Some terminology

A top-down approach

Composites

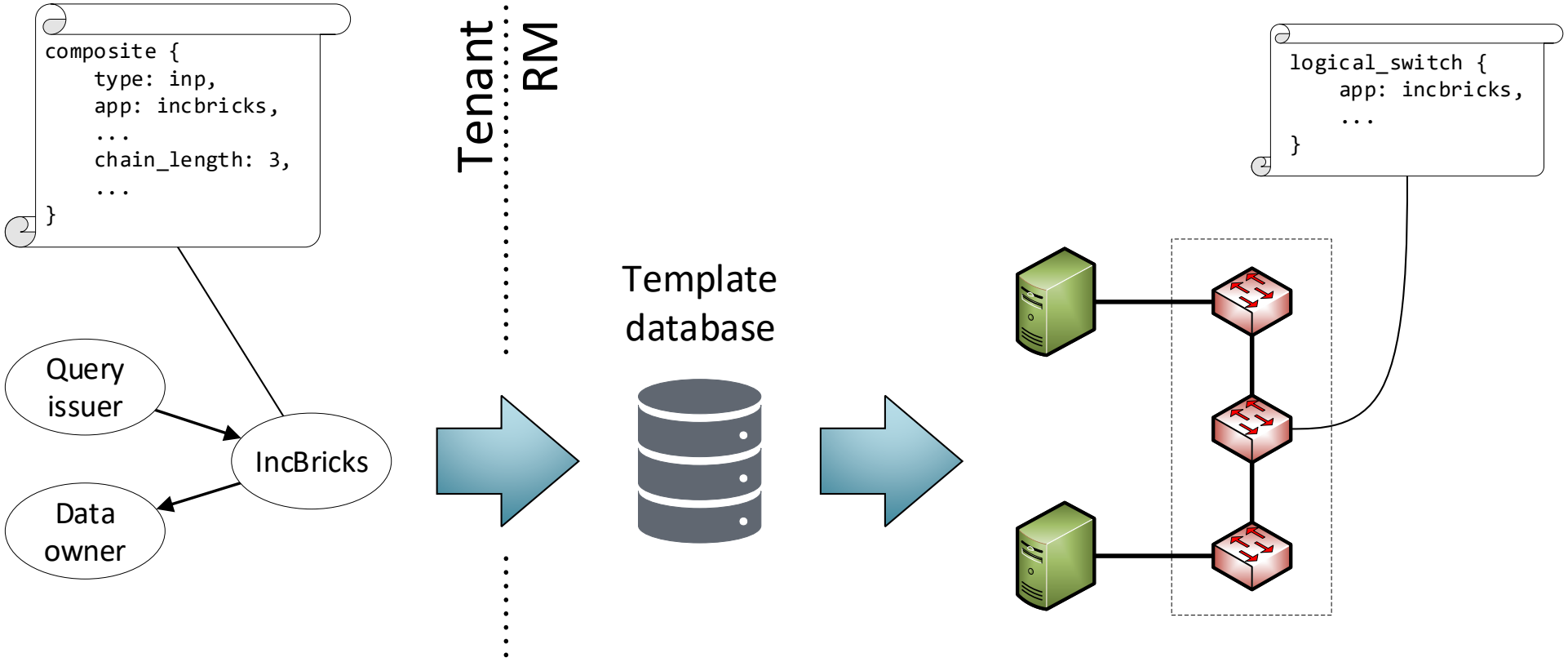
- A composite is a template that describes high-level logical components
  - It can be of two types:
    - Server (e.g., “*web server*”, “*database*”, …)
    - INP (e.g., “*IncBricks caching system*”, “*NetChain locking system*”, …)
      - With generic groups it would be possible to specify generic application *types* (like “*in-network data aggregation*”) rather than specifying specific solutions (like *Daiet*)
  - It can be made out of
    - Other composites
      - A composite *loop* must not be valid, since it would be impossible to place
    - Logical resources (next slide)

Logical resources

- Logical resources are logical representations of physical resources
- They can be of three types:
  - Server (e.g., VMs, containers, …)
  - Switch (performing specific in-network functions)
  - Edge (expressing bandwidth/latency demands)
- They represent the input of the placement algorithm

