Alternative Aspects of Cloud and Utility Computing

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Overview

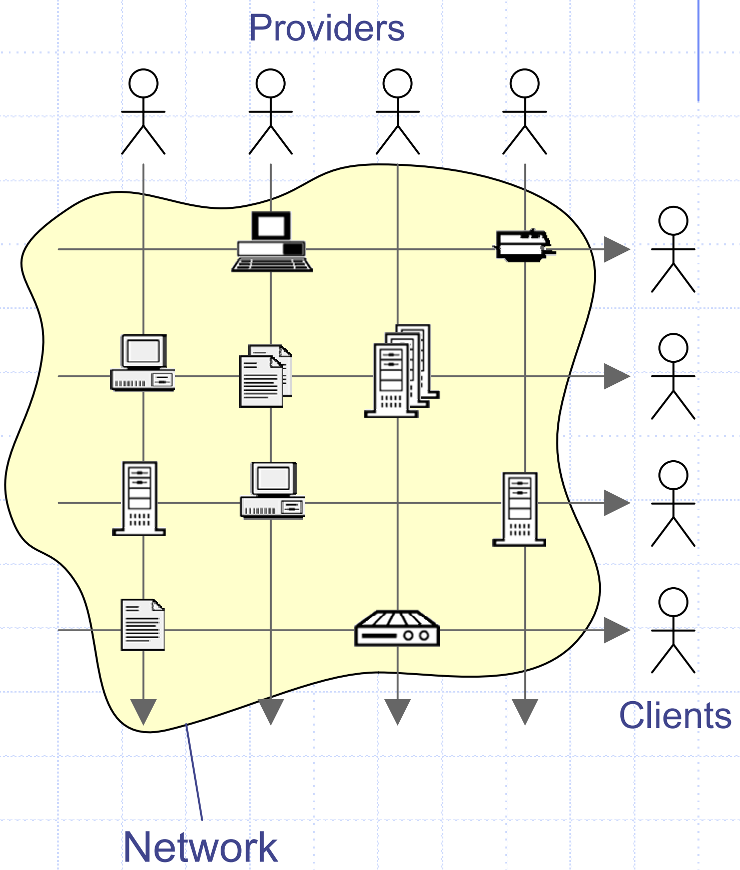
- Metacomputing research
  - Software systems for heterogeneous concurrent computing
    - PVM, IceT, H2O, Harness …
  - Focus on resource and communications management
    - Customize (condition) resource according to application needs
    - Support multiple (selectable) communication frameworks
    - Base programming model, but enable deploying others
- Current project: Unibus
  - Lightweight, self-organizing framework for metacomputing
  - Relationship to Grid/Cloud/Utility computing
    - Resource sharing and aggregation to create a coherent concurrent computing environment

Unibus Goals

- Key requirements/functionality
  - Aggregation and sharing of diverse resources
    - Make compatible or unify to the extent possible/required
  - Customizing resources as needed
    - Deploy most suitable (concurrent) computing environment
- Additional self-organizing properties
  - Adaptivity and resilience via dynamic resource management
  - Reduced/localized global state
    - Provider-provider, provider-client
- Central idea
  - Client side overlay and virtualization for aggregation and unification

Resource Sharing Abstraction

- Providers own resources
- *Independently* make them available over the network
- Clients discover, locate, and utilize resources
- Resource sharing occurs between single provider and single client
  - Relationships may be tailored as appropriate
  - Including identity formats, resource allocation, compensation agreements
- Clients can themselves be providers
  - Cascading pairwise relationships may be formed



