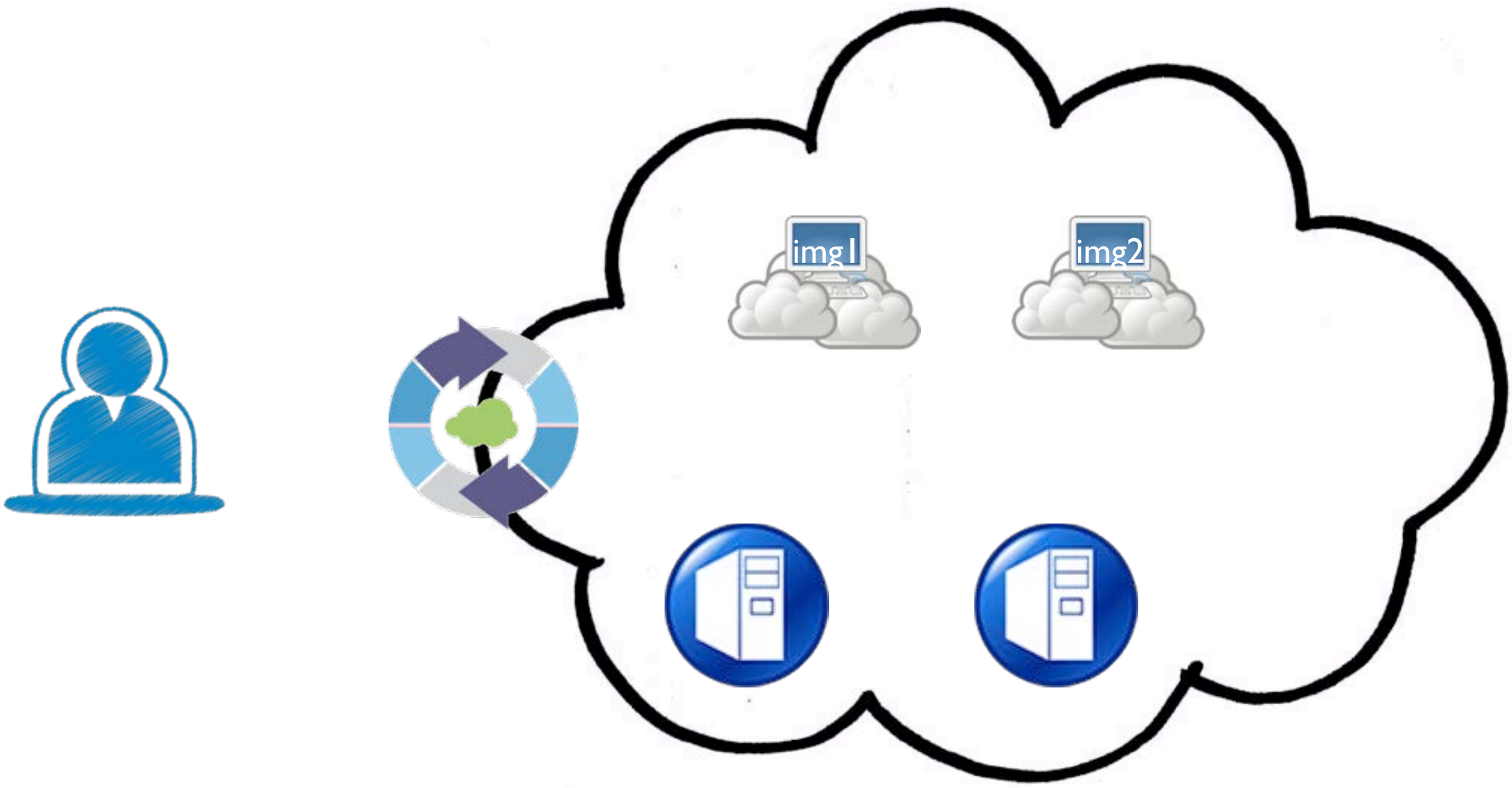
Outline

- Motivation
- Example : Cloud administration
- Attributed Structures
- Sesqui-PO Rewriting of Attributed Structures
- Conclusion and Future work