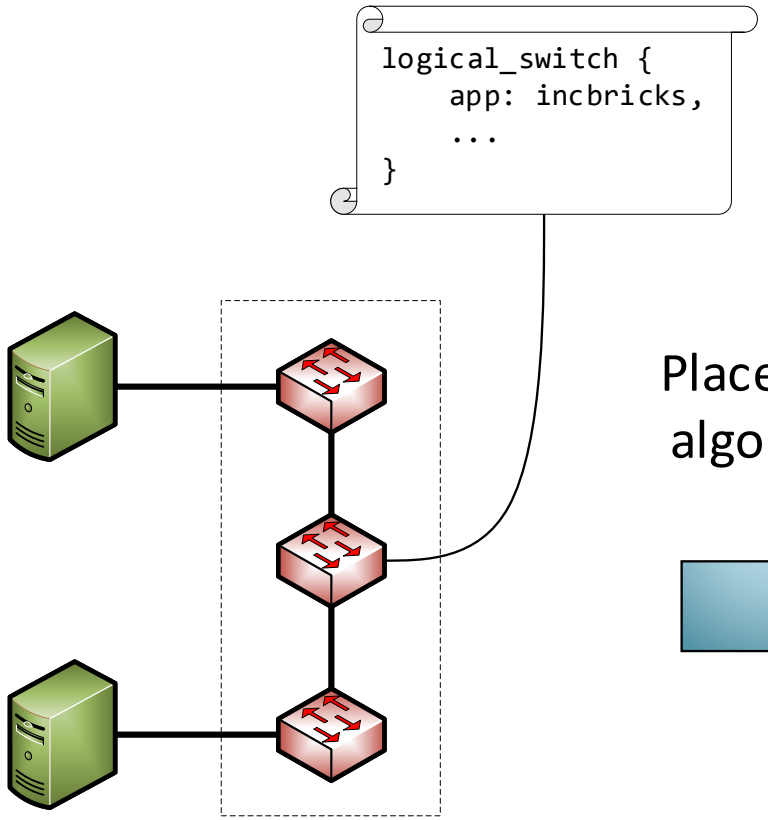
Mapping composites to logical resources

- Composites must be translated into logical resources
- This is done by using a *template database* managed by the RM

