# Network virtualization: What? Why? How? Challenges?

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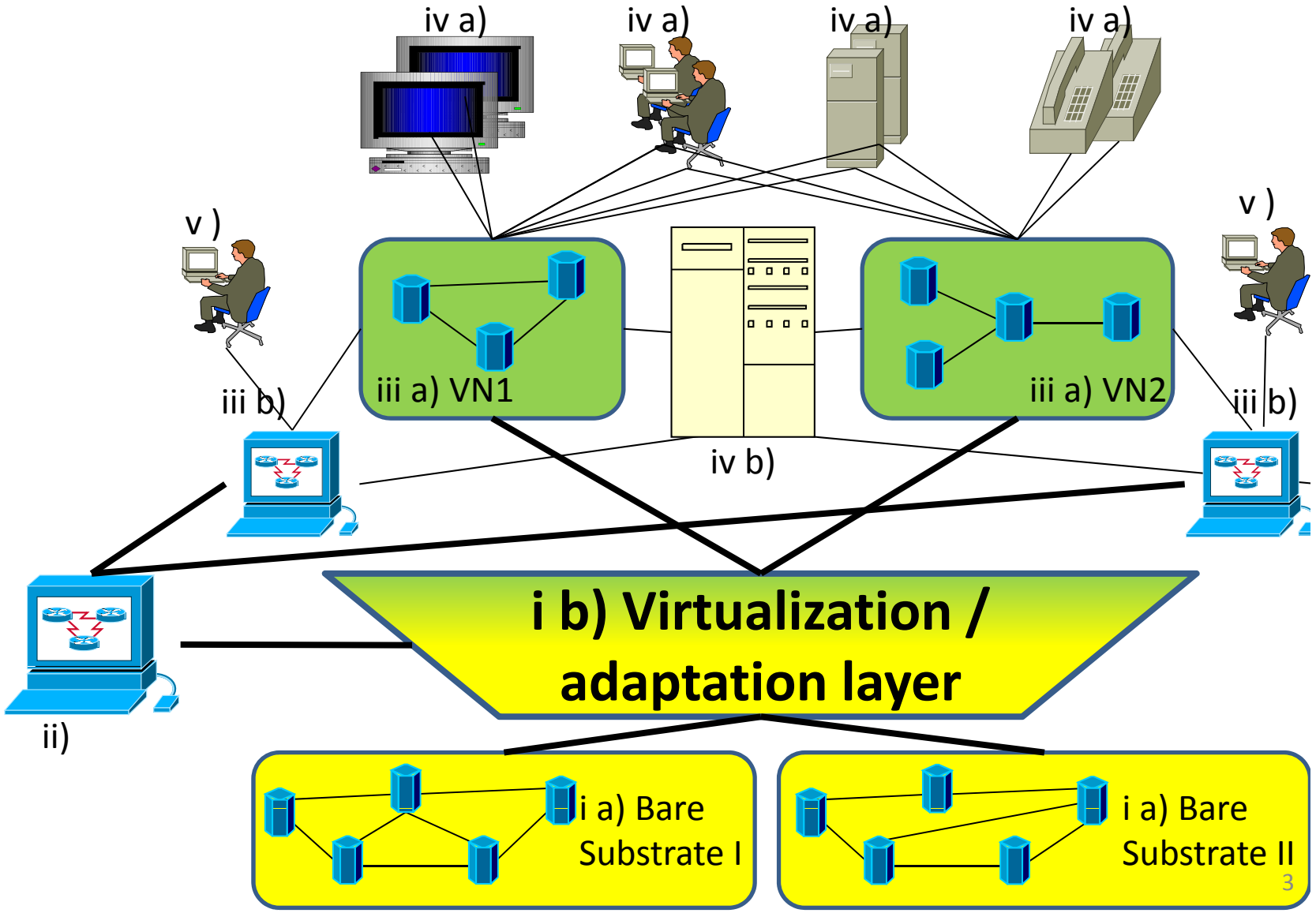
# Network virtualization: what?