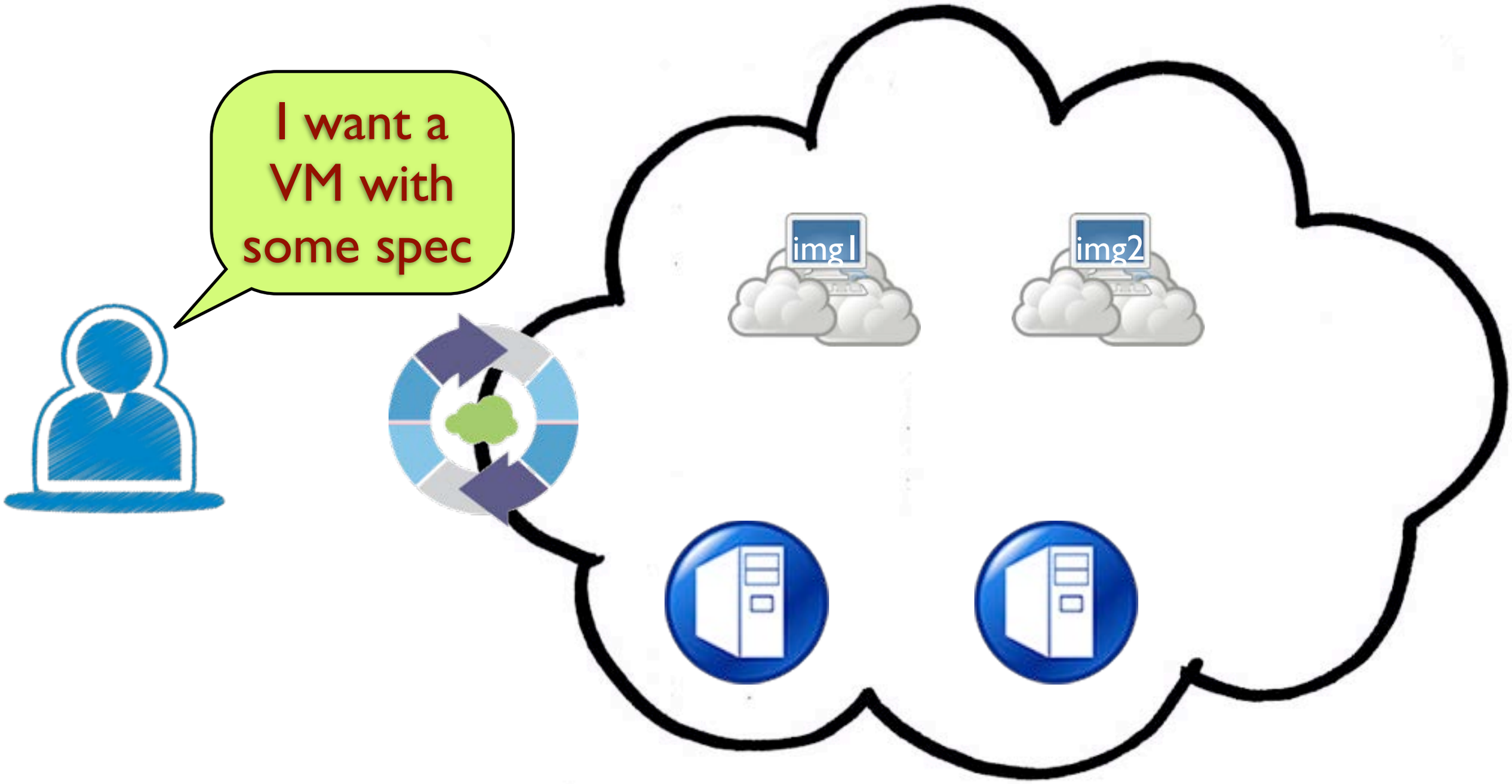
Motivation

- Simple but generic attribute notion
- Cloning possibility

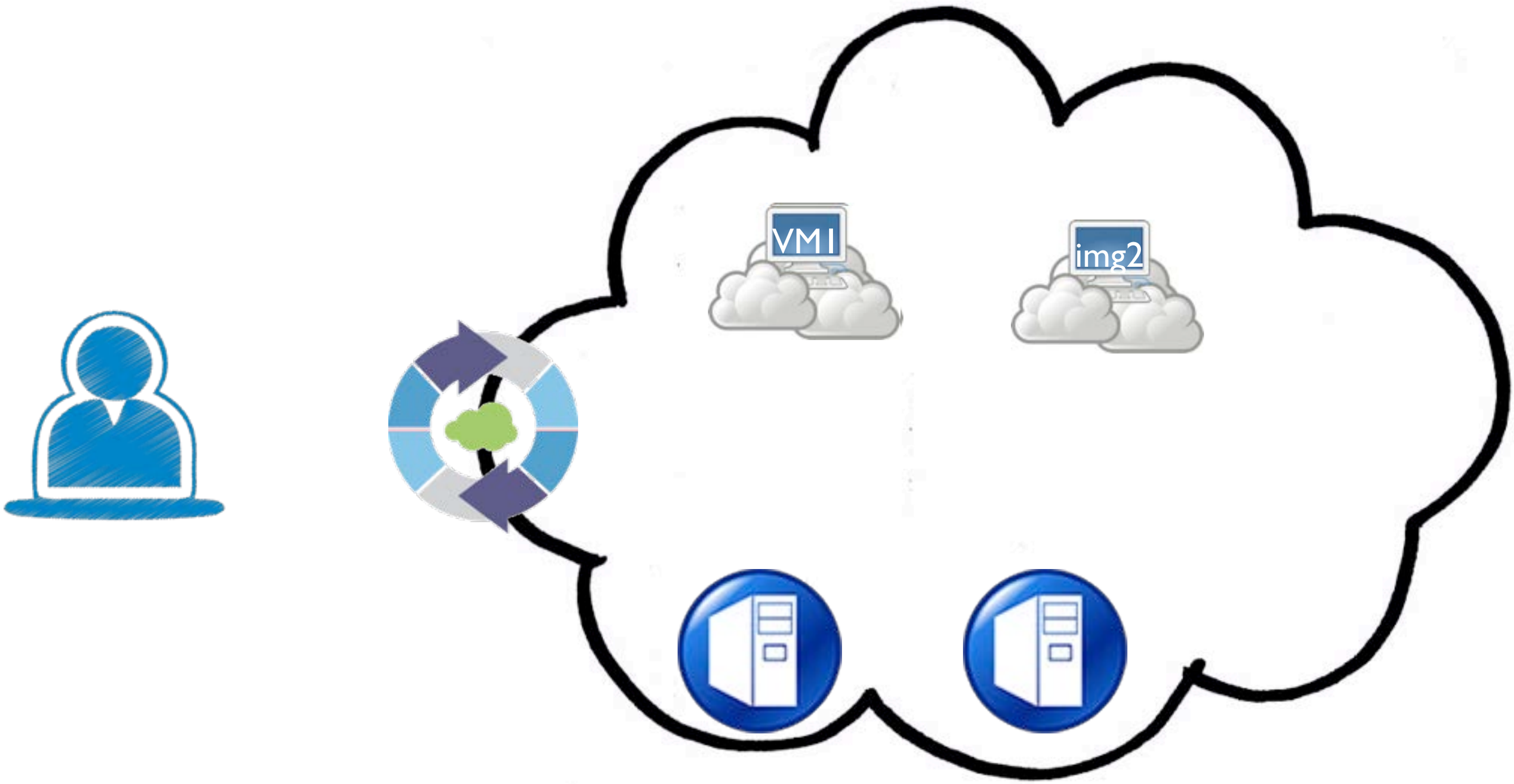
Example: Cloud Adm



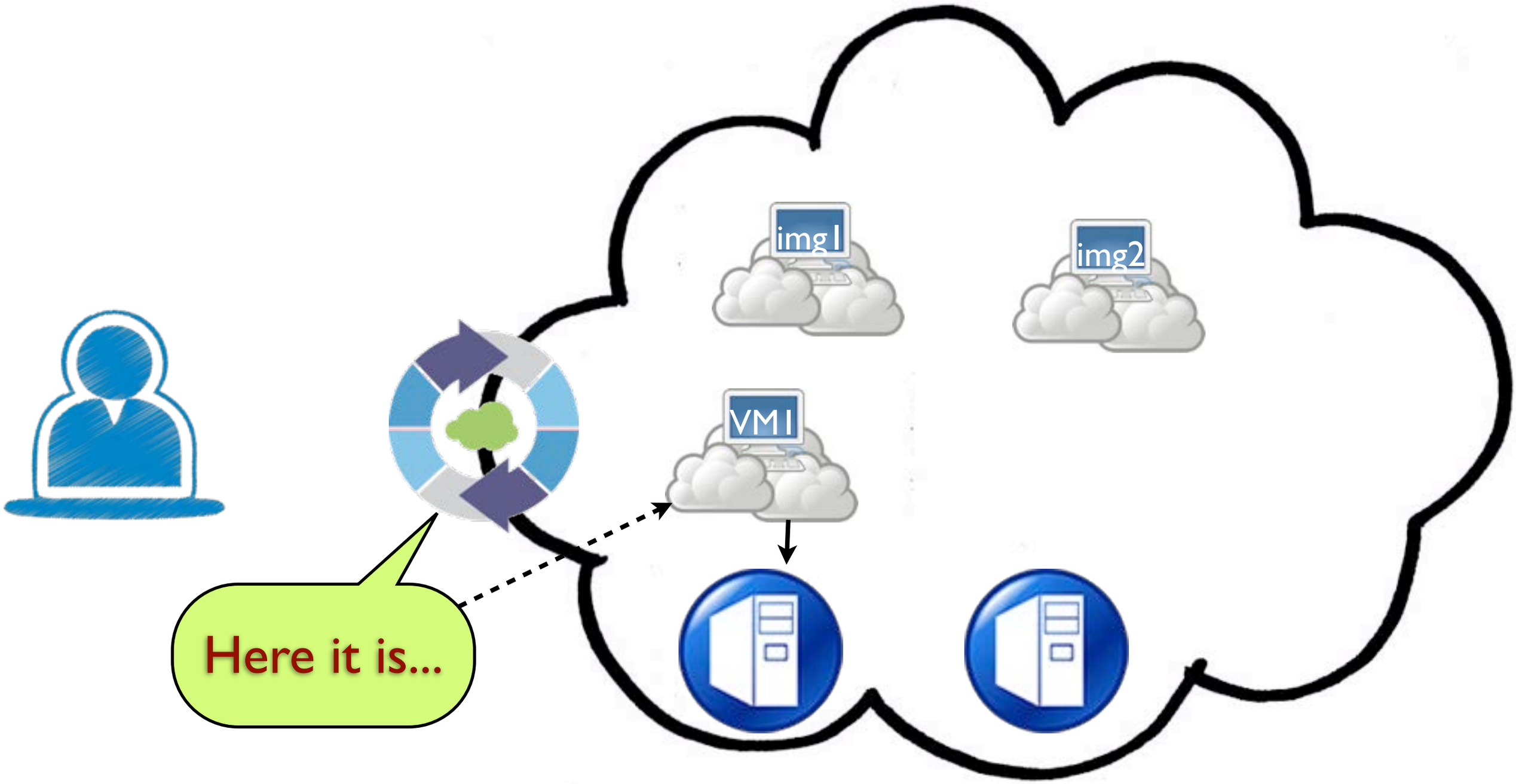
Example: Cloud Adm



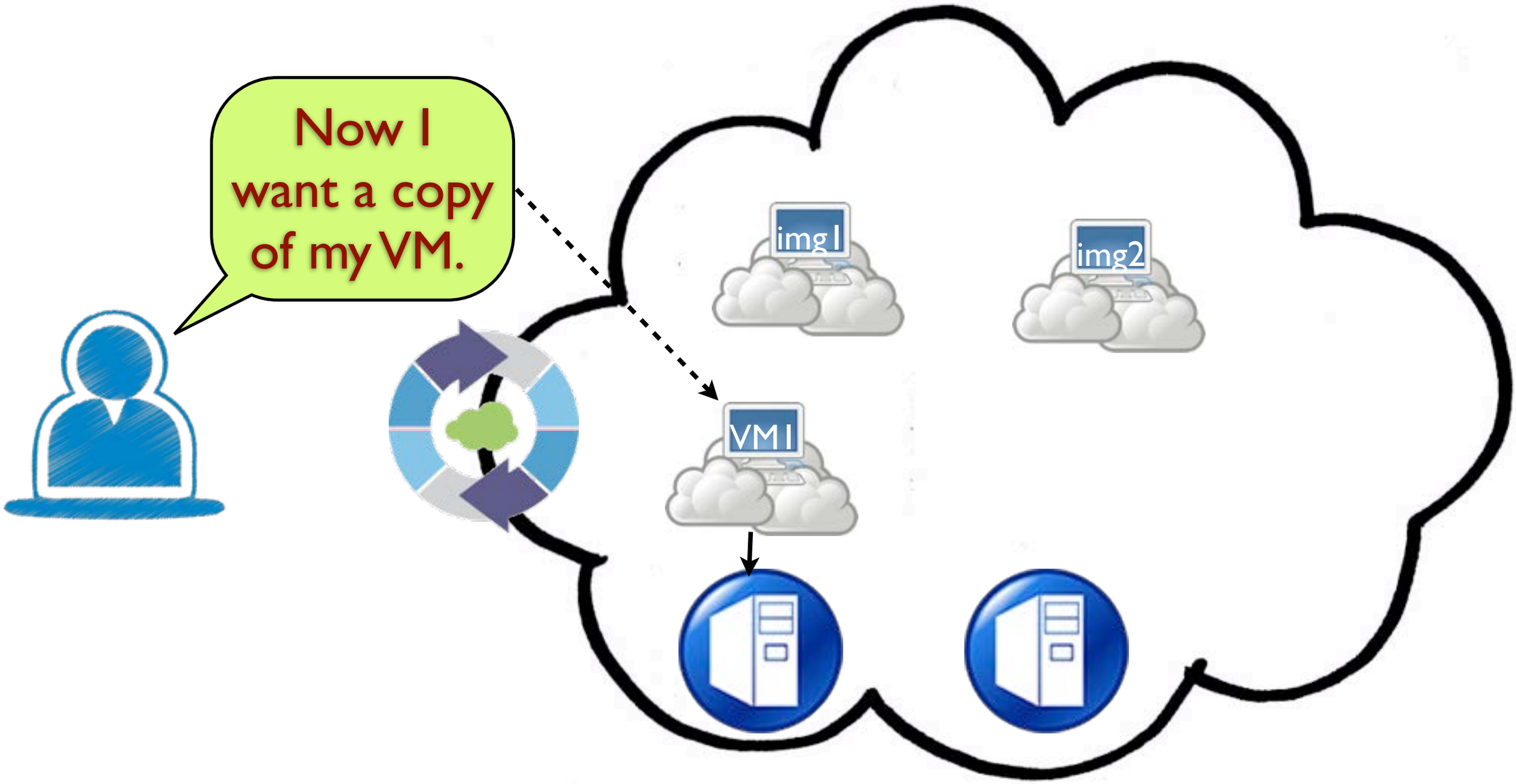
Create VM



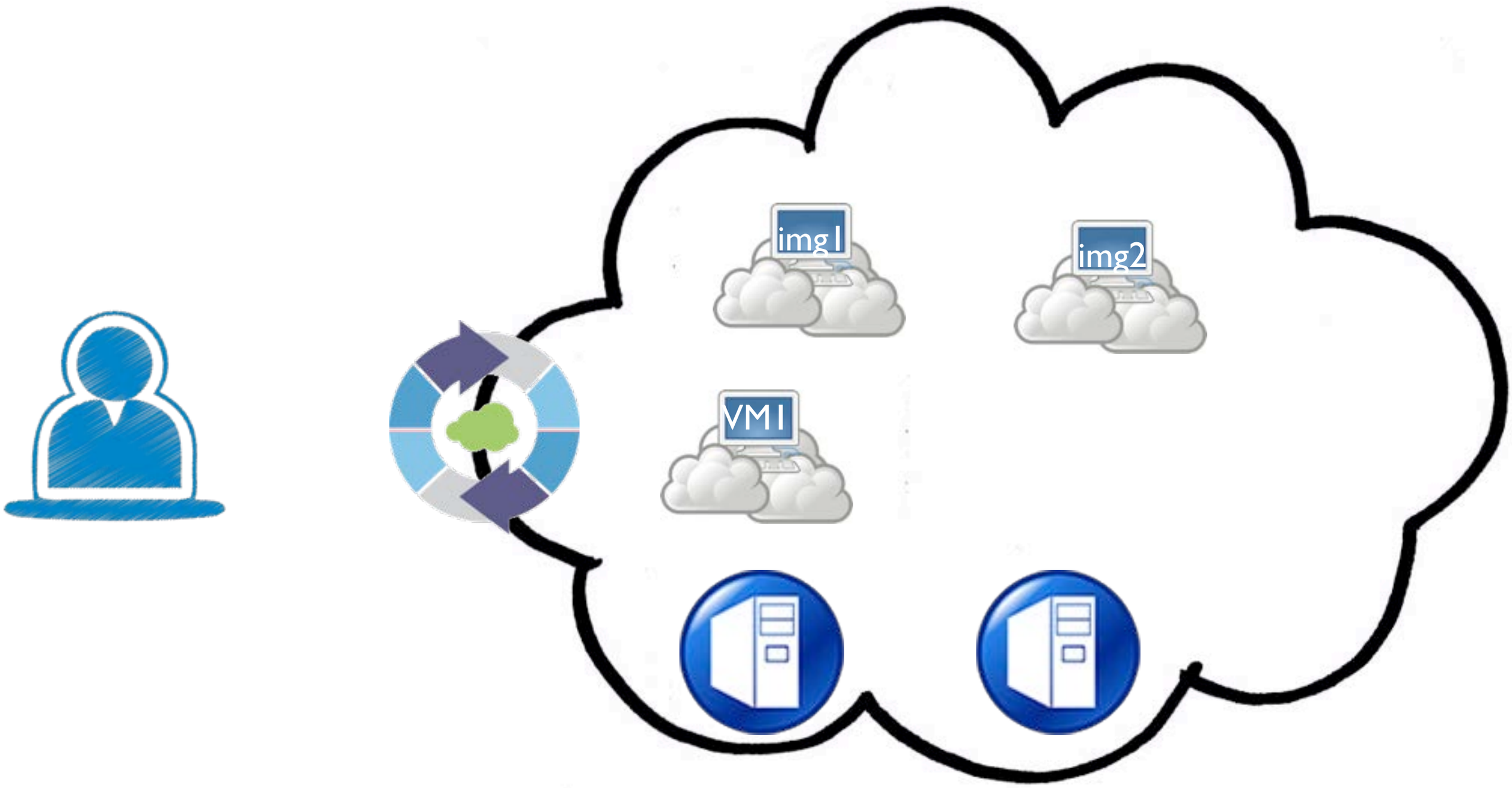
Create VM



New request...



Replicate VM



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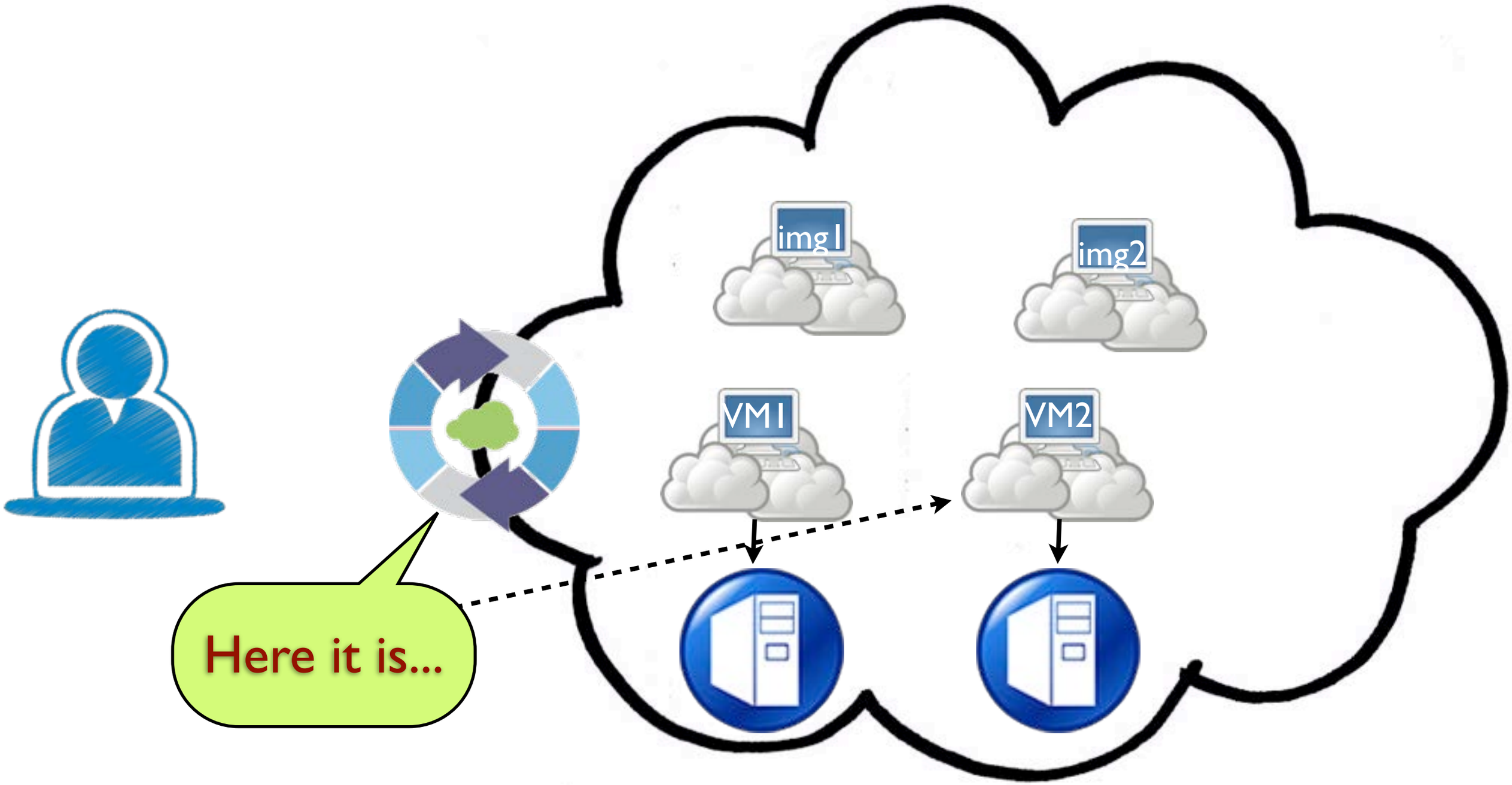

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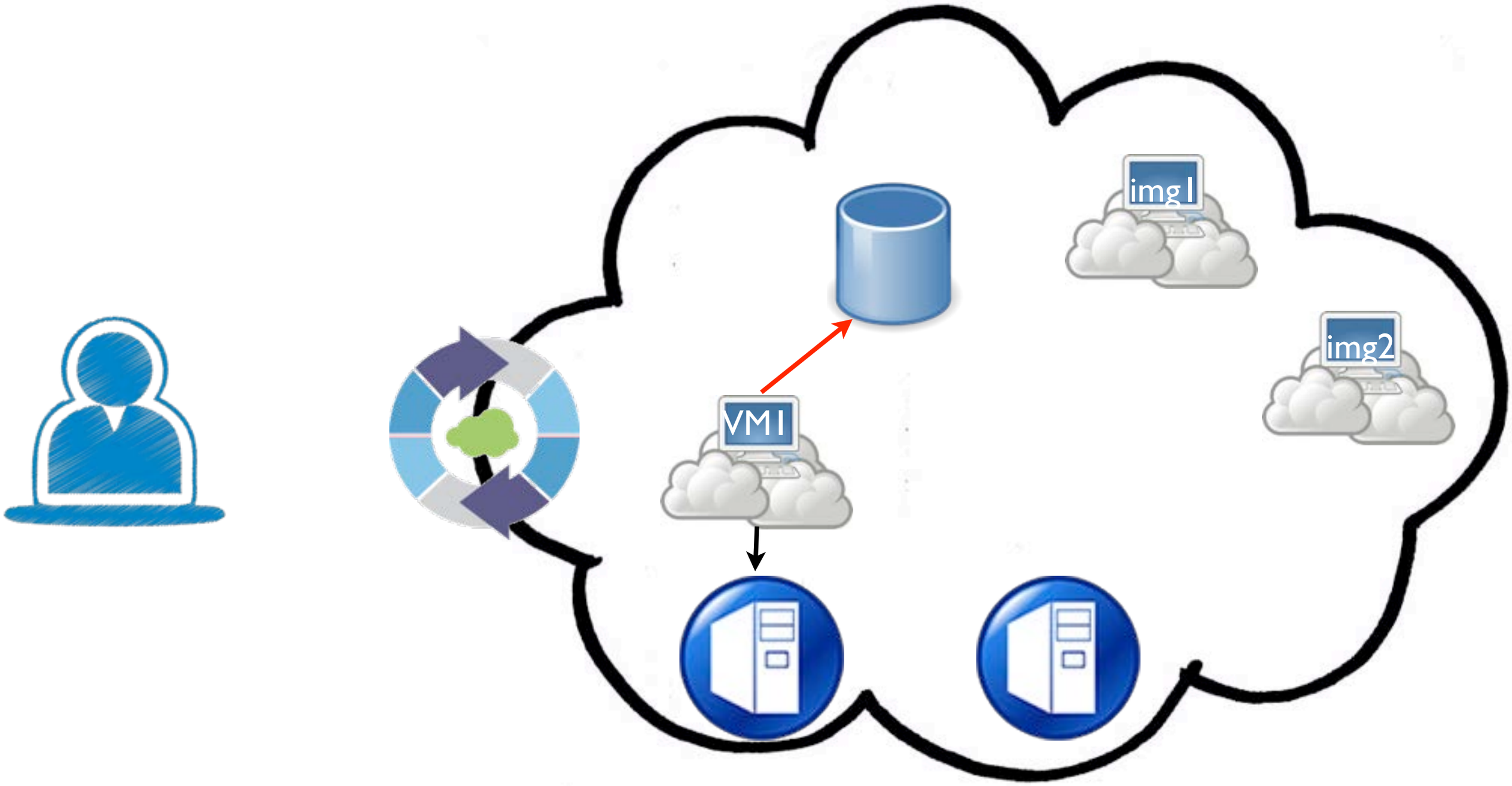

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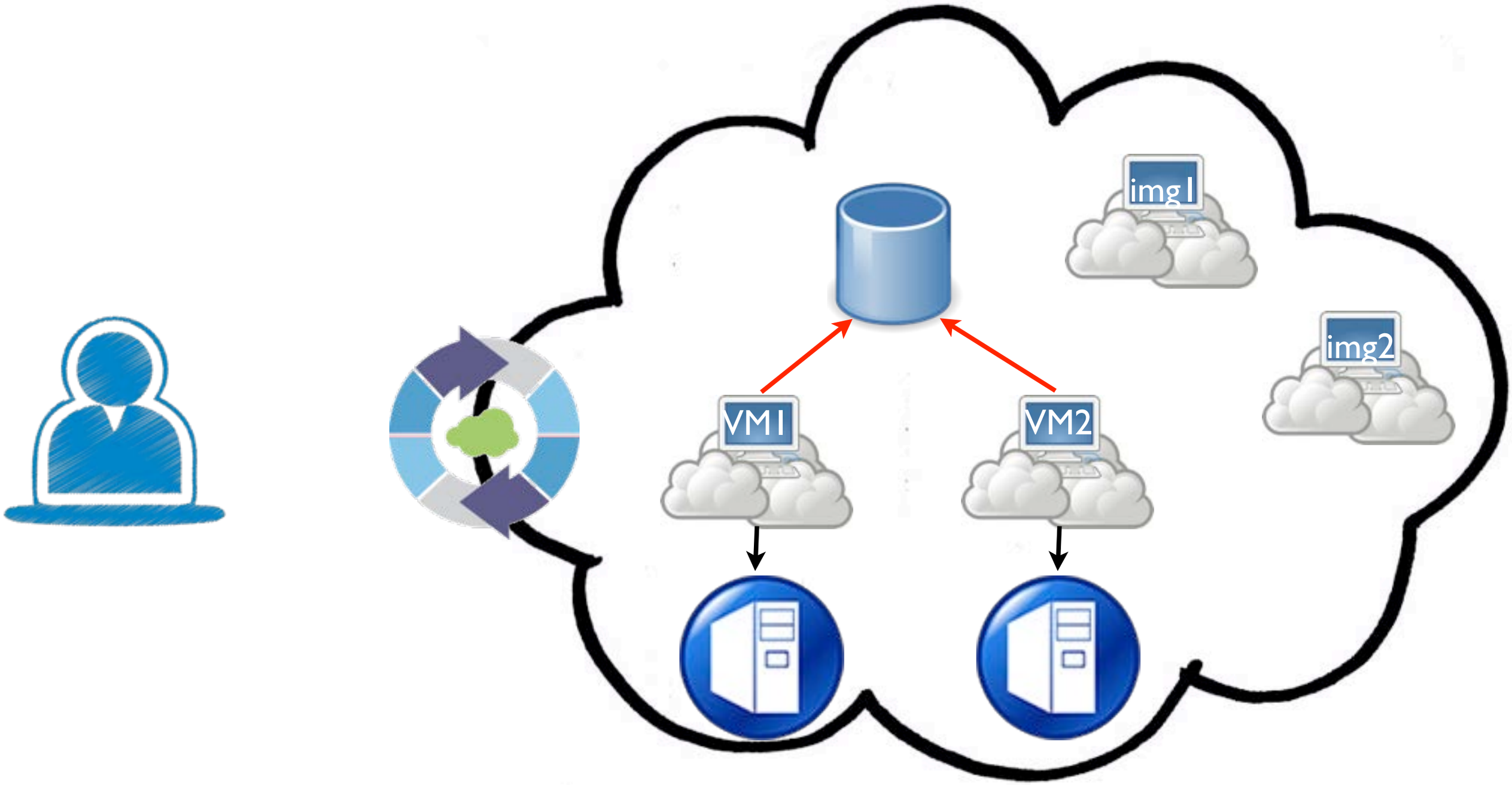

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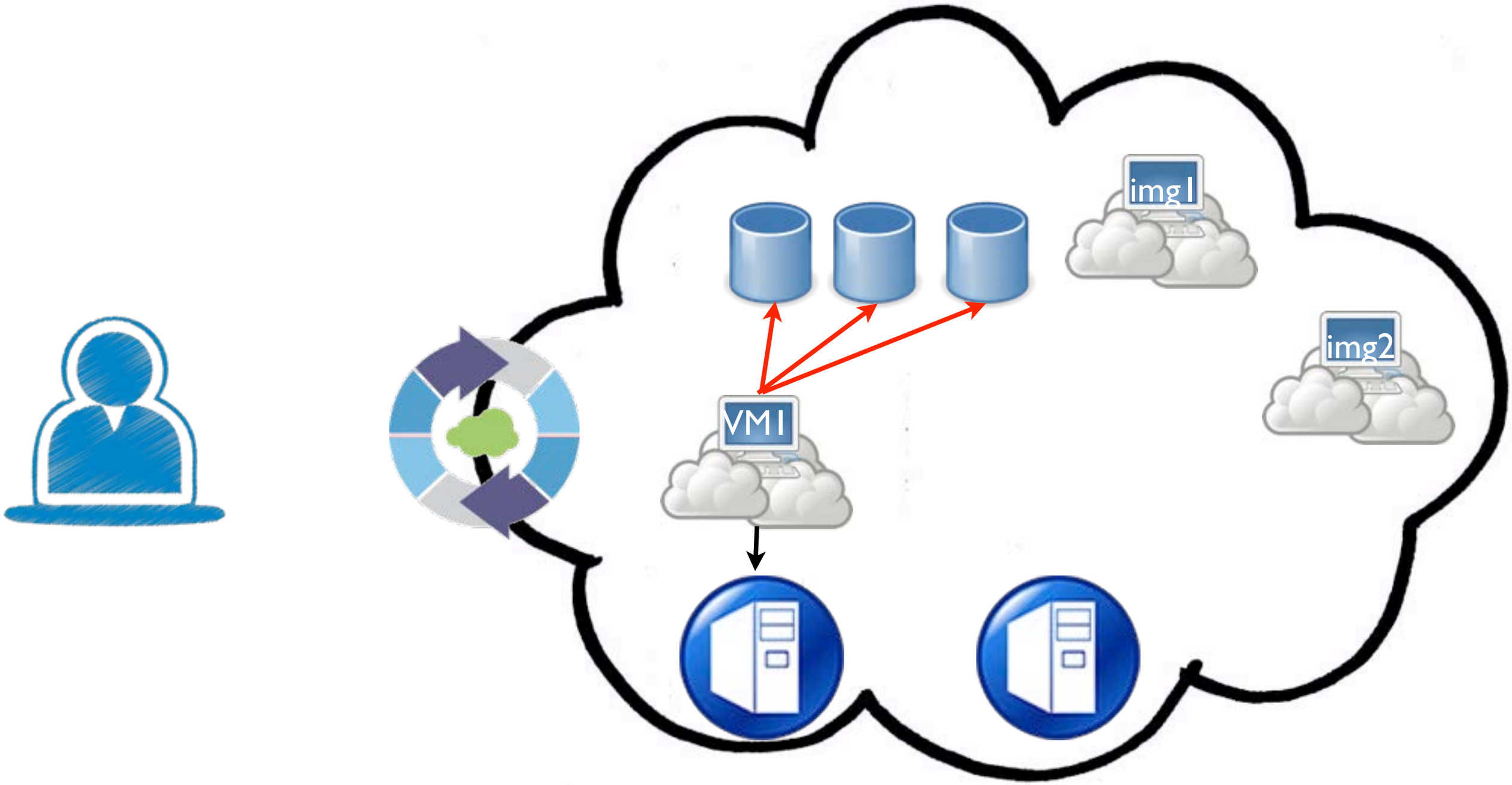