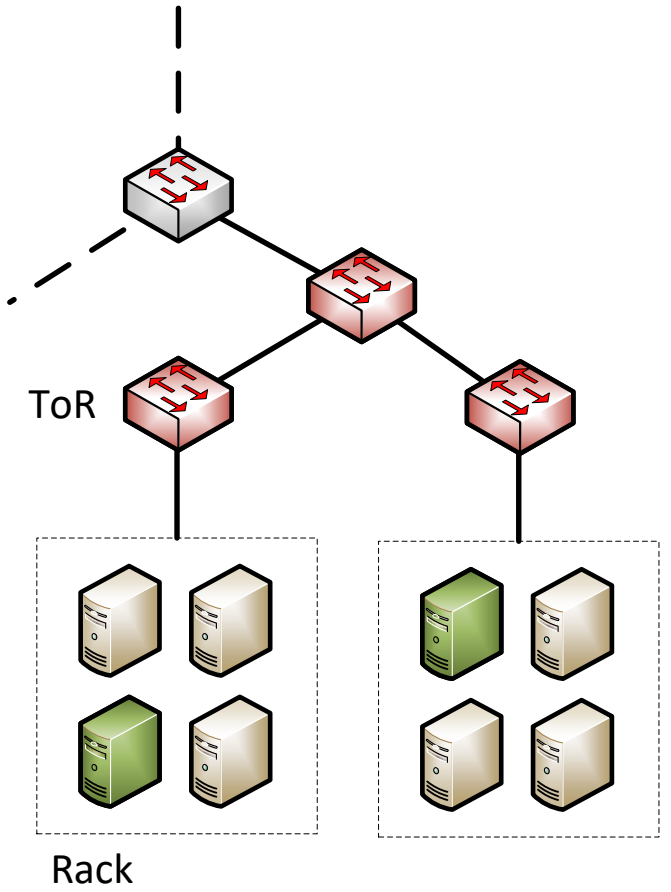


Physical resources

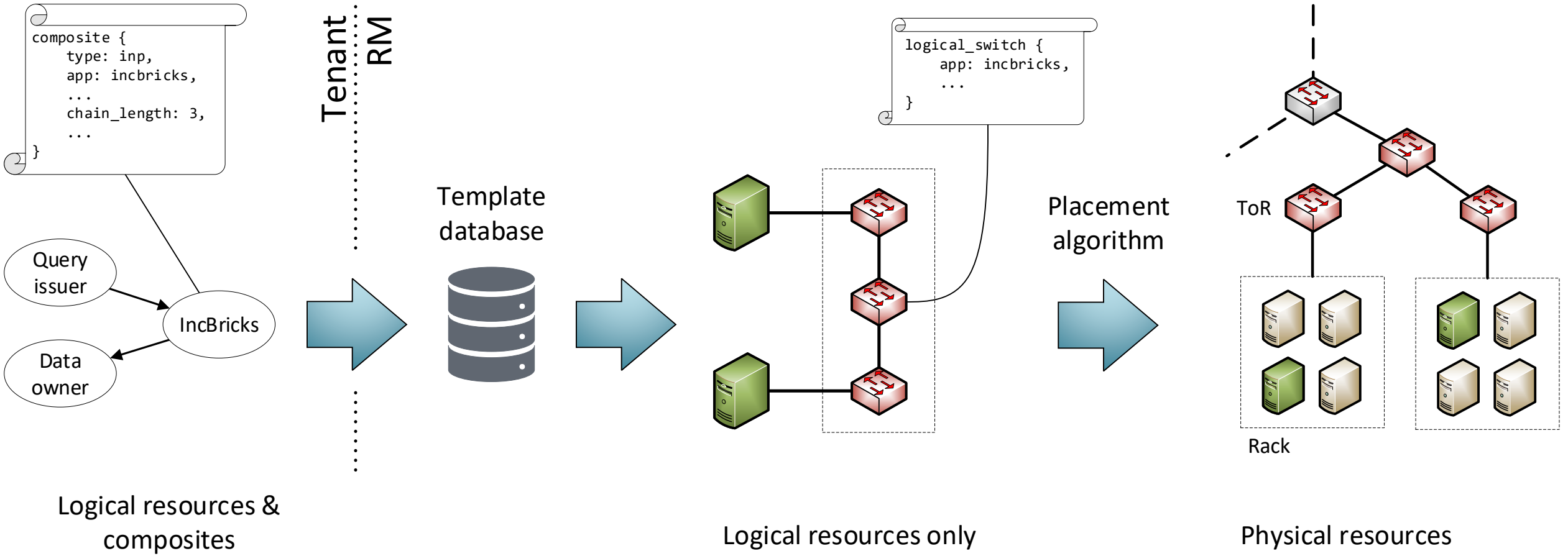
- The placement algorithm places logical resource into physical ones
- Three types of physical resources:
  - Server
  - Switch
  - Links