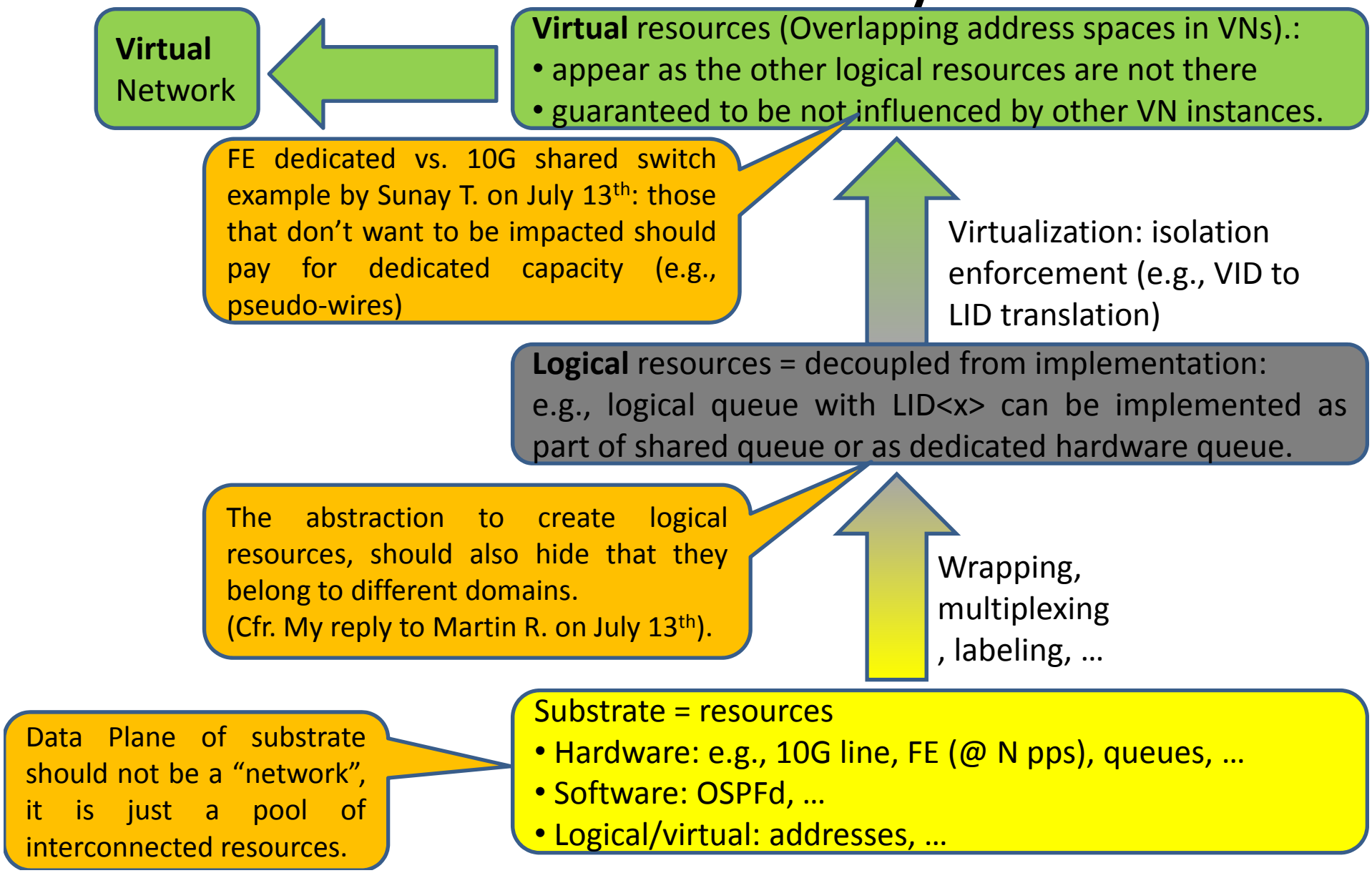
- A virtual network:
  - is a ... that appears to be a NETWORK
  - but is VIRTUAL in the sense that it does not necessary correspond 1:1 to a physical network.