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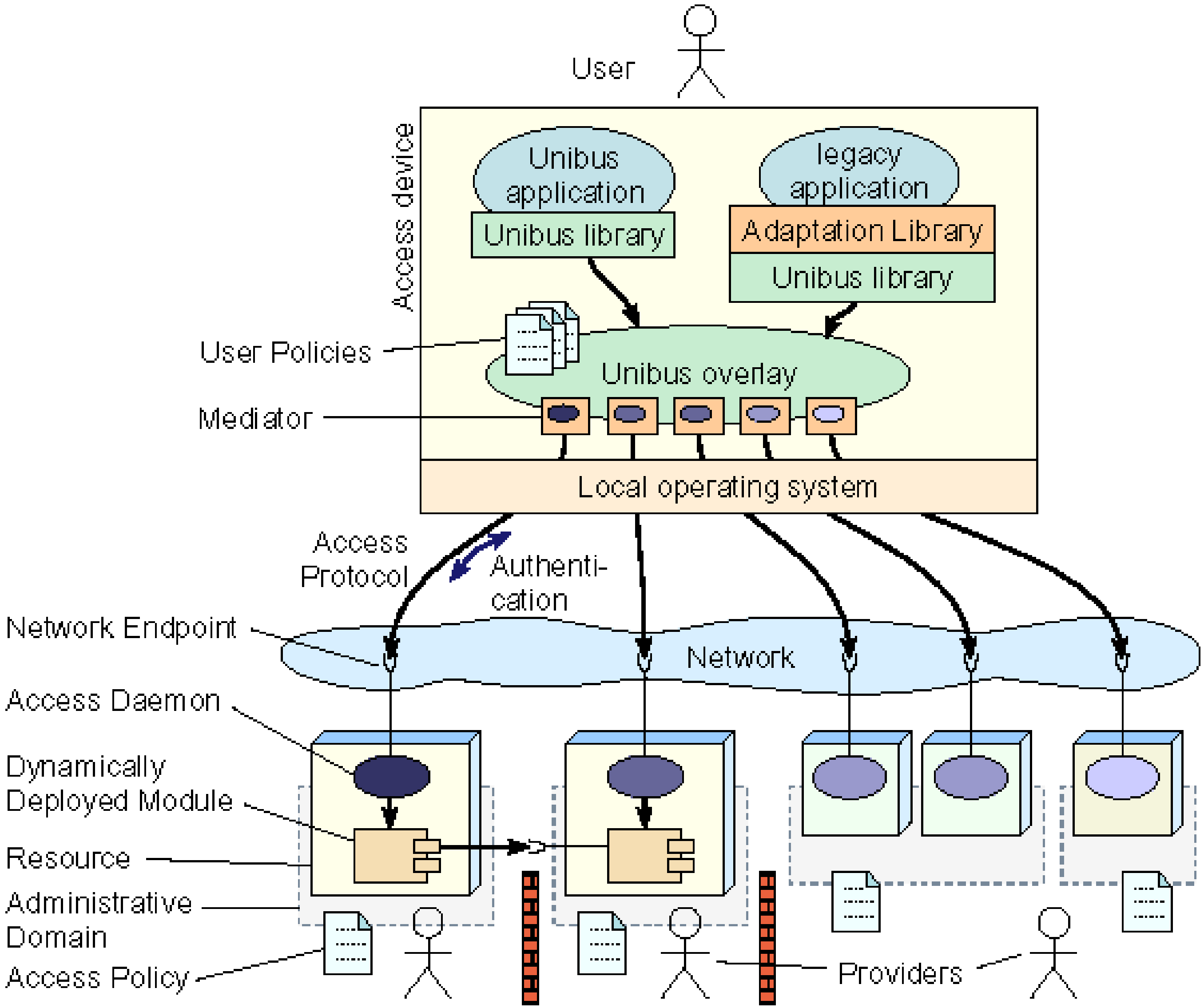
Unibus Approach

- Coherence and Unification
  - Device driver model: device = remote resource
  - Driver + handle (e.g. vnode) = access daemon + mediator
  - Interfaces suited to device (resource) class
- Adaptivity and Dynamism
  - Plug-and-play (event) model
  - Dynamic environment preconditioning
    - Similar to loading drivers / mounting filesystem
- Reducing global state
  - *Client*-side overlay, virtualizing resources via proxies
  - Similar devices grouped together at *interface* side
    - No coordination necessary at remote end