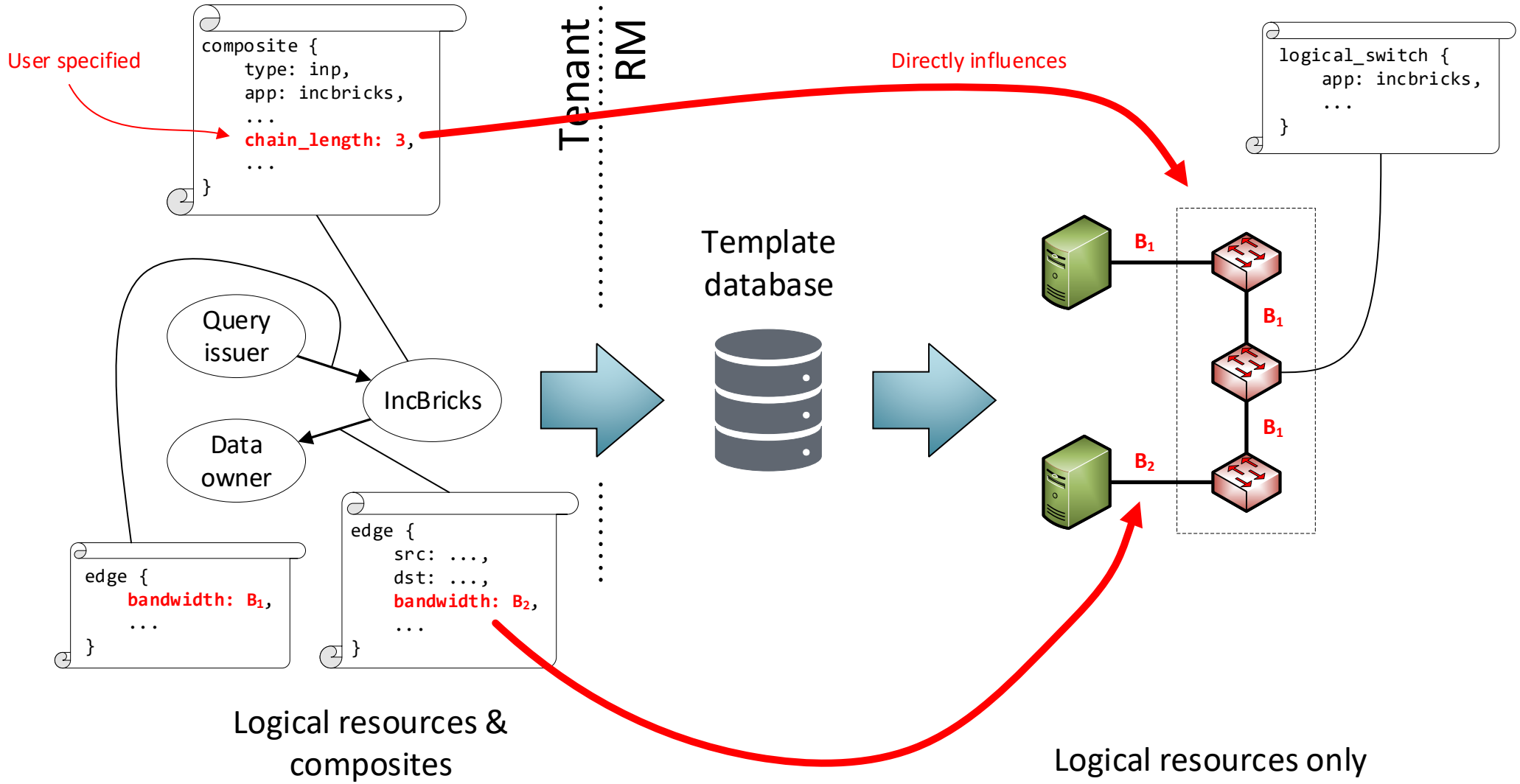
Placement algorithm



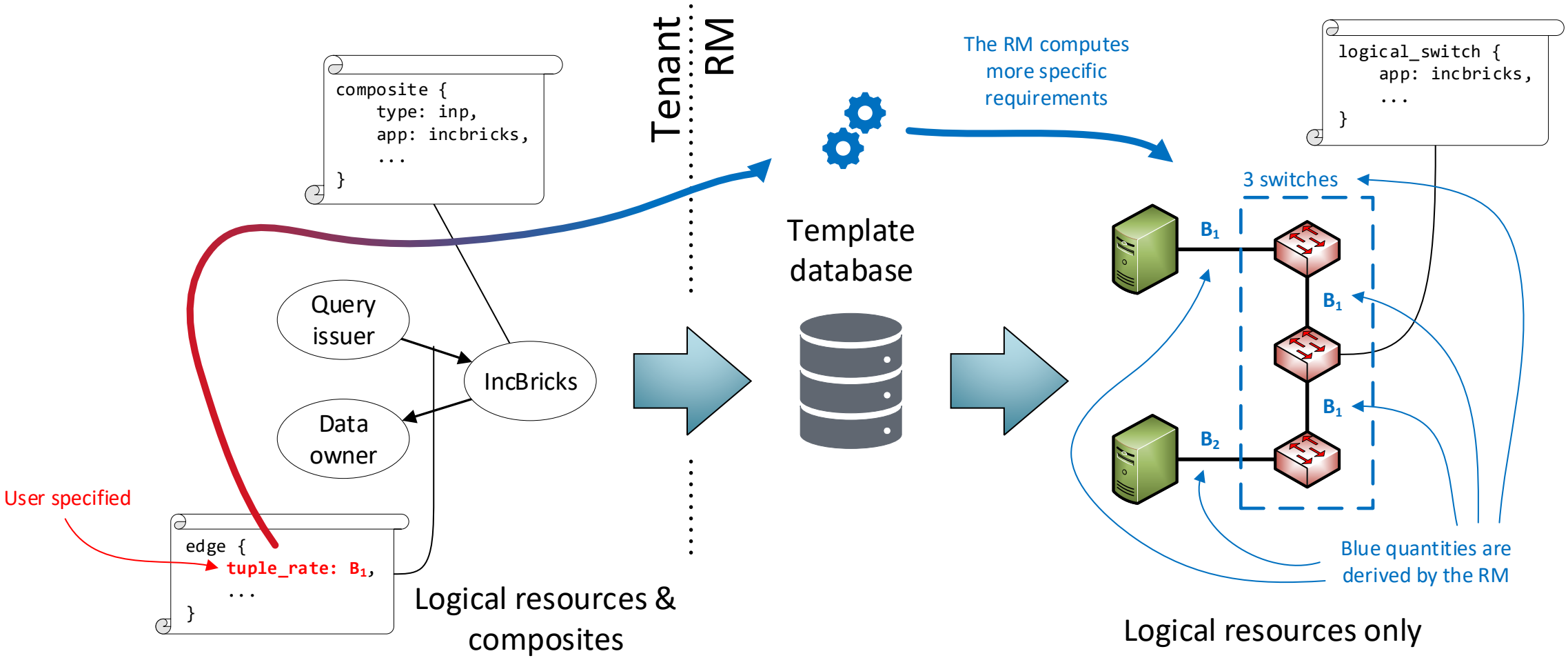
The whole picture



1st alternative: passive template mapping



2nd alternative: active template mapping



Resource model

- Model capable of describing composites and logical resources.
- The model exposed to tenants and the one internally used by the RM could be different.
  - **Tenant-side** model: resource model exposed to tenants by the system API.
  - **RM-side** model: resource model internally used by the placement algorithm in order to allocate logical resources.

A model for INP resources

Requirements

Some model requirements

- **FR1** The tenant-side model must be able to describe server and INP composites.