- More formal: a virtual network is a network build from virtual resources. Virtual resources:
  - Virtual Network Element =
    - Virtual NICs
    - Virtual Data Plane: E.g.,
      - Forwarding Engine: lookup plus modify headers (e.g., TTL decr)
      - QoS related functions: shaping, marking, classifying, queuing, scheduling, …
    - Virtual Control/Mgmt Plane
  - Virtual links (or more general “virtual media”…) connecting the virtual NICs.

# Network virtualization framework



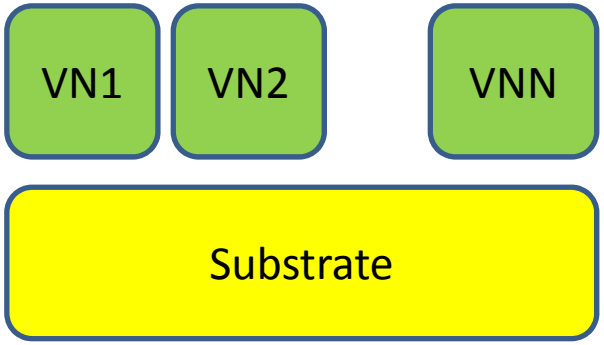
# Virtualization layer



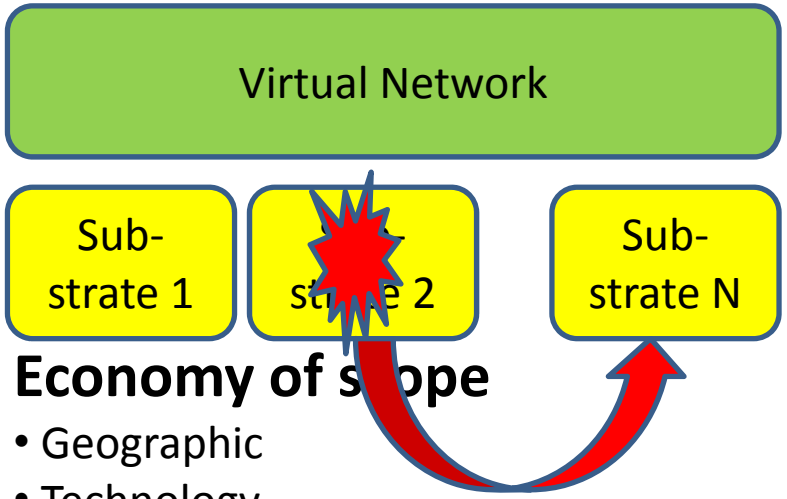
# Virtual resource

- Abstraction of implementation
  - Does not equal hiding (abstracted info like SRLG should still be visible to the VN owning the virtual resource)
- Relocation:
  - Is something the virtualization layer can do INVISIBLE to the VN owning the virtual resource.
  - If needed as property of the virtual resource, like SRLG info abstract location info should be available (e.g., customer endpoints).
- Interfaces:
  - Virtual Data Plane interfaces (e.g., a queue has an in and out).
  - Virtual config interface (e.g., let virtual control plane config the RED threshold)
  - Mgmt interface (let virtualization layer (ib) or VN instance mgmt system (ii) config the size of the queue).
  - Subject to proper indirection schemes (virtual2logical2physical).