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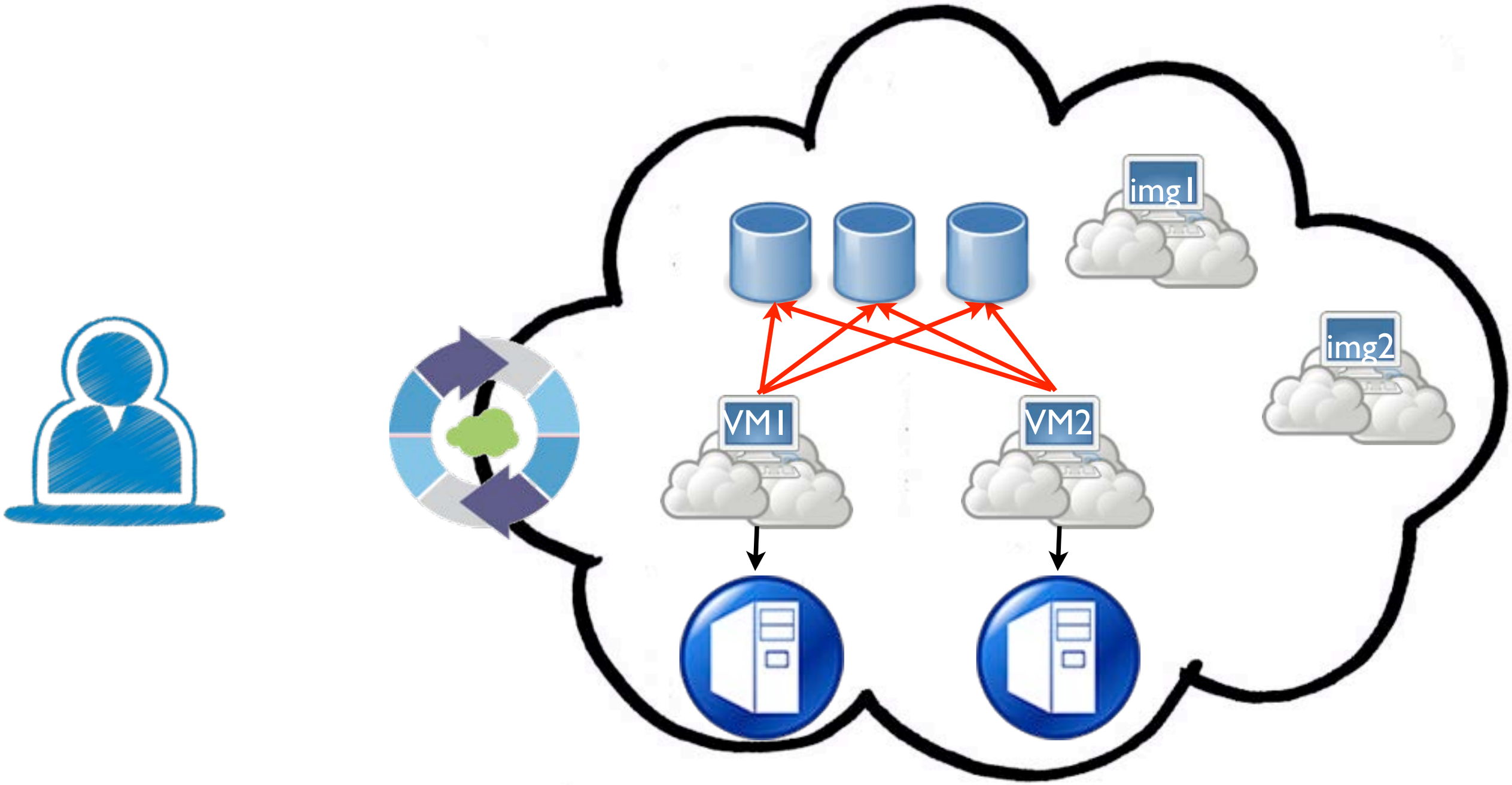
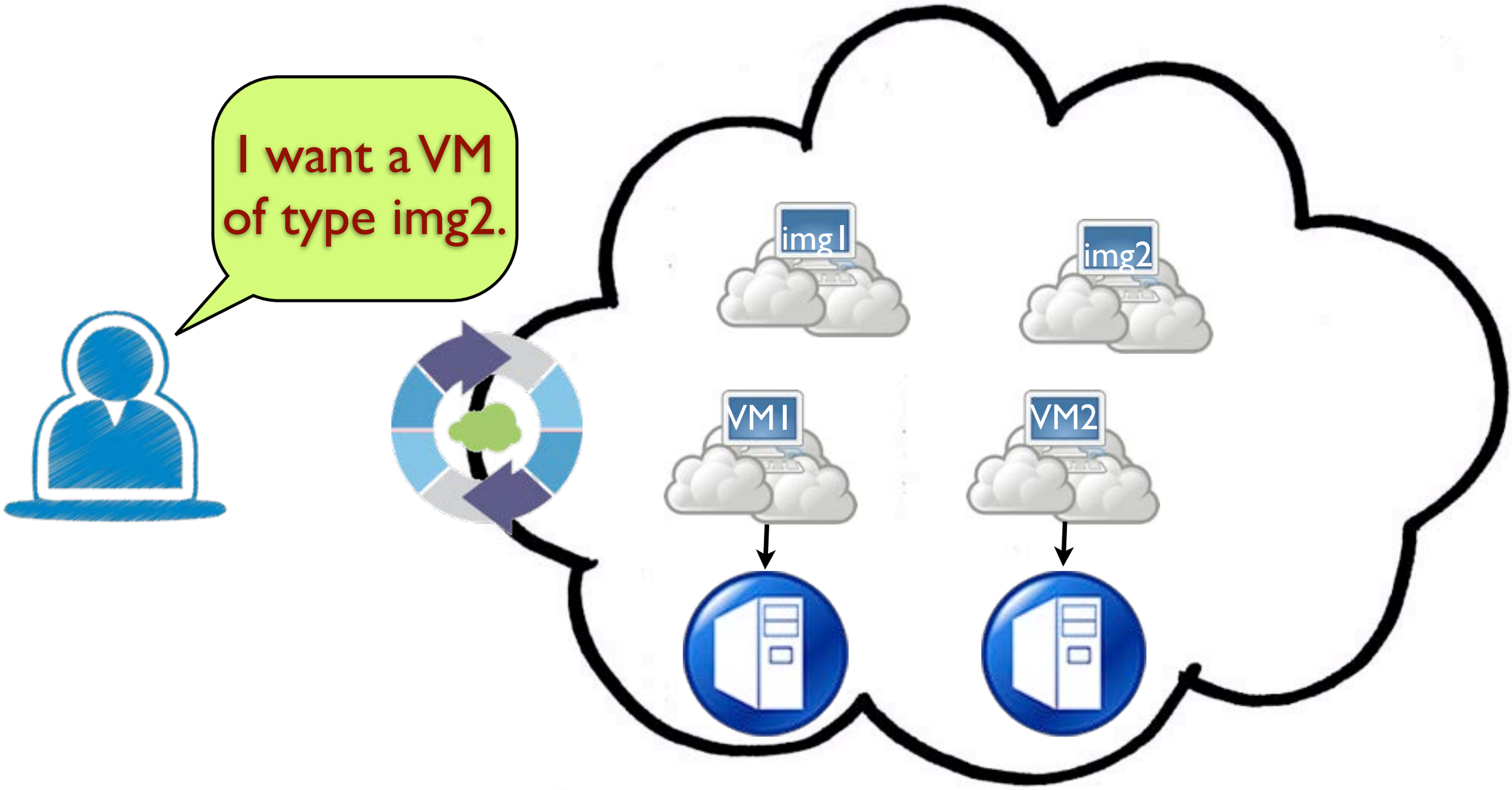


Cloud needs more Mch



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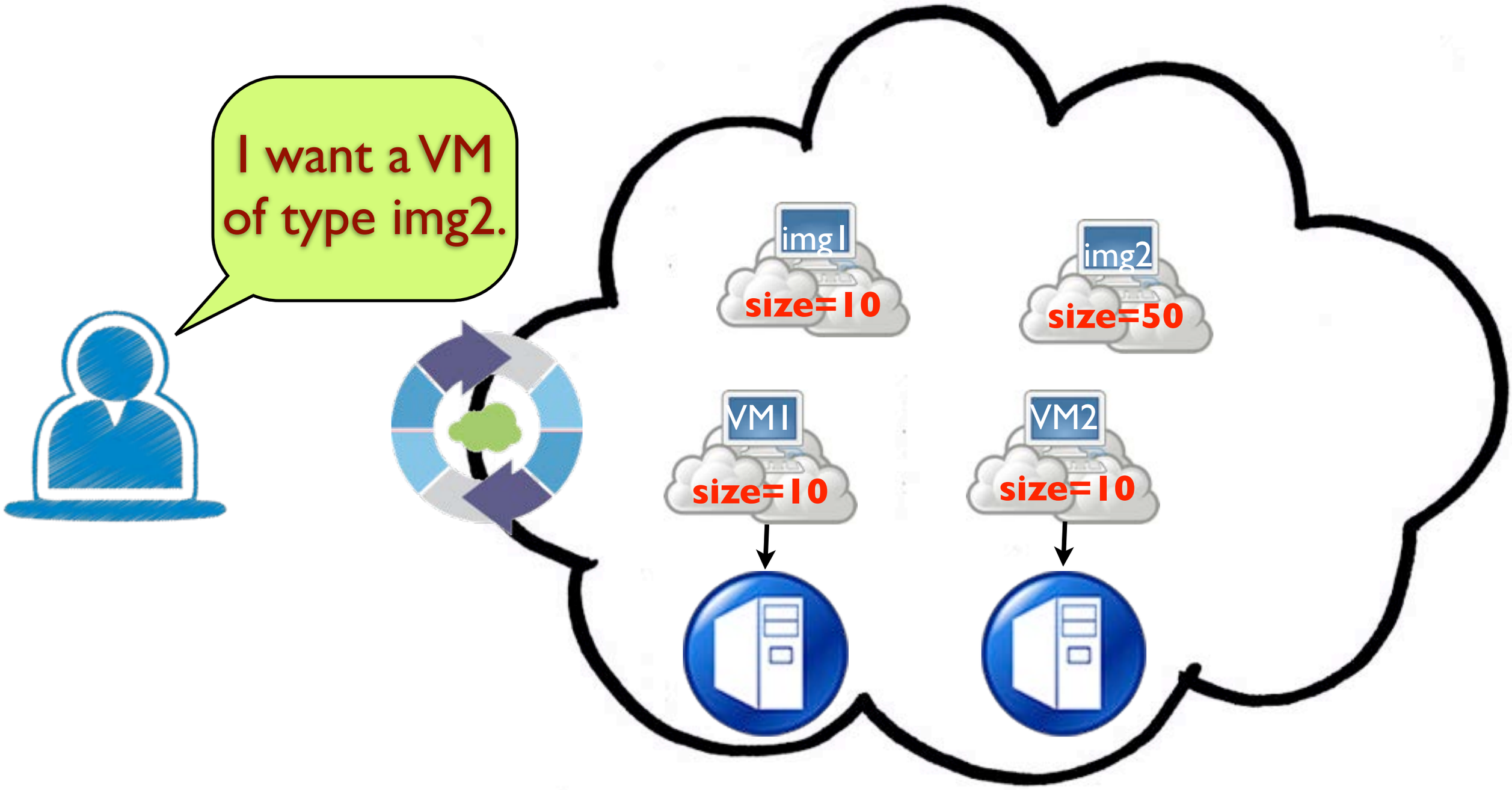
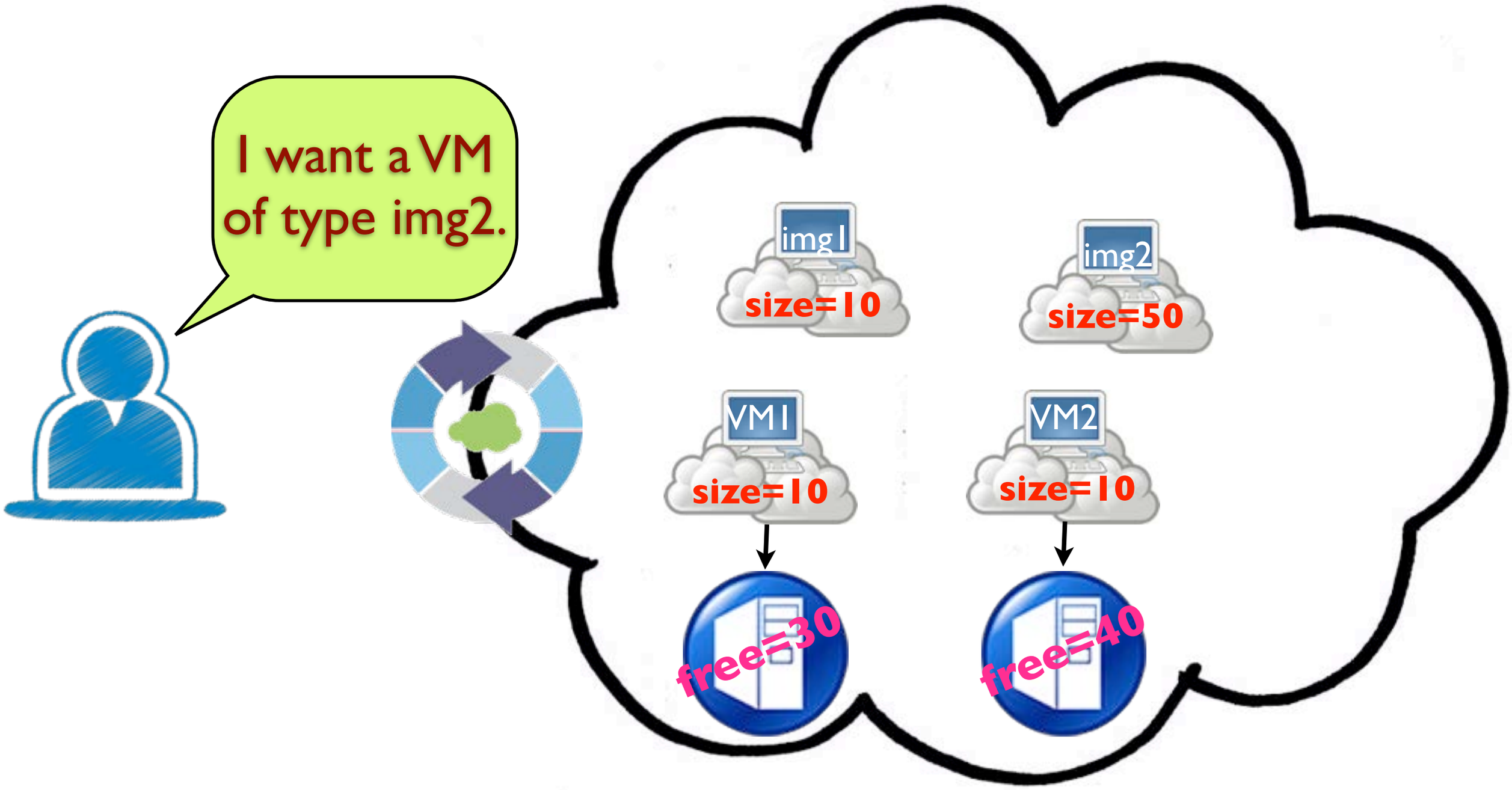
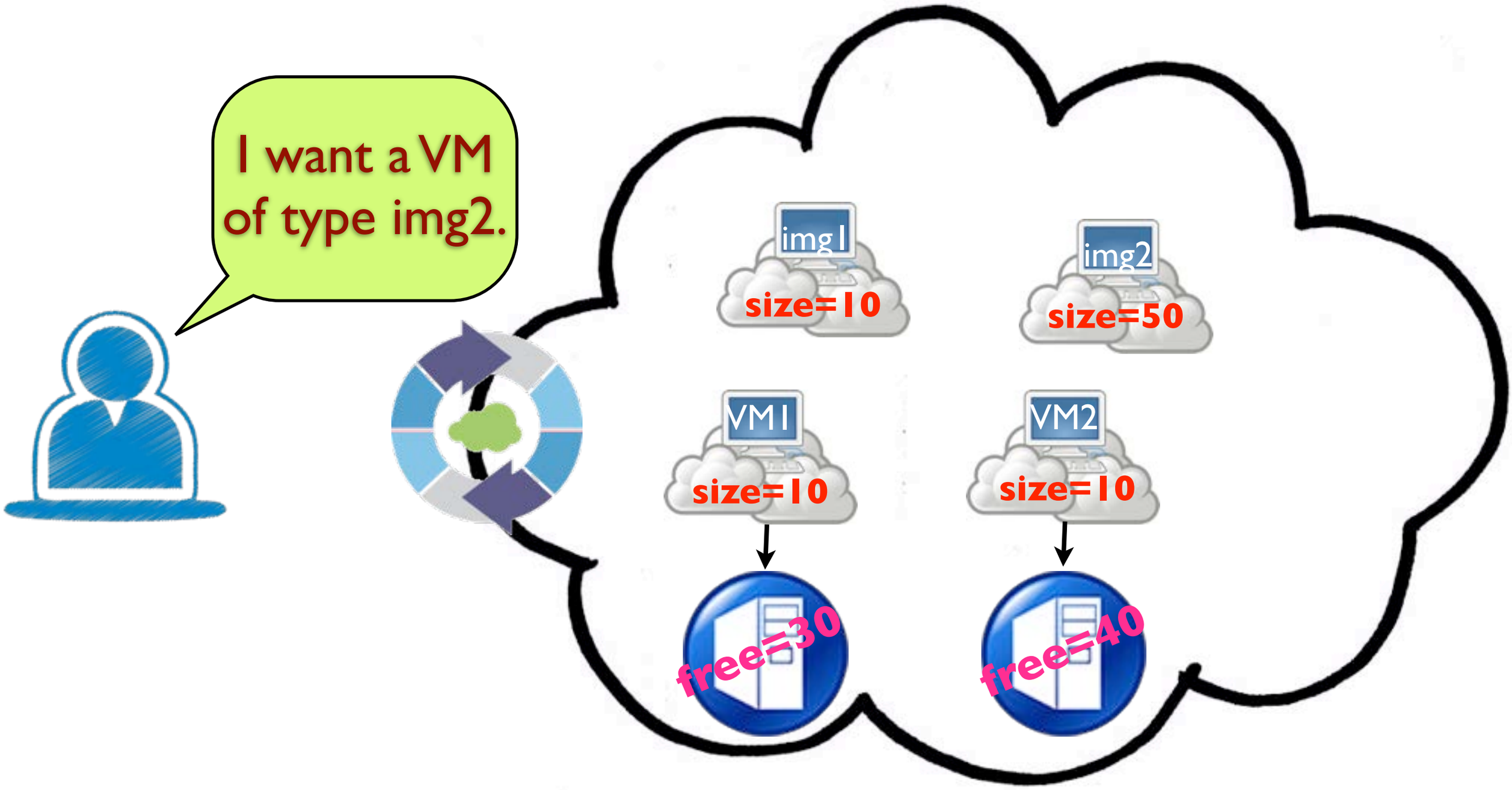