- **FR2** The tenant-side model must be able to describe all kinds of logical resources.
- **FR3** The RM-side model must be able to describe all kinds of logical resources.
- **FR4** The tenant-side model must allow the tenant to specify different bandwidth demands for different composites and logical resources.

Some model requirements

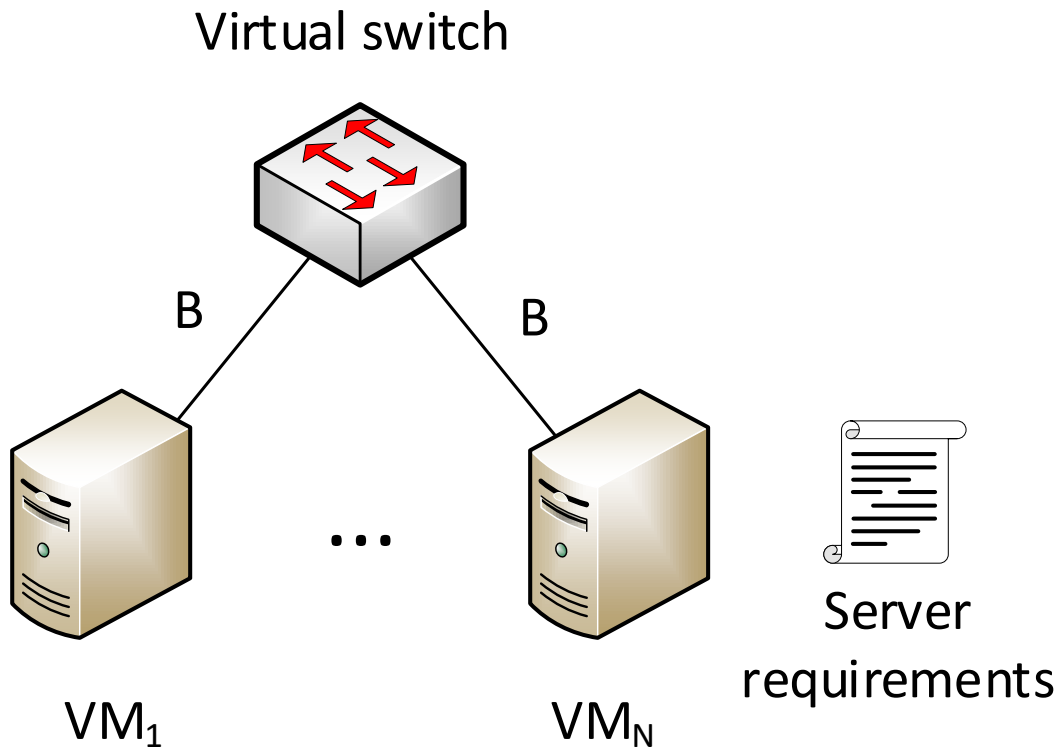
- **FR5** The tenant-model must be able to describe any kind of network topology.
- **FR6** The tenant-side model (and the corresponding APIs) must not change upon the release of new INP solution or version.
- **FR7** The translation from composite requirements to logical resource requirements must be done by the RM and not by the tenant application.