# Network virtualization: why?



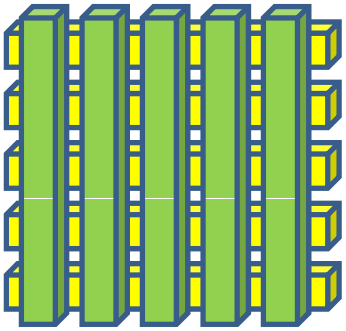

**Economy of scale**




**Economy of scope**

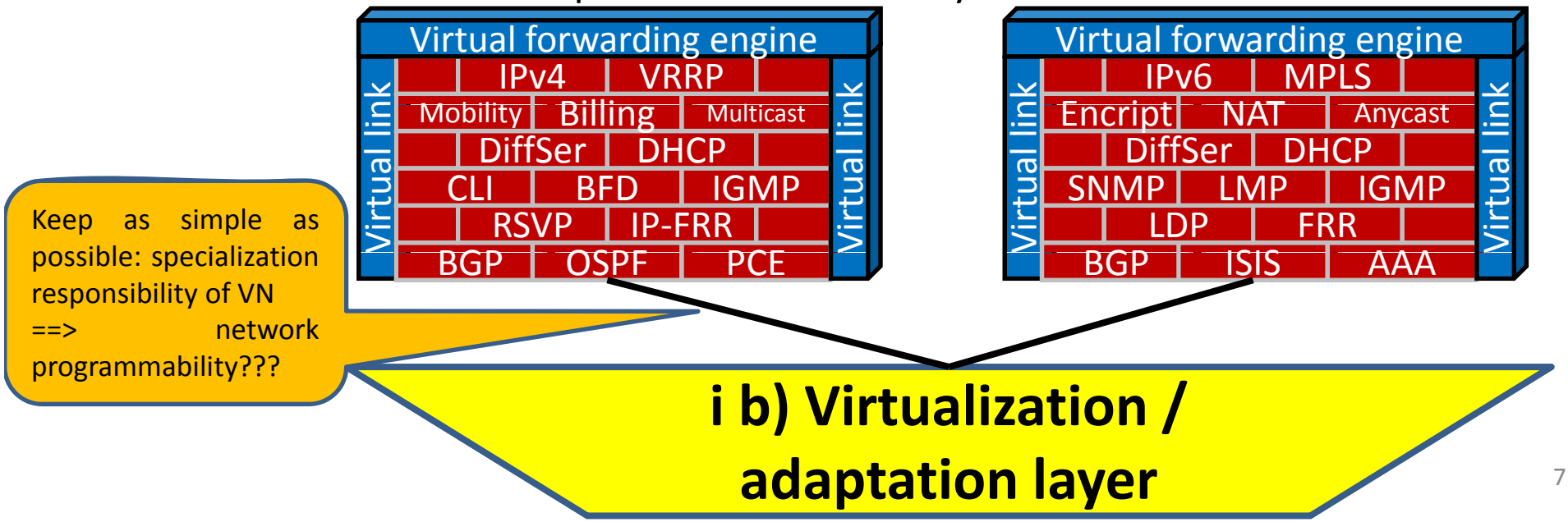
- Geographic
- Technology
- …

**Survivability**



# Network virtualization: why?

- Separation of concerns:
  - Infra provider <---> Network provider
- Standardized interface between VN instance and virtualization layer
  - ==> improved portability
  - Does not avoid need for horizontal interoperability, but becomes a VN-instance INTERNAL problem ==> flexibility



# Network virtualization: challenges?

- Performance:
  - Control Plane: less time critical --> VID to LID to PID translation possible.
  - Data Plane: rather part of index into table than translations.
- VN instance isolation
  - Inside network: by design and/or proper indirection rules on virtual config interfaces.
  - Edge: translation, labeling, … , but also traffic shaping, etc.
  - Bandwidth slicing:
    - Metro-core: often probably dedicated bandwidth slice (= no overbooking)
    - Access: customer decides /participates in decision when what VN instance is “active and thus guaranteed” (= huge overbooking)

# Network virtualization: challenges?

- Accountability and fault localization: in case of problems: is the VN/VN operator or infra/infra operator responsible for any issue that may occur.
- Virtual Resource properties: abstracted information (e.g., SRLG)
- Gateways between VN instances: who? How? …
- Demarcation point: where? How?
  - Customer-VNO demarcation
  - Customer-infra operator.

# Questions

- ITU-T FG on Future Networks has set up a new standards group on Virtual Infrastructures / Networks
  - Should we align our work with their activities? / have a liaison with them?
- Does this group or do other such groups already have a blueprint for the answer on the questions posted by Joe on June 8th?