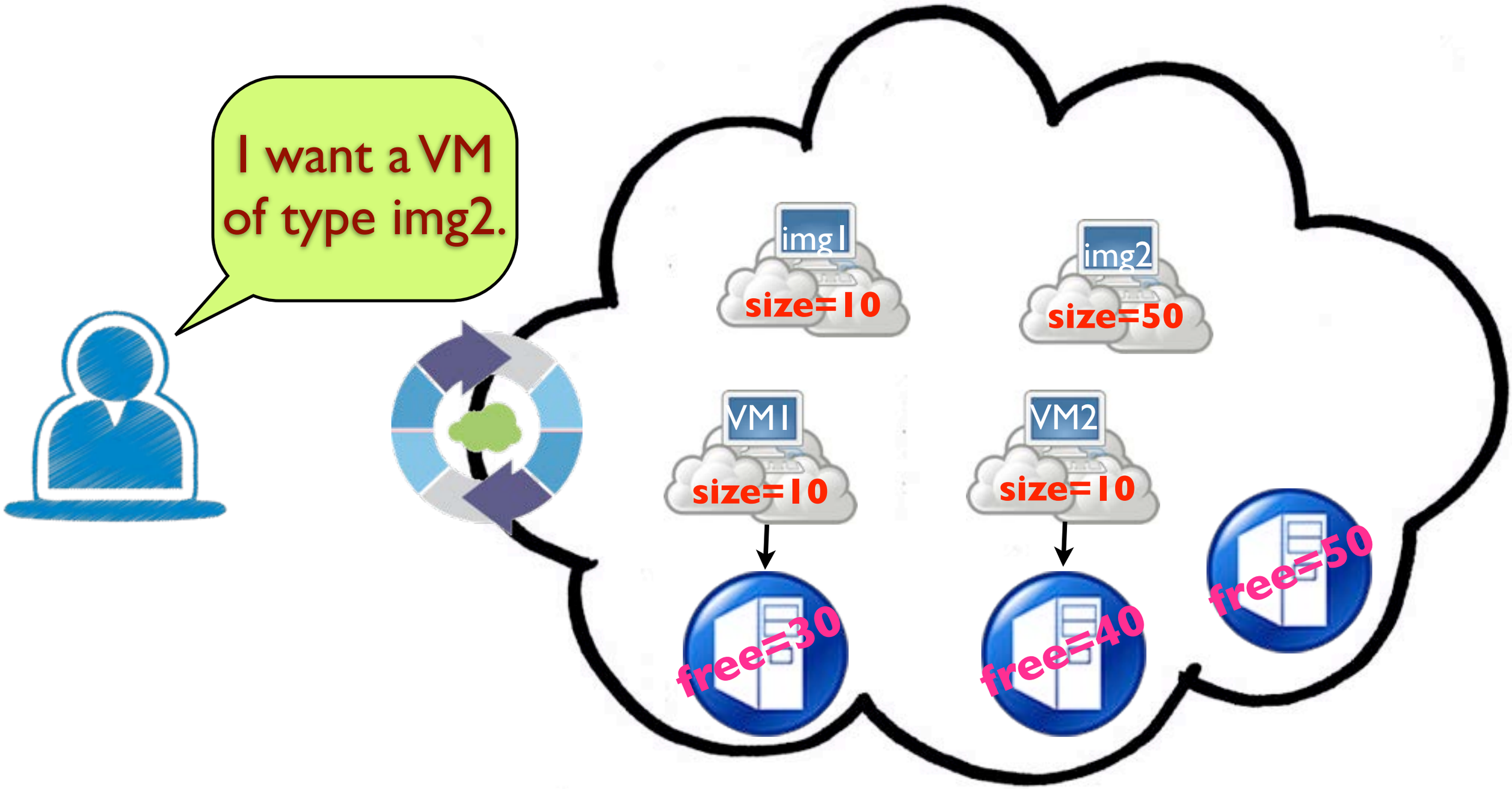
Cloud needs more Mch



Turn on Computer



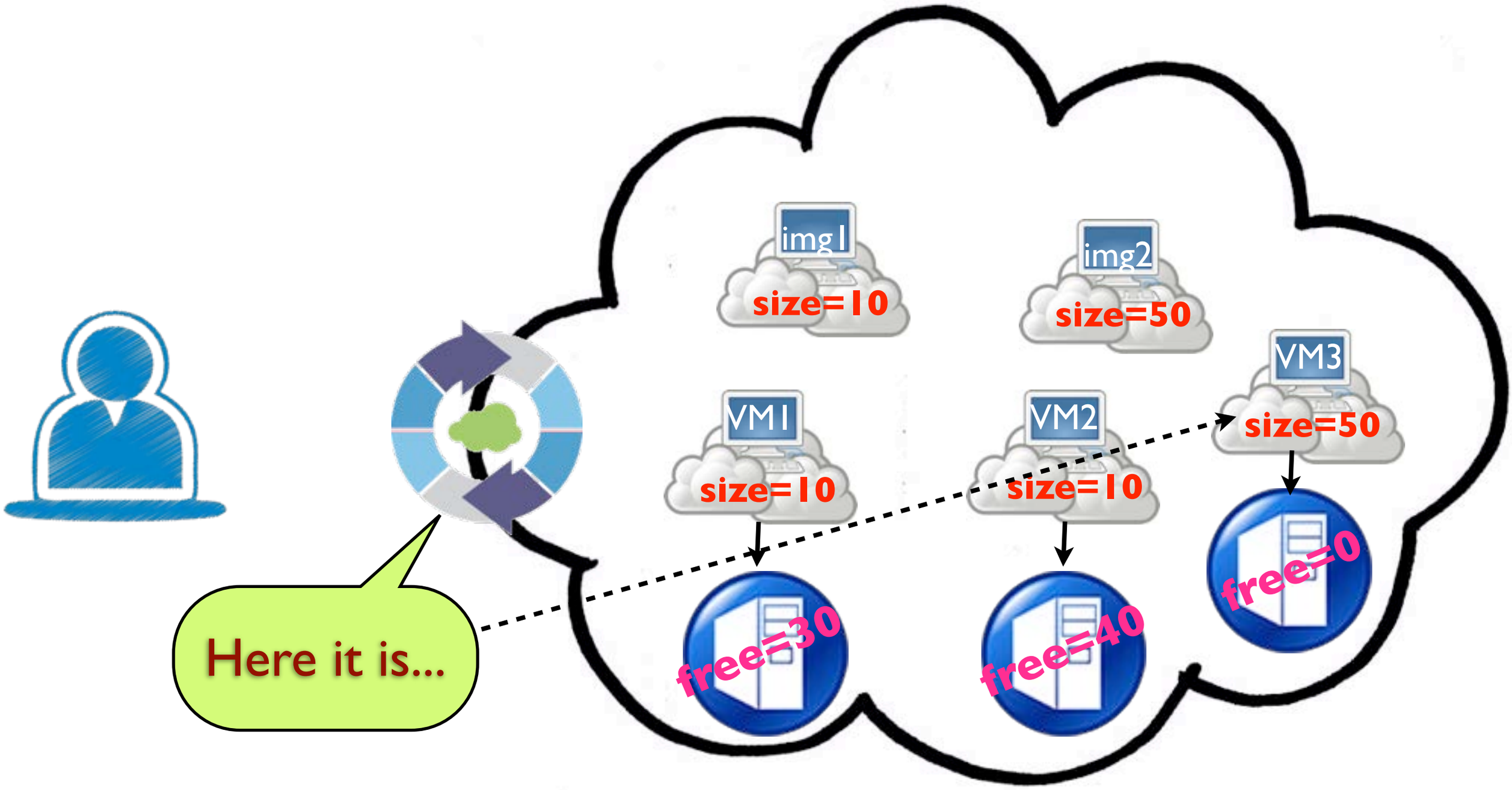
Turn on Computer



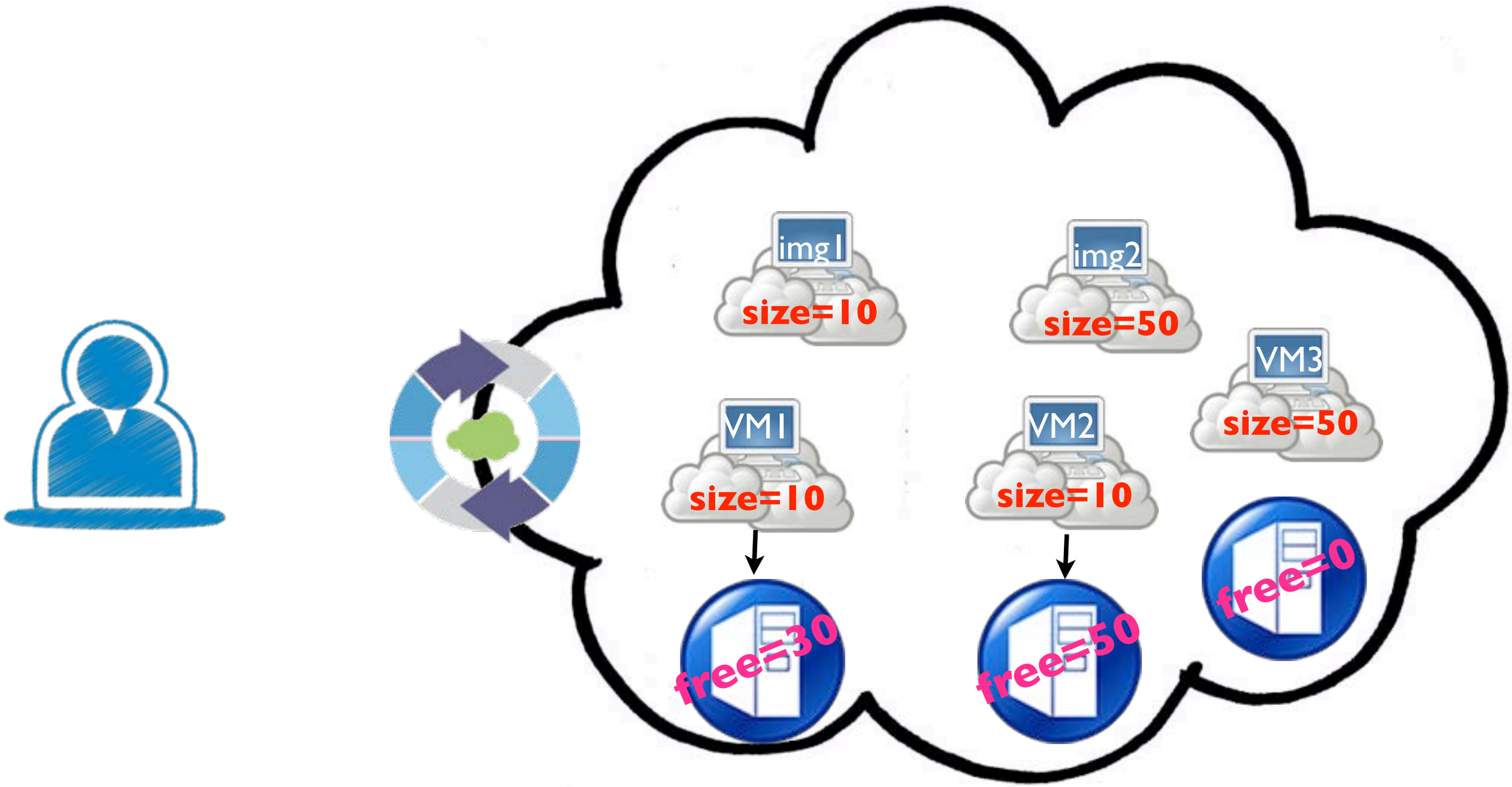
Create VM


img1
size=10
img2
size=50
VM1
size=10
VM2
size=10
free=30
free=40
free=50

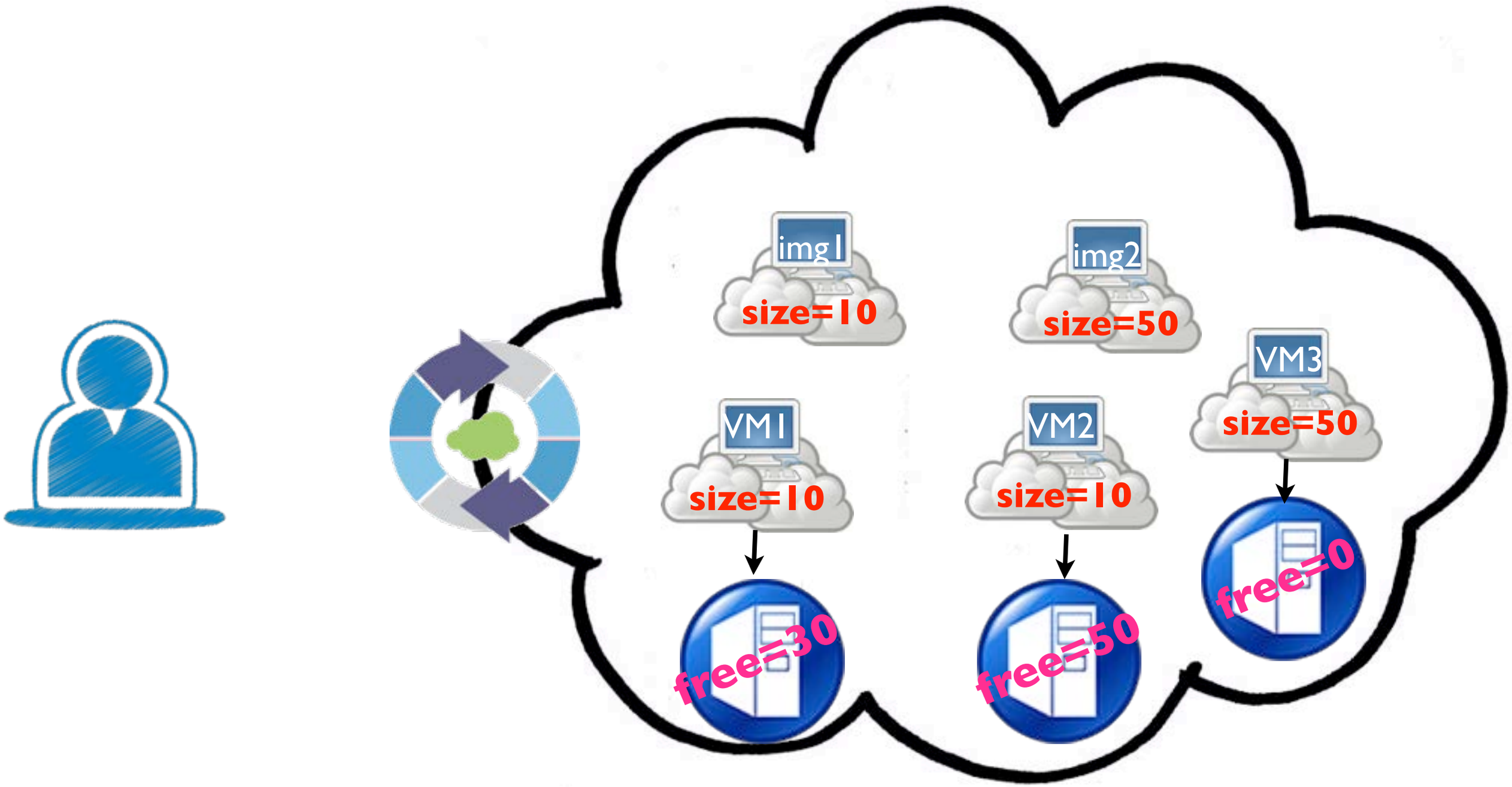
Create VM


img1
size=10
img2
size=50
VM3
size=50
VM1
size=10
VM2
size=10
free=30
free=40
free=0
Here it is...