A model for INP resources

Design sketch

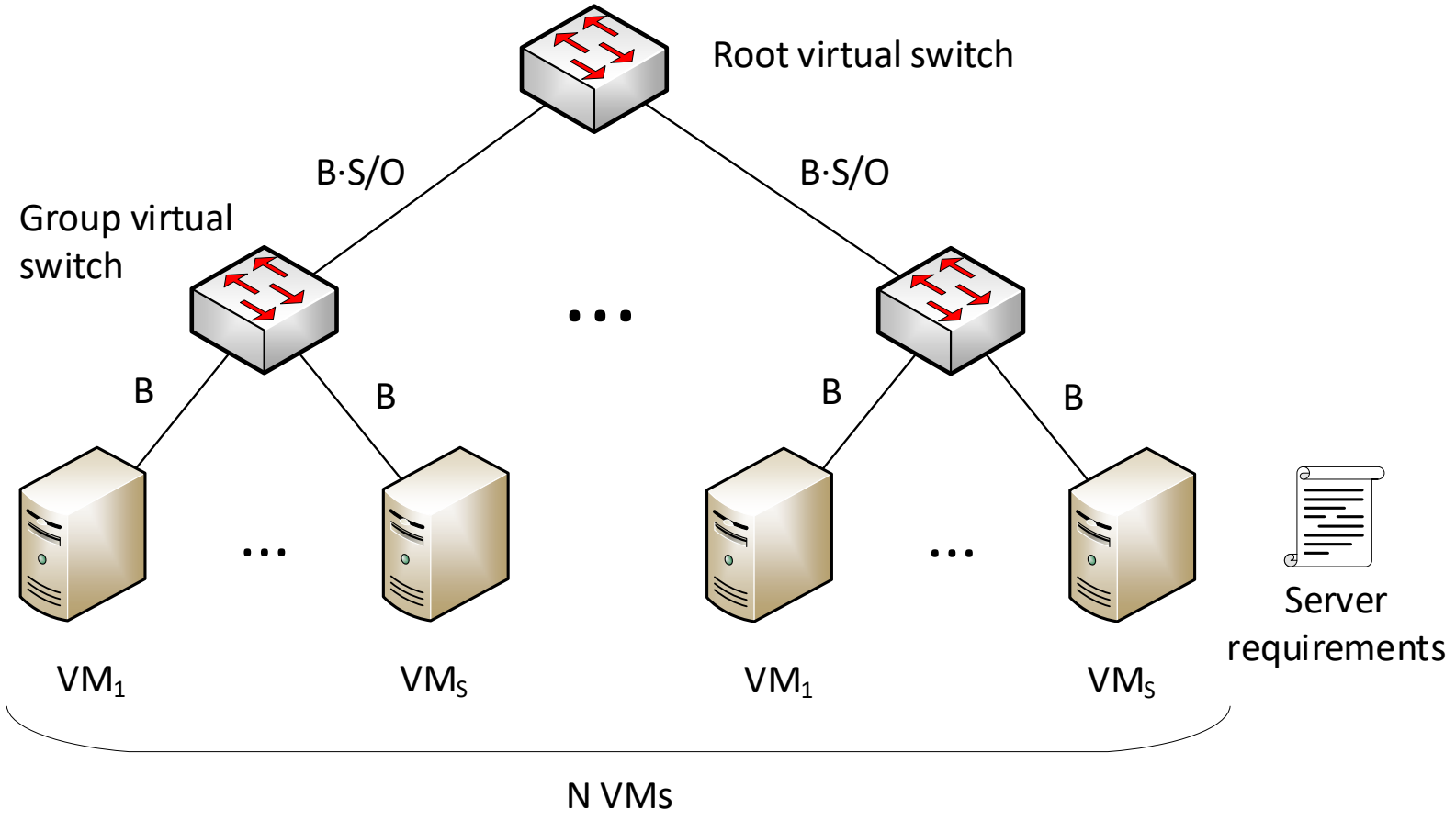
Virtual Cluster (VC)