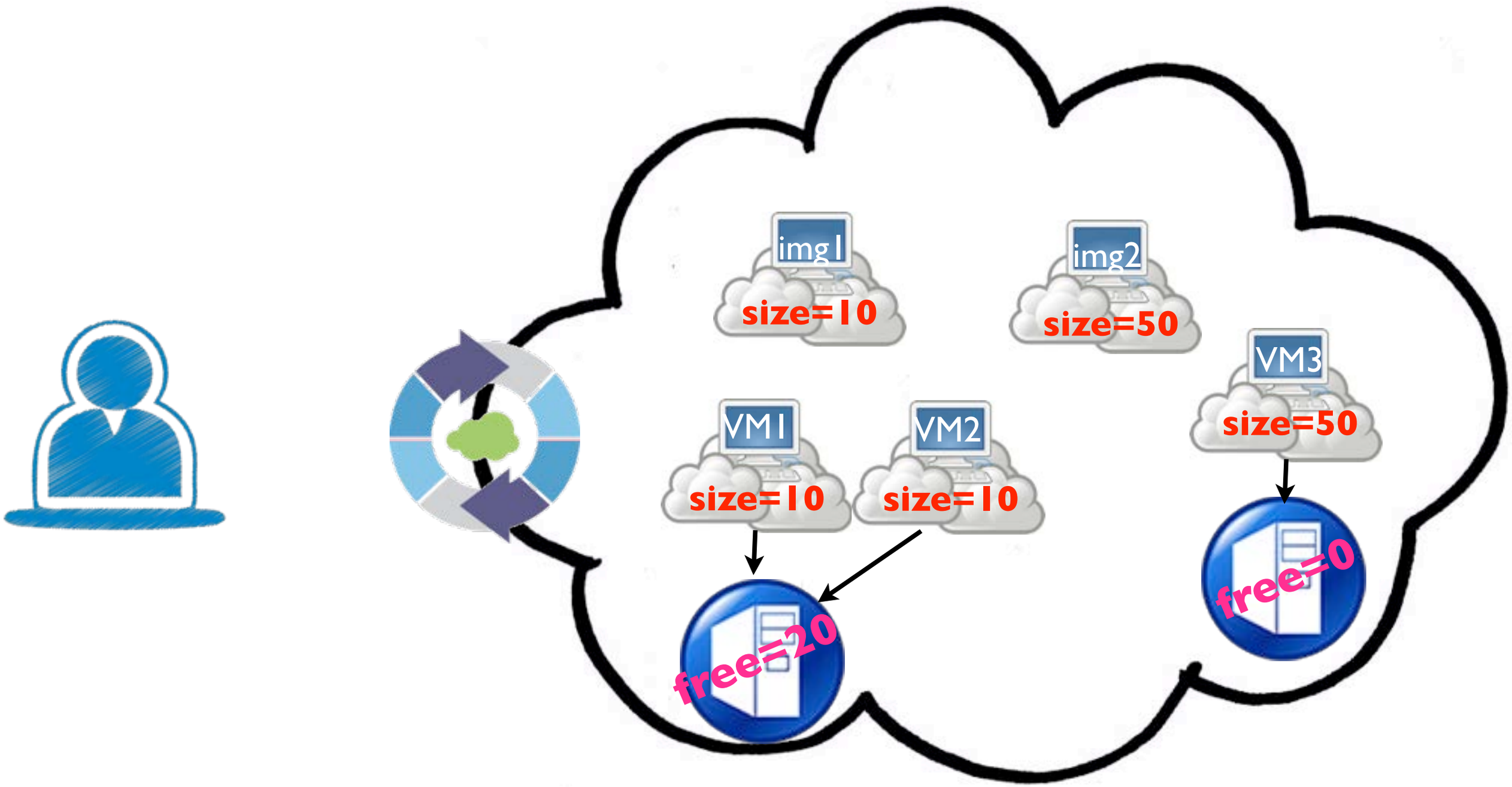
Turn Off Machine



Turn Off Machine



Turn Off Machine



Attributed Structures

Structures

$S : G \to Set$

Attributes

$T : A \to Set$

AttG = (S ↓ T)

$$\begin{array}{c} \widehat{G} \\ \downarrow{\scriptstyle \widehat{g}} \\ \widehat{G'} \end{array} \quad = \quad \begin{array}{c} G \\ \downarrow{\scriptstyle g} \\ G' \end{array} \qquad \begin{array}{ccc} SG & \xrightarrow{\alpha} & TA \\ \downarrow{\scriptstyle Sg} & = & \downarrow{\scriptstyle Ta} \\ SG' & \xrightarrow{\alpha'} & TA' \end{array} \qquad \begin{array}{c} A \\ \downarrow{\scriptstyle a} \\ A' \end{array}$$

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Graph

Alg
λ-terms

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Morphisms preserve attributes

Partially Attributed Structures

Structures

$S : G \rightarrow Part$

Attributes

$T : A \rightarrow Part$

PAttG = (S ⇣ T)

$$\begin{array}{c} \widehat{G} \\ \downarrow{\scriptstyle \hat{g}} \\ \widehat{G'} \end{array} = \begin{array}{c} G \\ \downarrow{\scriptstyle g} \\ G' \end{array} \qquad \begin{array}{ccc} S_pG & \xrightarrow{\alpha} & T_pA \\ {\scriptstyle S_pg}\downarrow & \geq & \downarrow{\scriptstyle T_pa} \\ S_pG' & \xrightarrow{\alpha'} & T_pA' \end{array} \qquad \begin{array}{c} A \\ \downarrow{\scriptstyle a} \\ A' \end{array}$$

Partially Attributed Structures

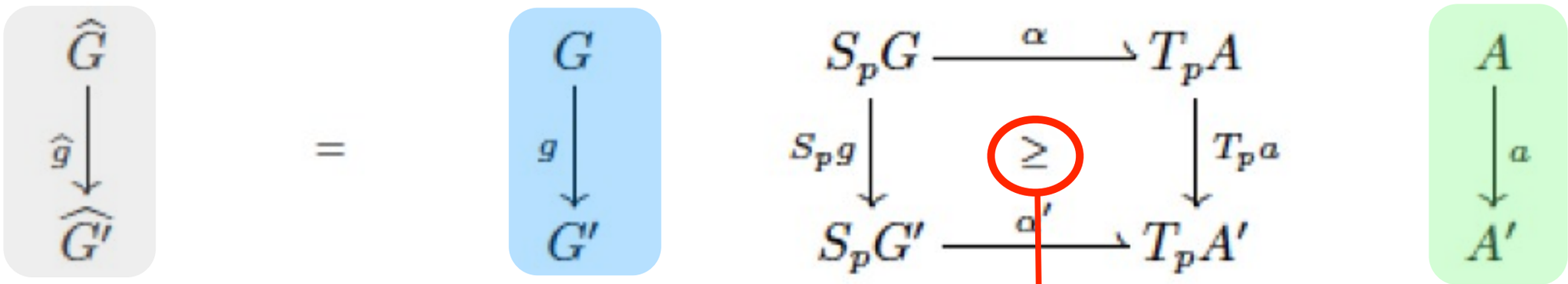
Structures

$S : G \rightarrow Part$

Attributes

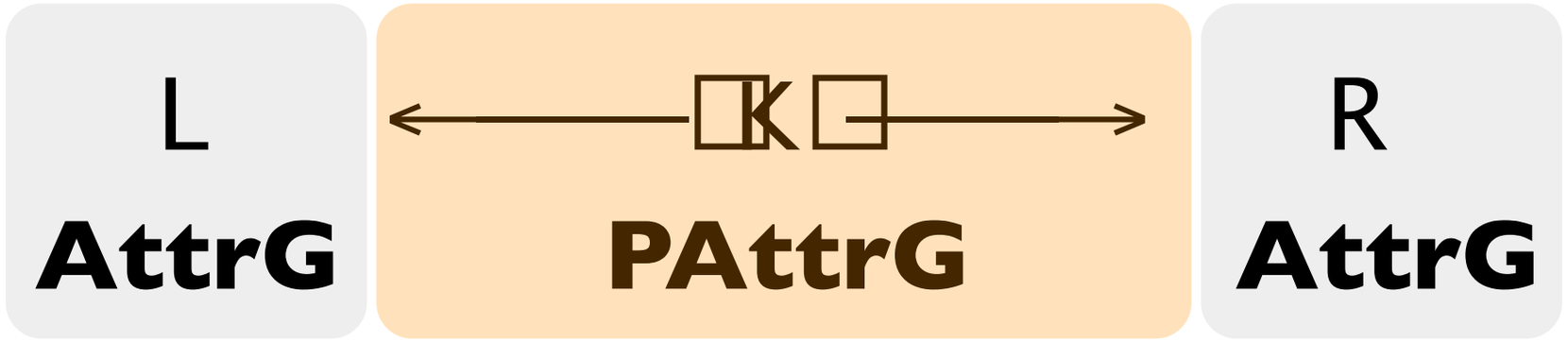
$T : A \rightarrow Part$

PAttG = (S ⇣ T)

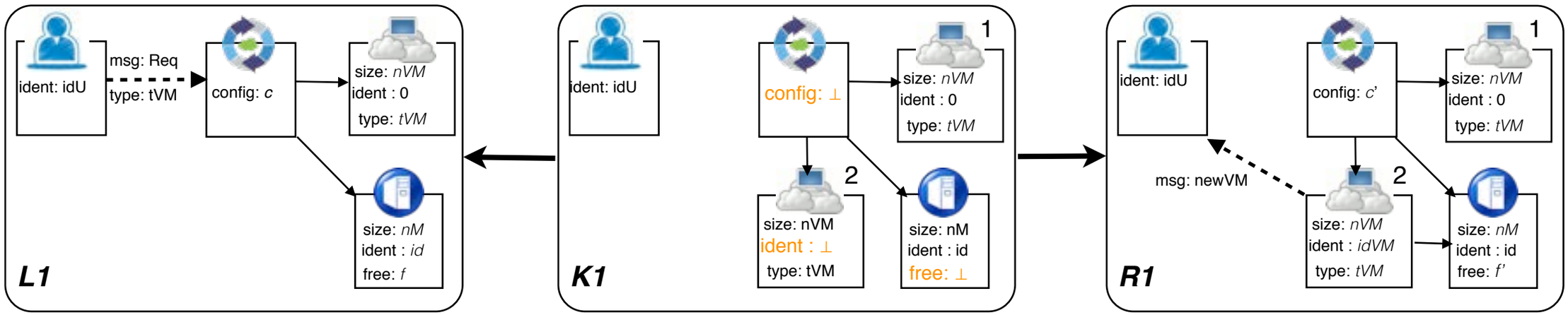


Morphisms preserve defined attributes

Graph Transformation Rule

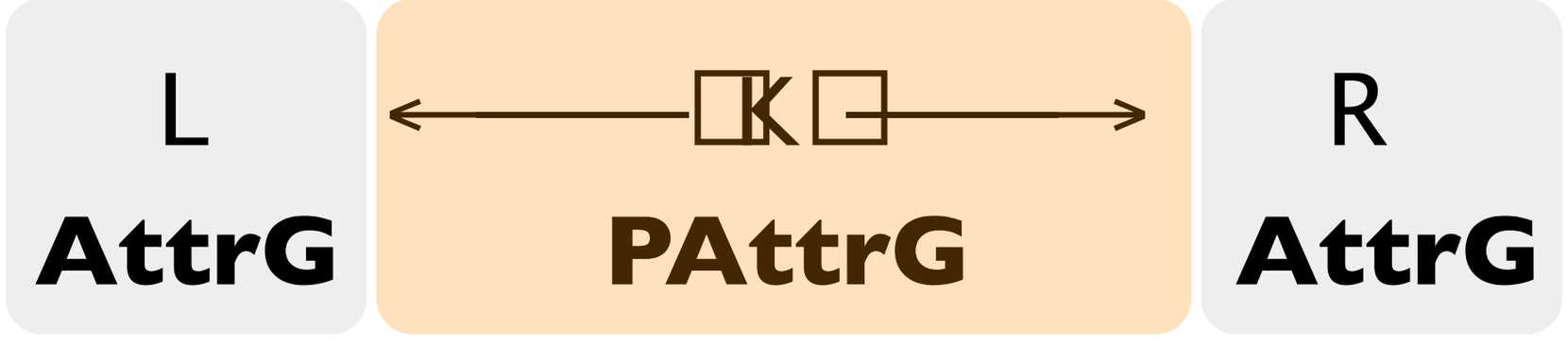


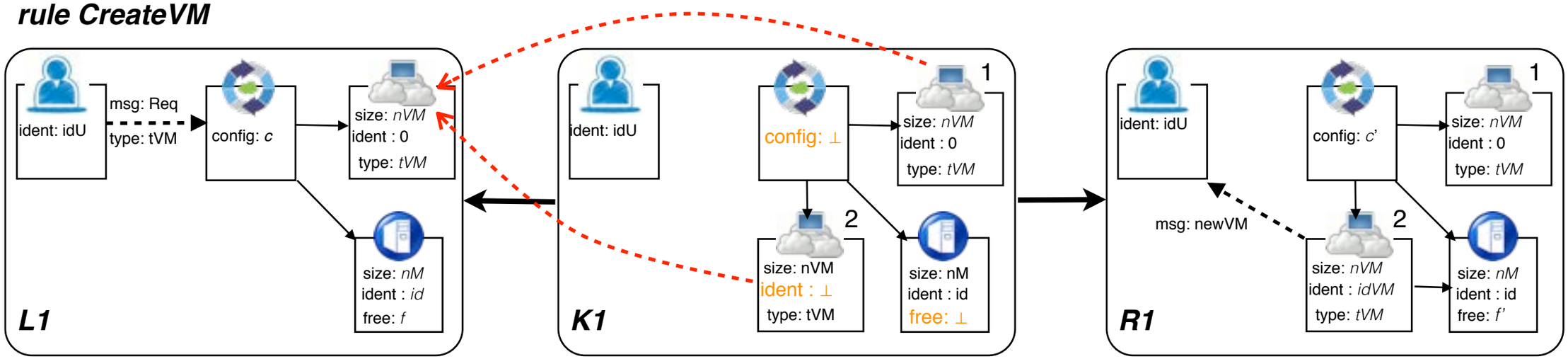
rule CreateVM



eqns: *idVM = newId(c) ;*
≤ (nVM,f) = true ;
f' = f - nVM ;
c'= newVM(c,idU,idVM,nVM,tVM)

Graph Transformation Rule





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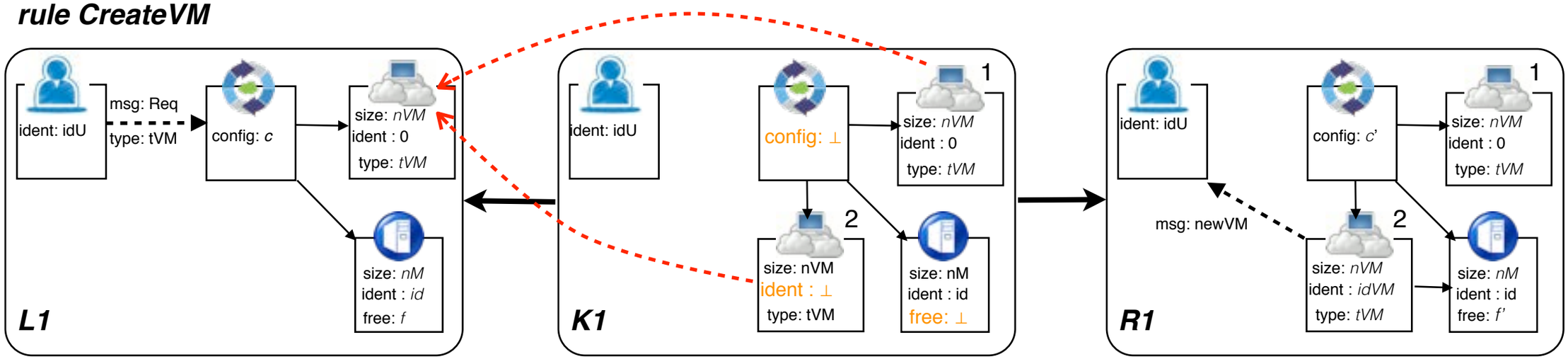
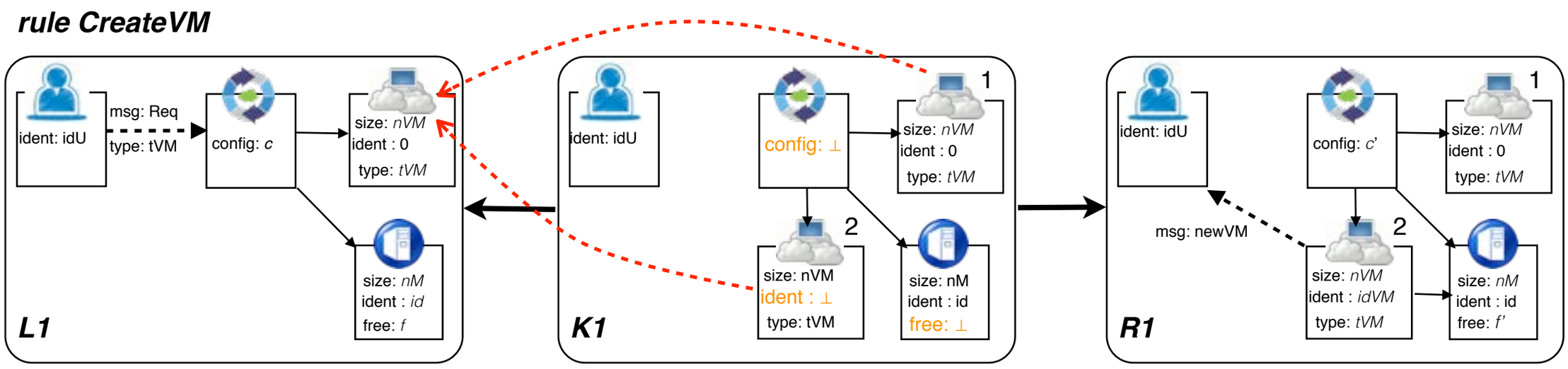
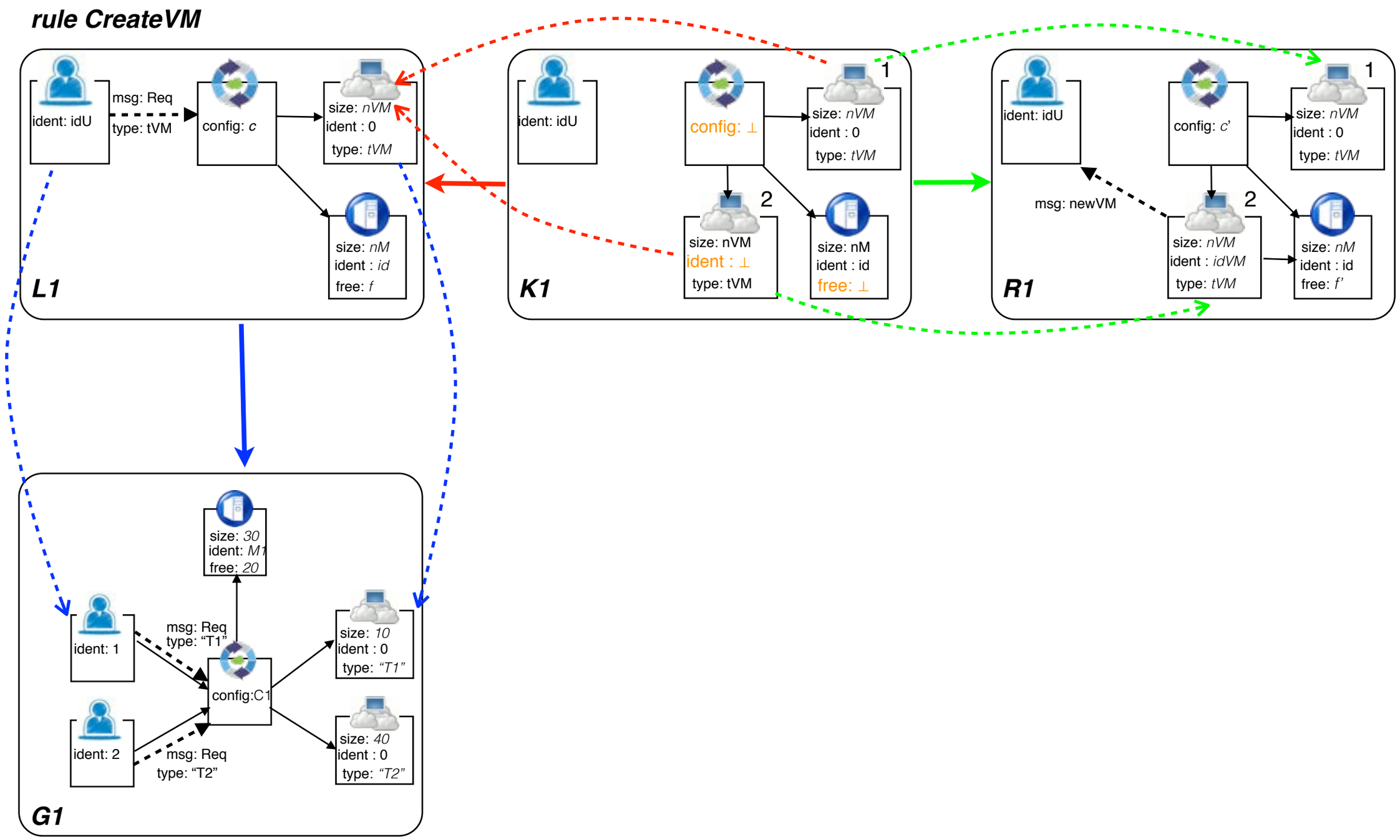
Rule Application