- All VMs require the same bandwidth (✗**FR4**)
- A one-level tree topology is restrictive (✗**FR5**)
  - No switch chains
  - No switch trees
- It is not possible to express logical switch resources (✗**FR2**)

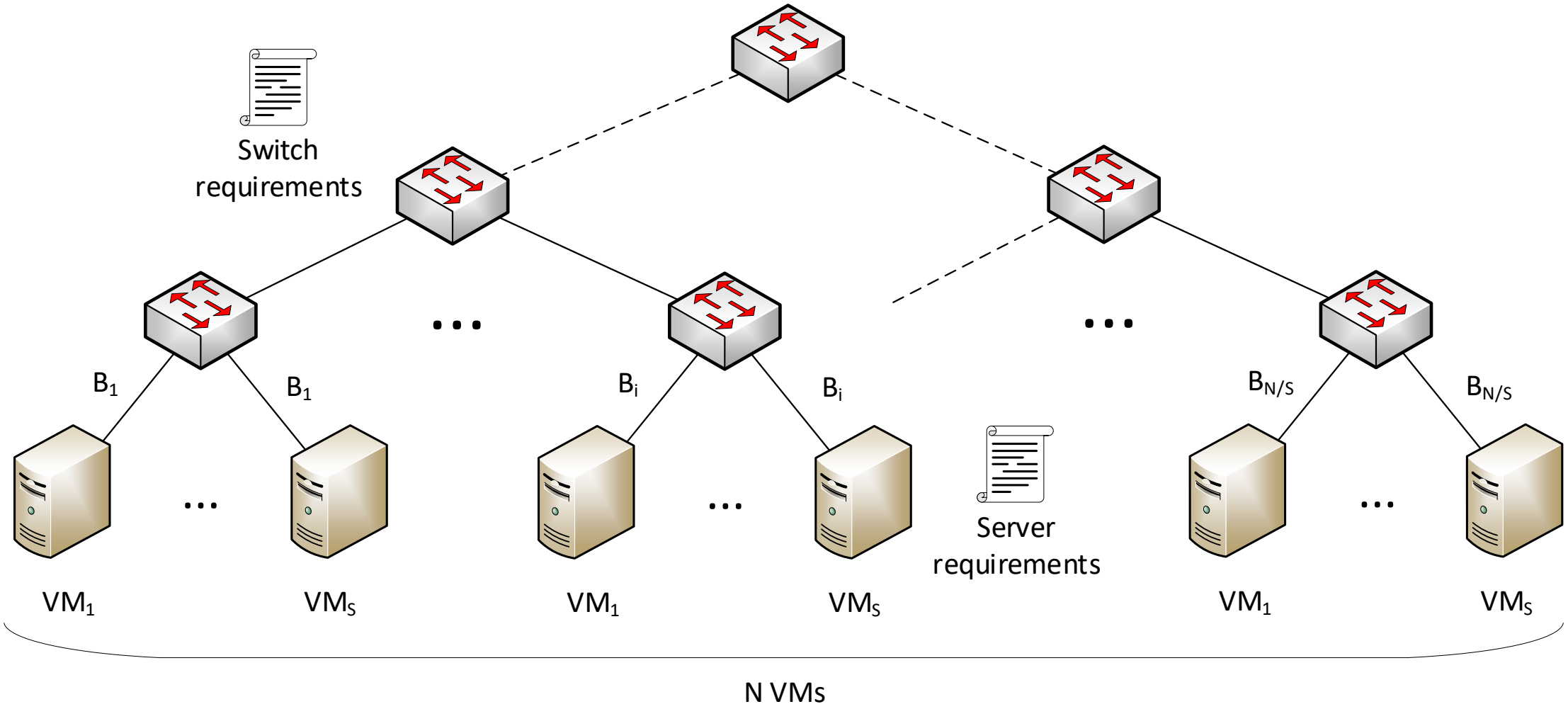


Virtual Oversubscribed Cluster (VOC)

- VM groups might require different bandwidth values (✗ **FR4**)
- Still a fixed-height tree topology (✗ **FR5**)
- Still not possible to express logical switch resources (✗ **FR2**)



A VOC variant

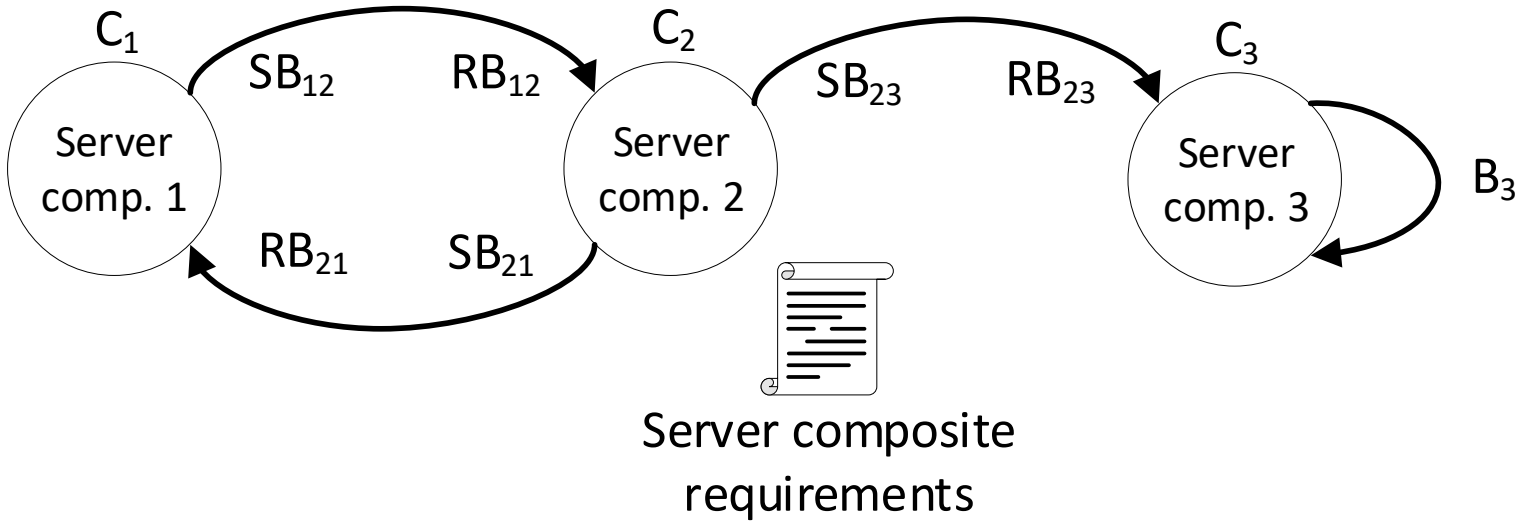


A VOC variant

- Features
  - Arbitrary height h
  - Different bandwidth demands for different VM groups (✓**FR4**)
  - Switch resources included (✓**FR2**)
- Drawback
  - Tenants cannot express any kind of switch topology (e.g., a switch loop for an in-network DHT chord) (✗**FR5**)
  - Tenants must convert INP high-level requirements (e.g., in-network total cache size, lock requests per second, …) into switch resource requirements (✗**FR7**)

Tenant Application Graph (TAG)

- It cannot describe INP composites (✗ **FR1**)
- It cannot describe logical switch resources (✗ **FR2**)



A TAG variant

- Capable of describing all composites (✓**FR1**) and logical res. (✓**FR2**)
- Different bandwidth demands (✓**FR4**) and topologies (✓**FR5**)
- Composite → logical res. translation not made by the tenant (✓**FR7**)