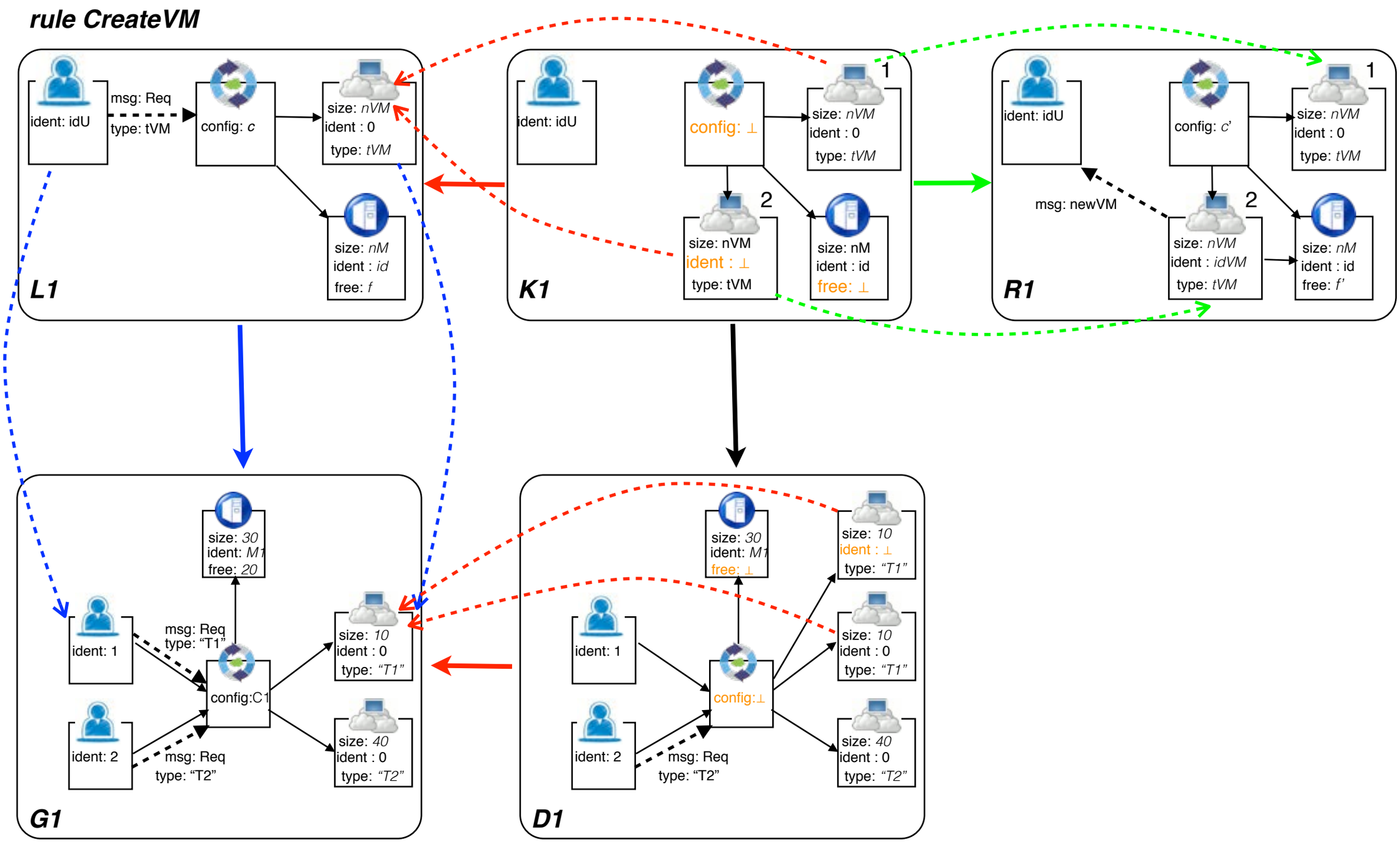
Rule Application



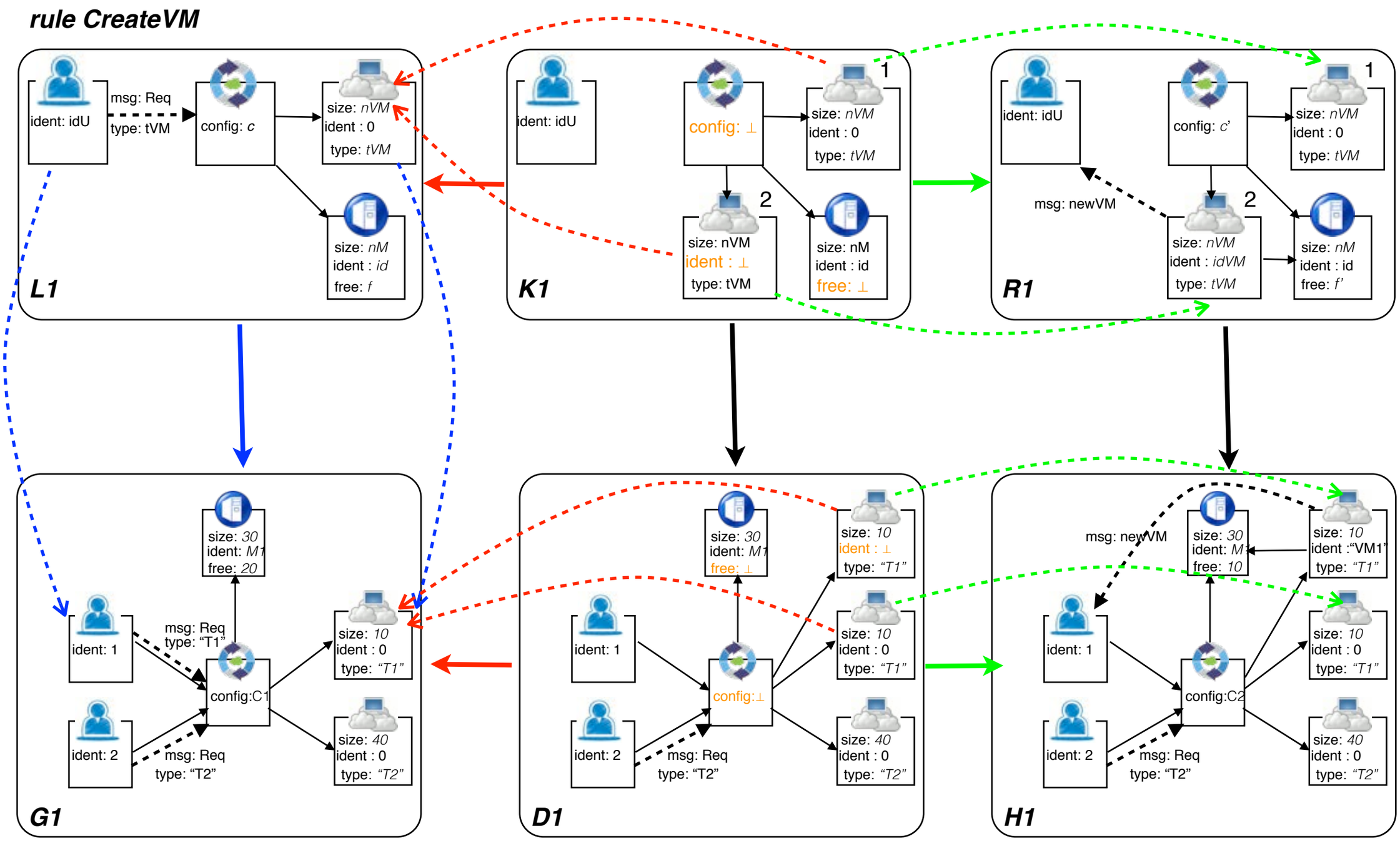
Rule Application



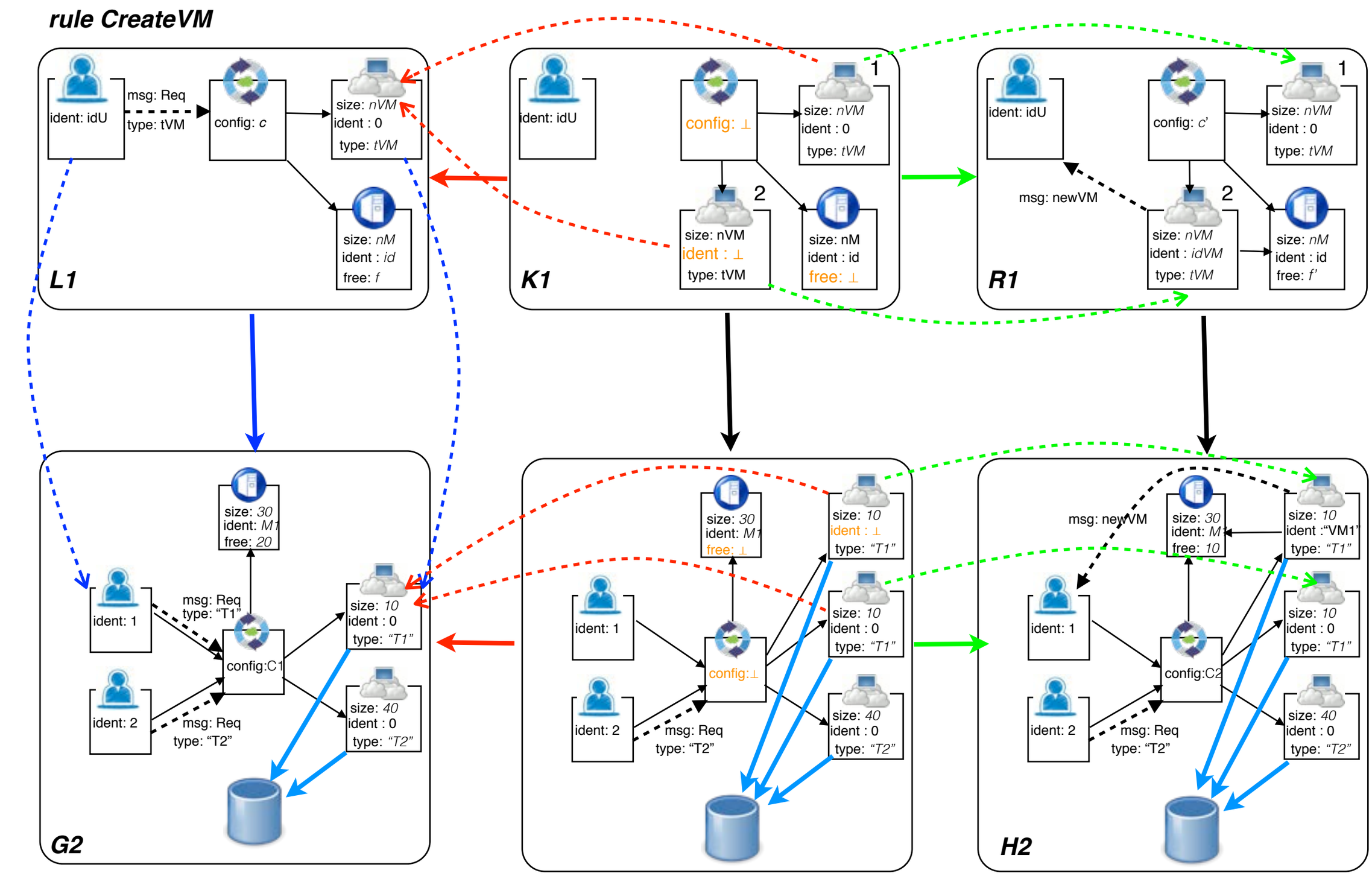
Rule Application



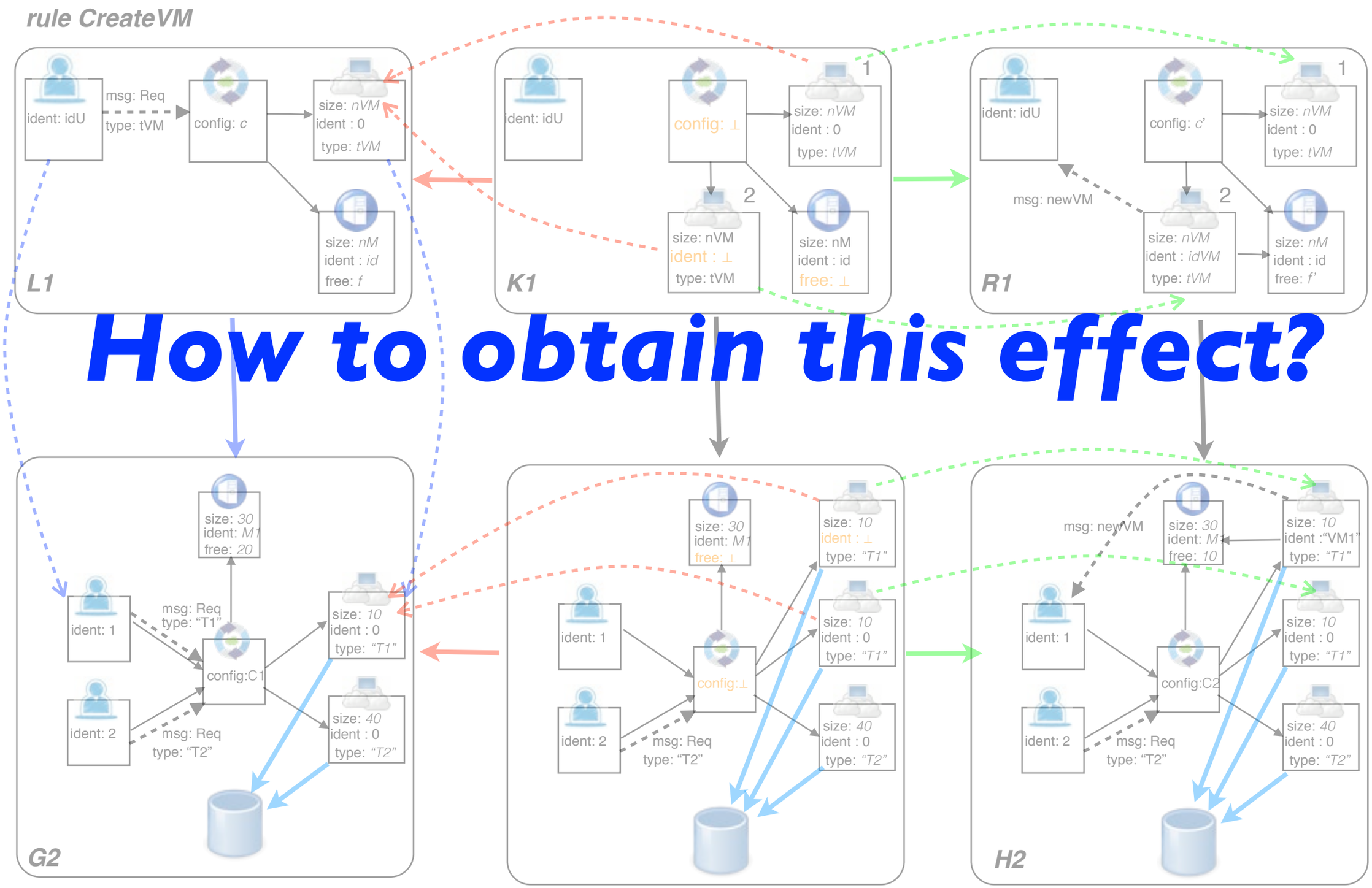
Rule Application



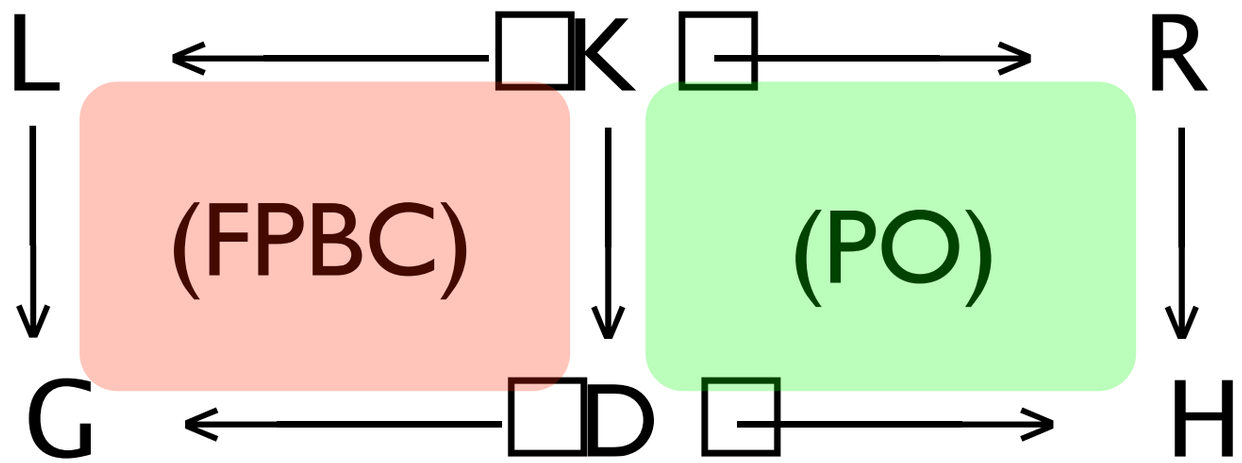
Rule Application



Rule Application



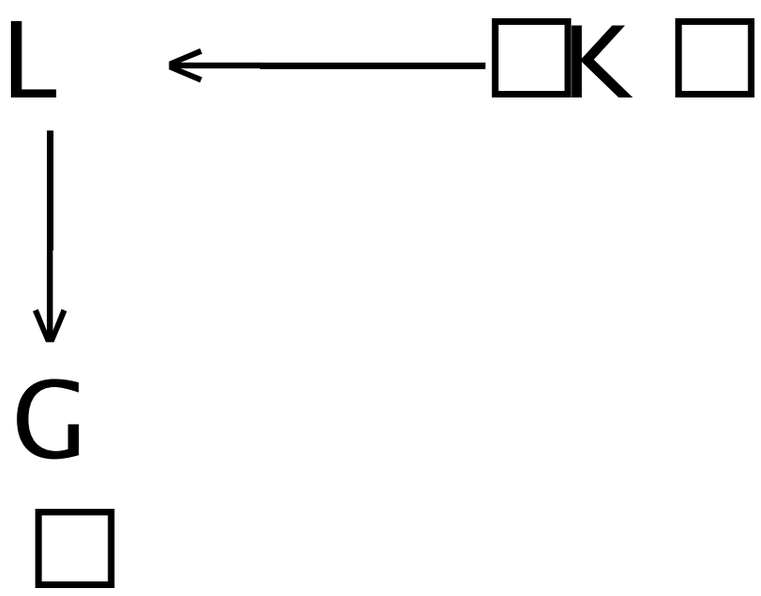
Sesqui-Pushout Approach



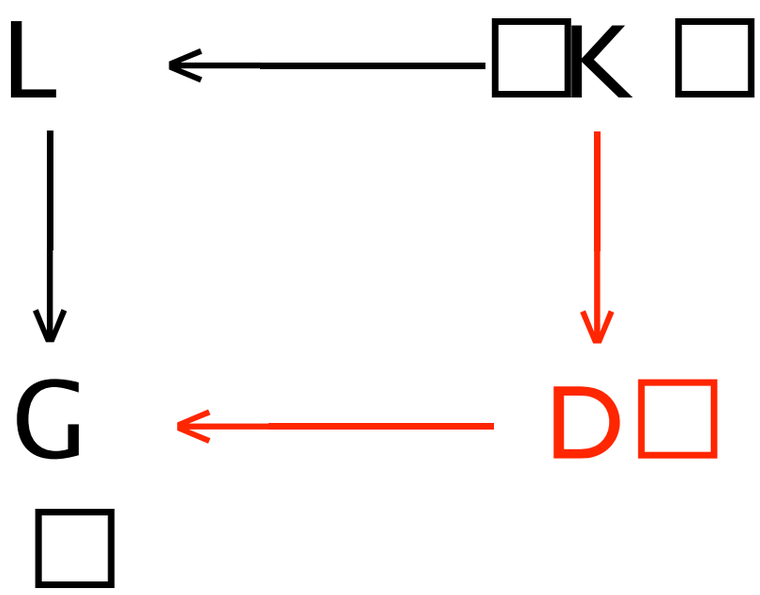
Final Pullback Complement (FPBC): Deletion and Copy

Pushout (PO): Creation and Merge

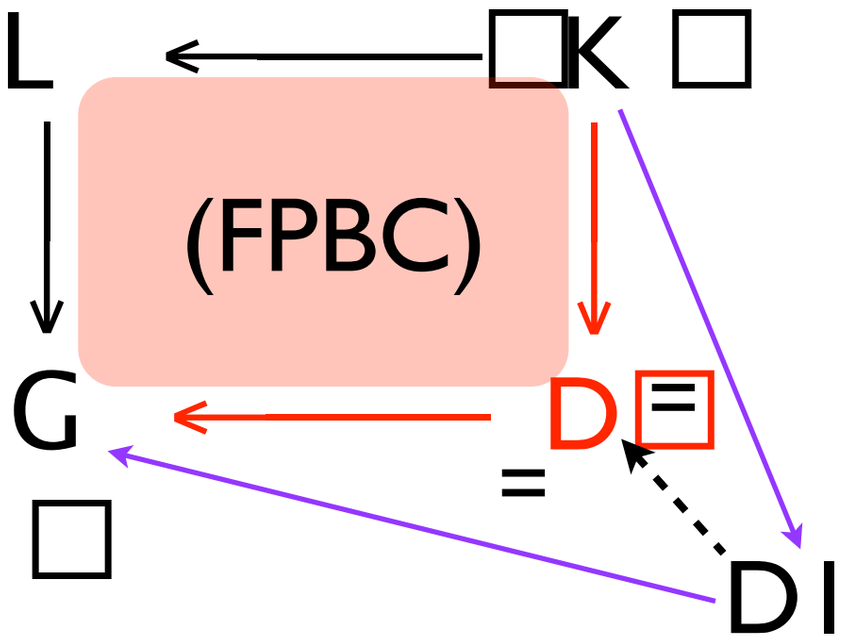
Final Pullback Complement



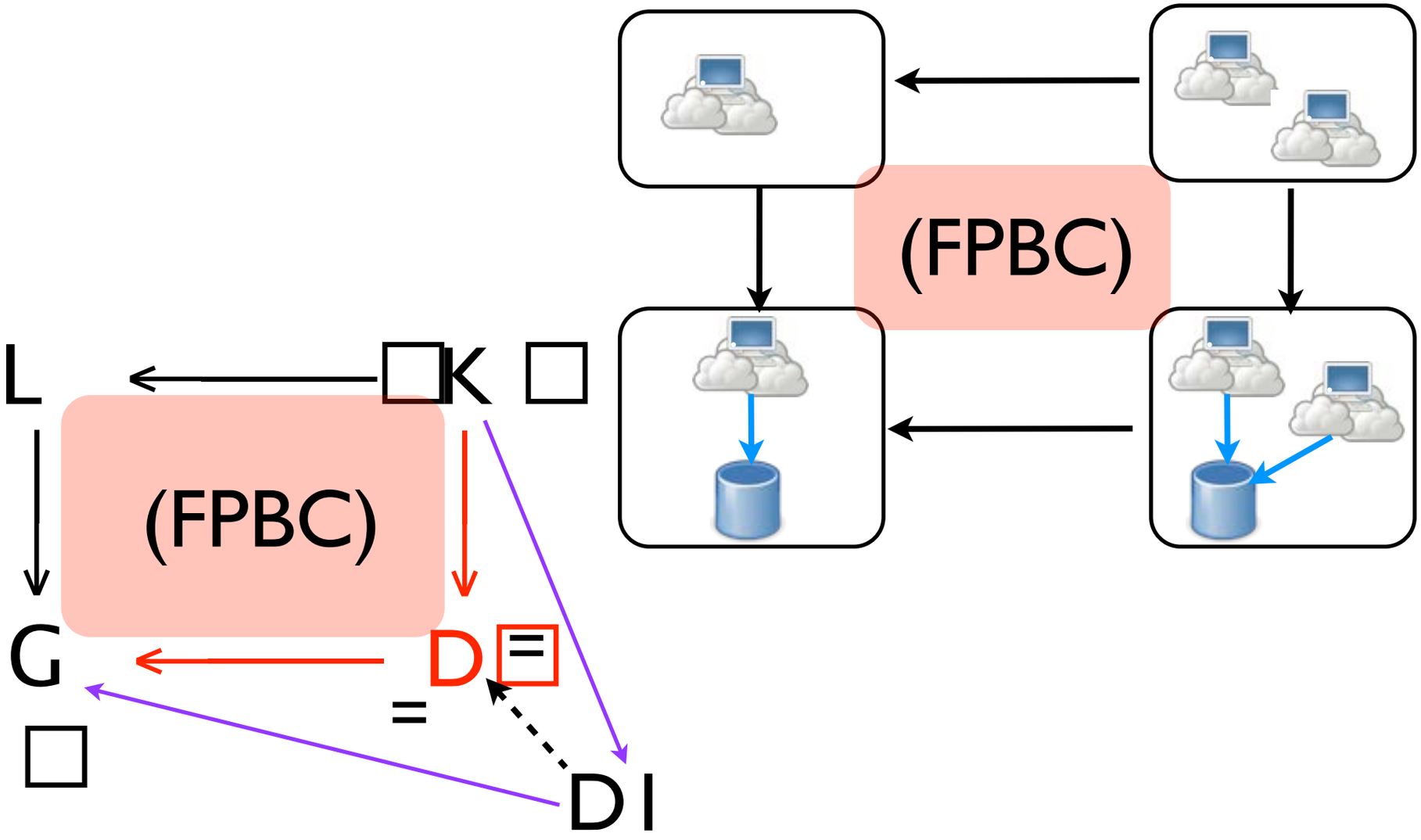
Final Pullback Complement



Final Pullback Complement



Final Pullback Complement



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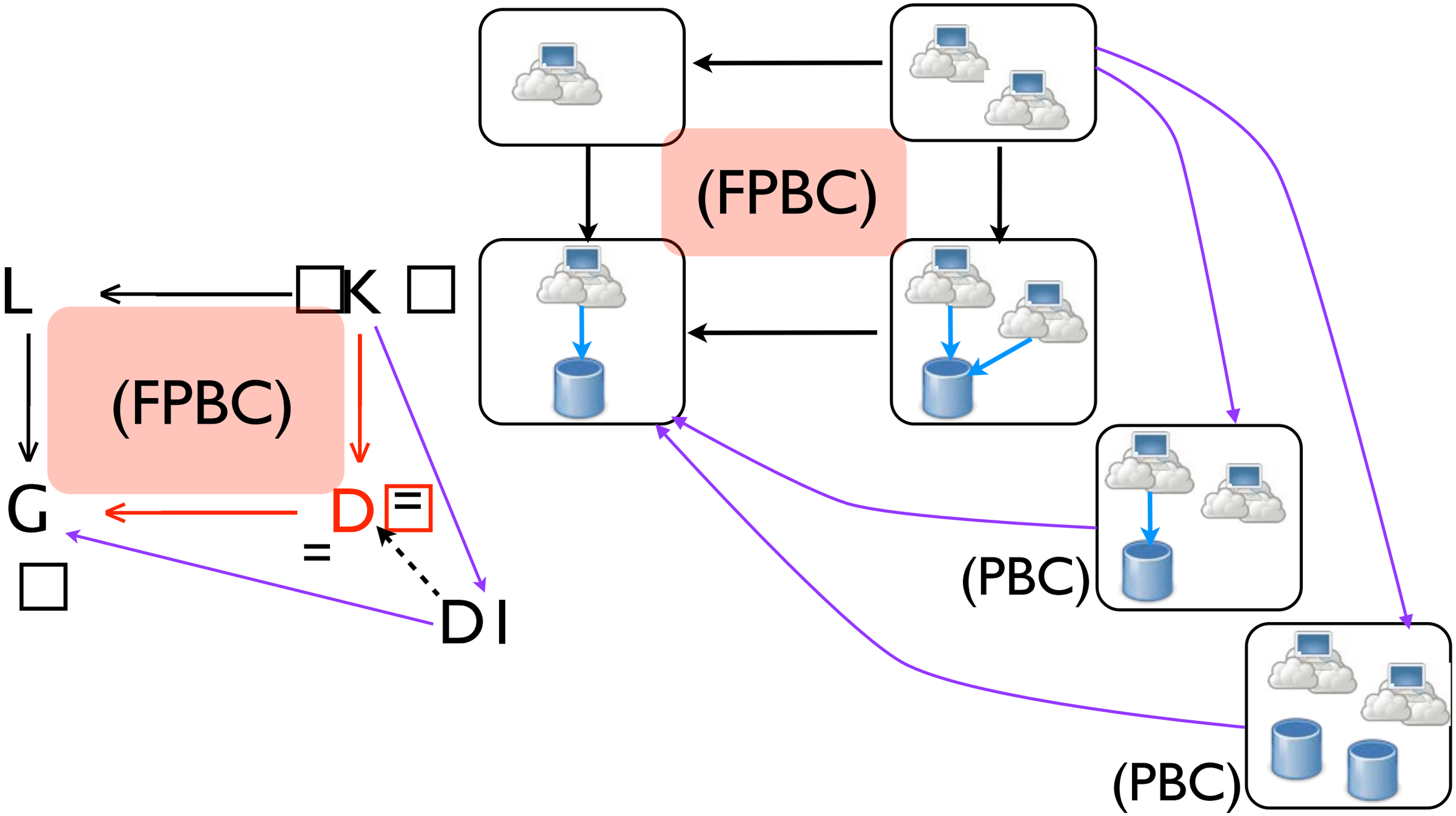
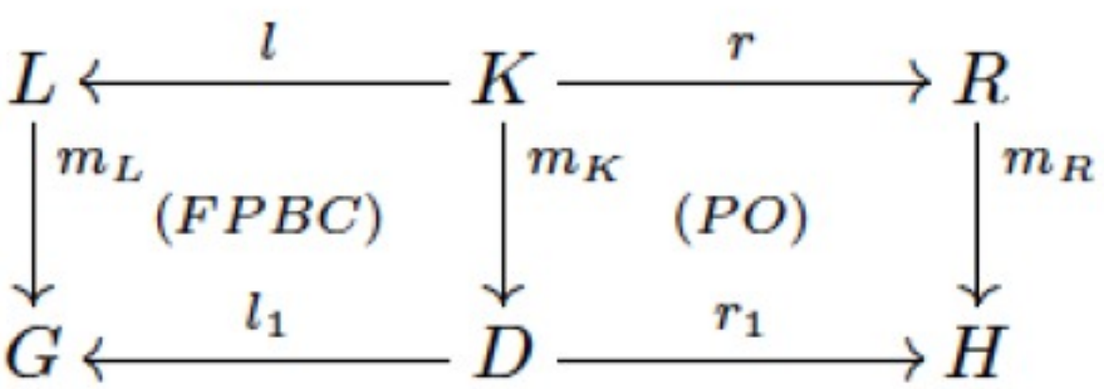


SqPO-Rewriting of Attributed Structures

Structures:

Δ :



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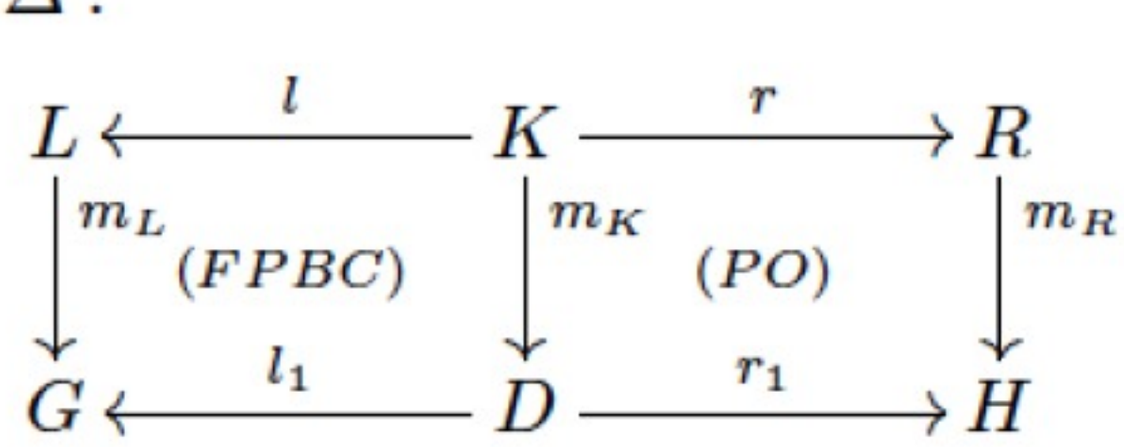
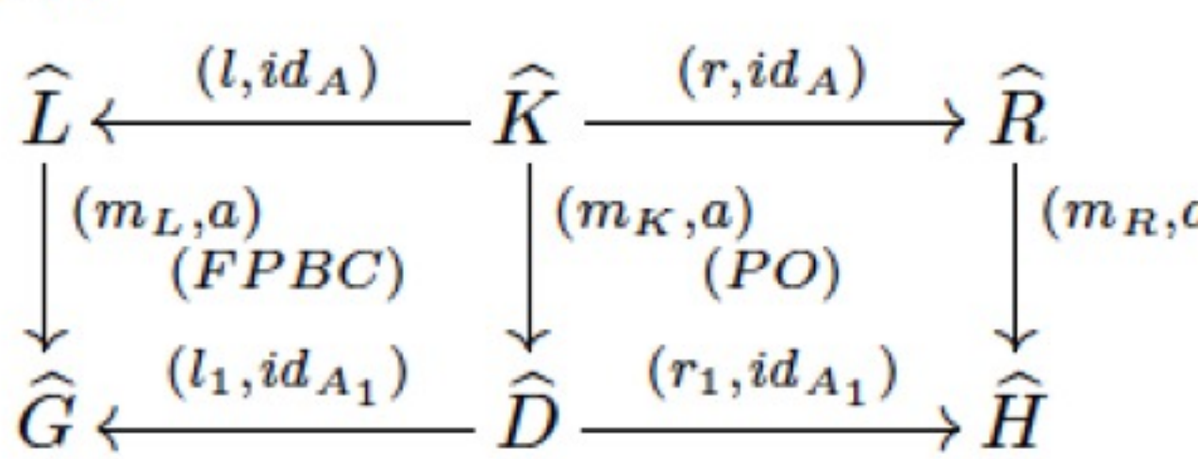


Attributed Structures:

$\widehat{\Delta}$:



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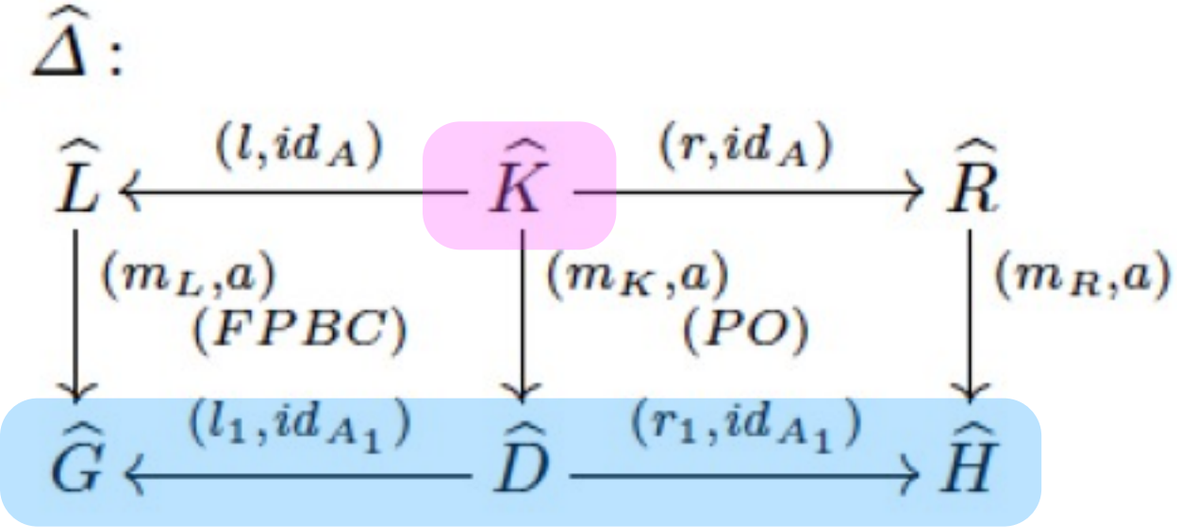


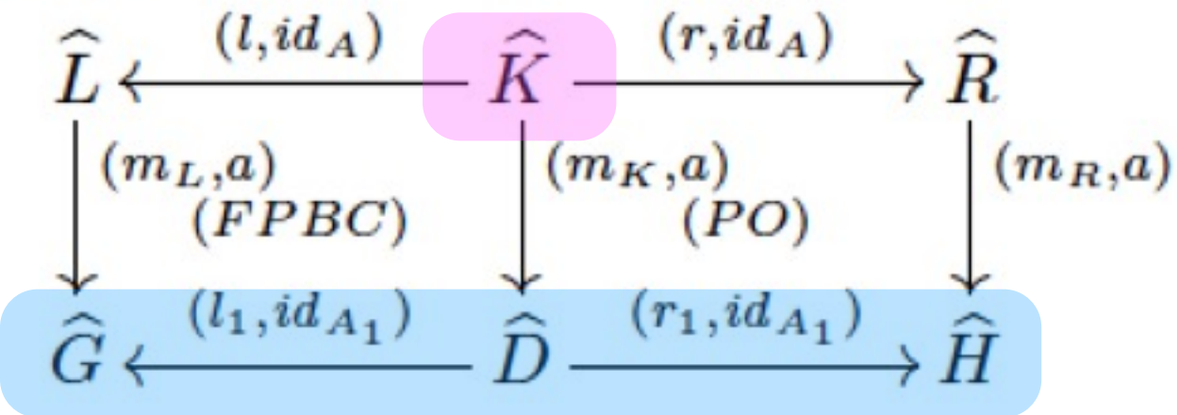
SqPO-Rewriting of Attributed Structures

x is context: *keep attribute*

$$l_1(x) : t_1 \longleftarrow\!\shortmid\, x : t_1 \shortmid\!\longrightarrow r_1(x) : t_1$$

Attributed Structures:

Δ :



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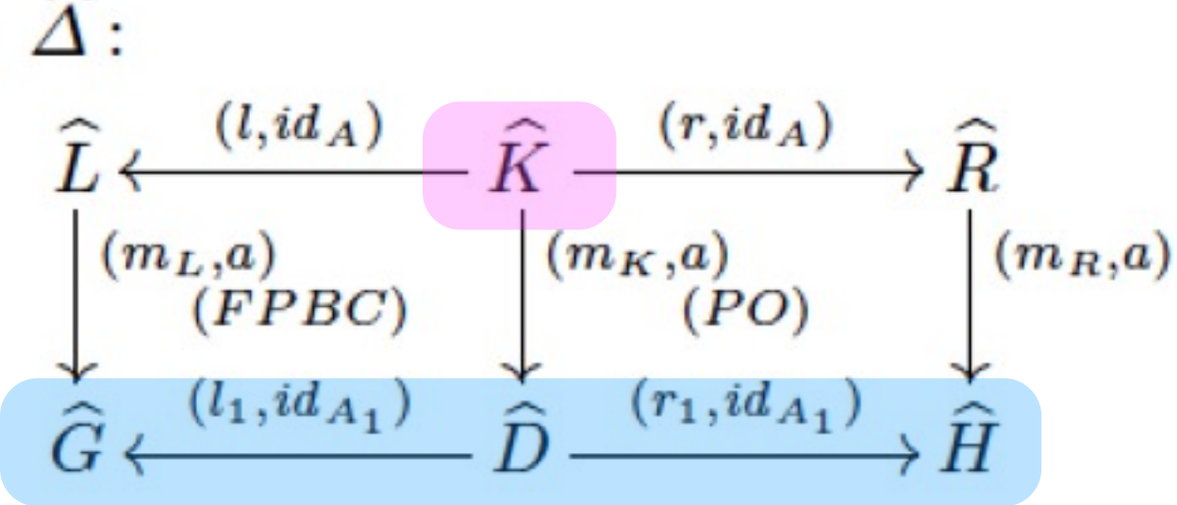
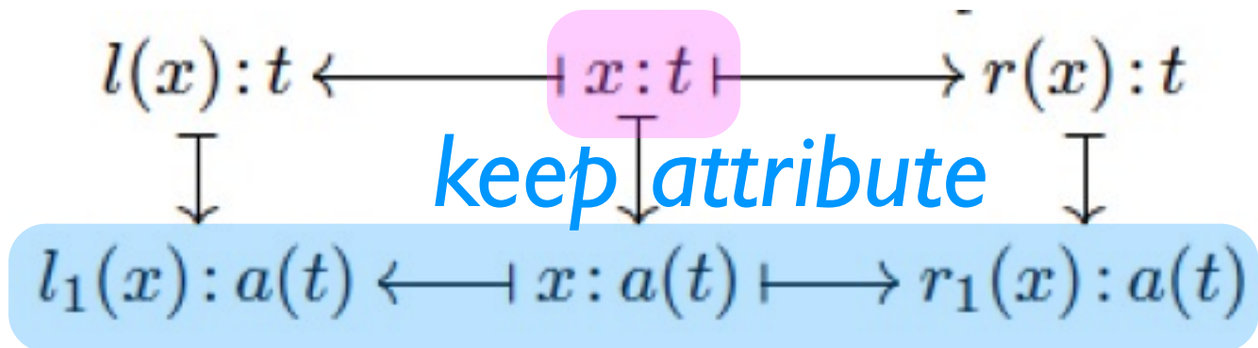
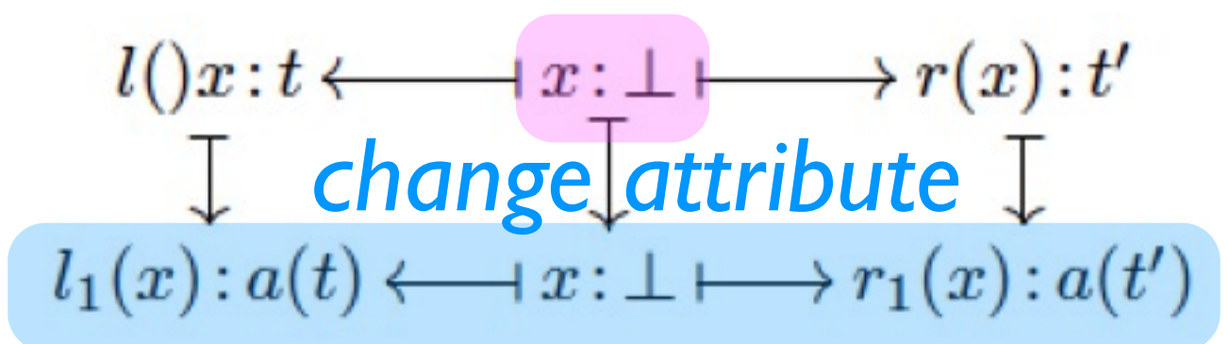


x is preserved by the rule:





SqPO-Rewriting of Attributed Structures

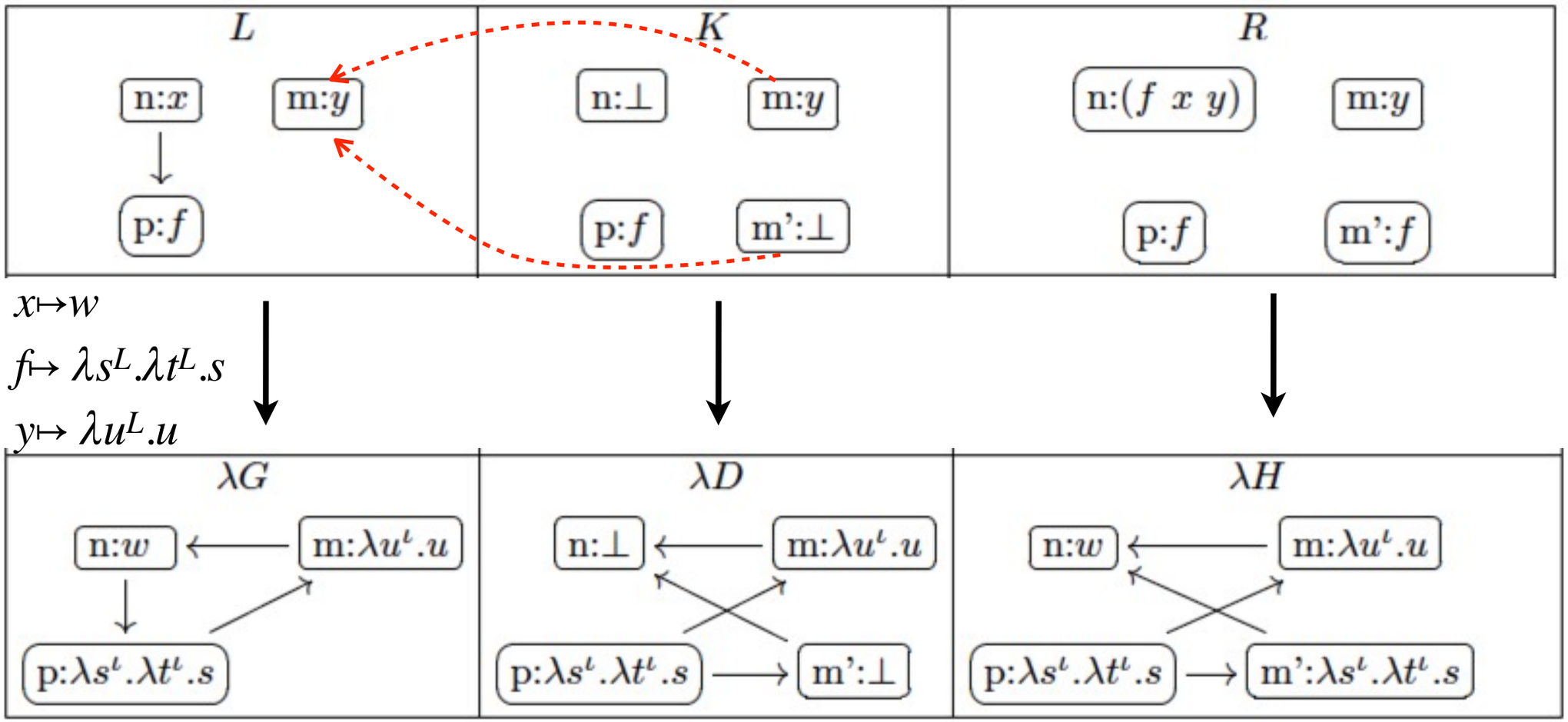
- A nice framework to define systems in the presence of cloning (and merging) operations

- Simple attribute handling:

  ➡ allowing to use different kinds of values;

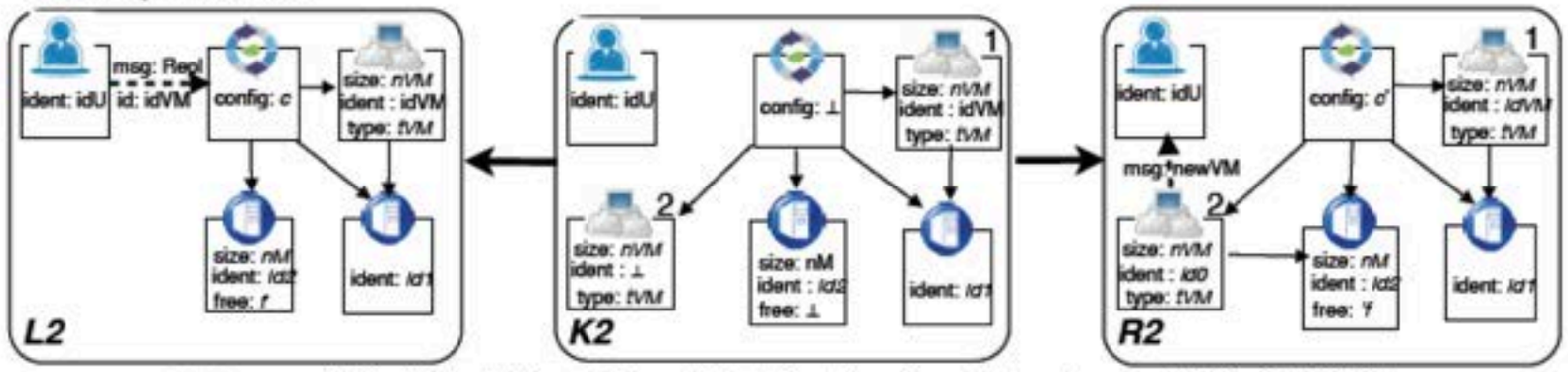
  ➡ enabling a modular approach to prove properties (due to the independency of the structure from the attributes)

λ-Terms as Attributes



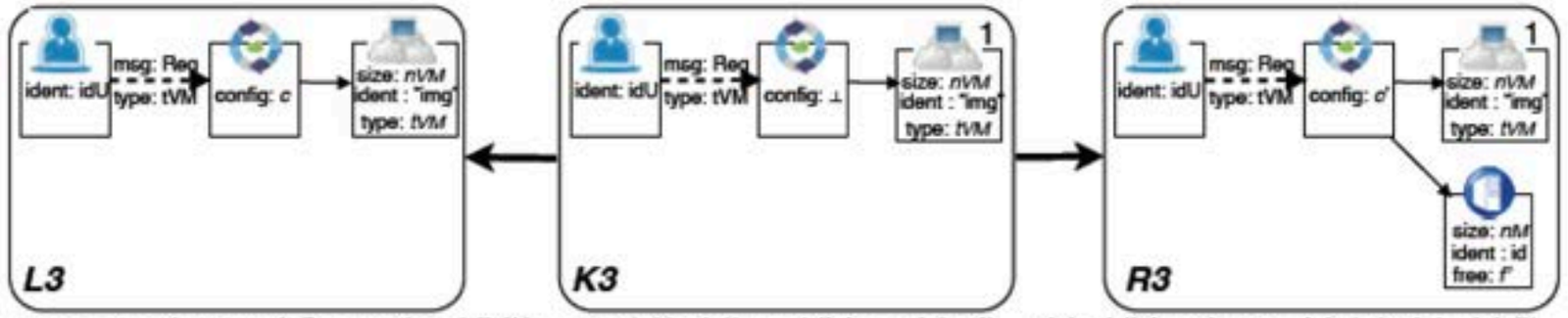
Cloud Administration

rule ReplicateVM



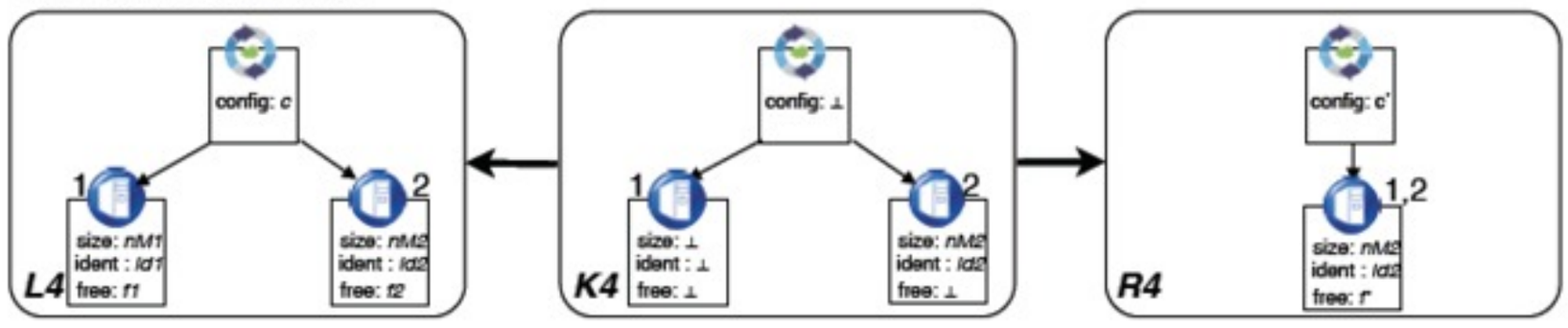
eqns: *newId(c,id0) ; id1 ≠ id2; nVM ≤ f ; f' = f - nVM ; c'= replVM(c,idU,id0)*

rule TurnOnMachine



eqns: *not(enoughSpace(c,nVM)); newId(c,id) ; nVM ≤ nM ; f'= nM-nVM ; c'=newMch(c,id,nM,f')*

rule TurnOffMachine



eqns: *nM1-f1 ≤ f2; f' = f2 - (nM1-f1) ; c'= mergeMch(c,id1,id2)*

Future Work

- Analysis of SqPO-transformation systems over attributed structures
- Case studies
- Tool support

Transformations of Attributed Structures with Cloning

Thanks for your attention!

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