Unibus Model



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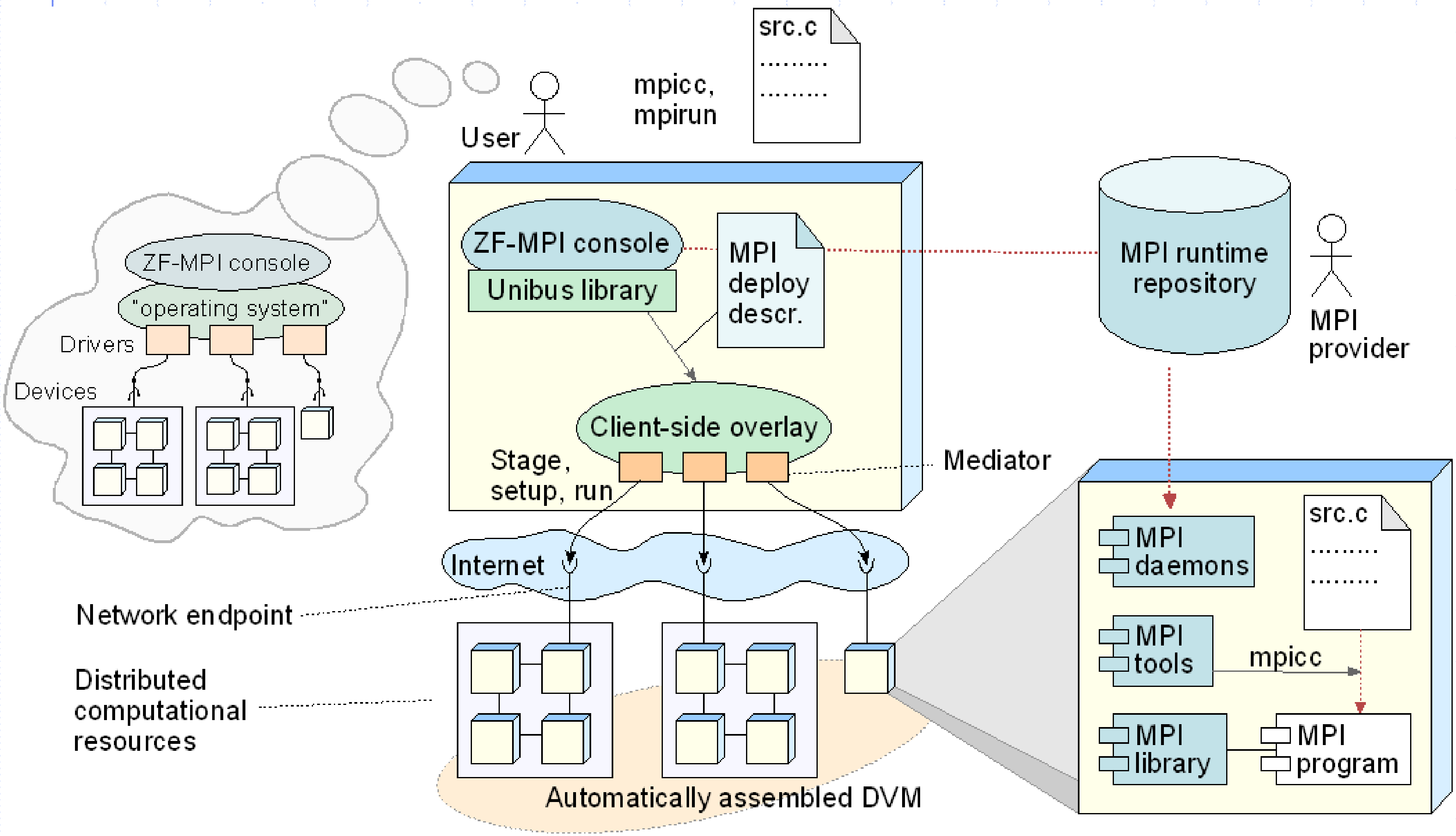
A Basic Implementation: ZF-MPI

- ZF-MPI Console
  - Virtual machine assembly
  - Data synchronization
  - Compile and build (// execution of remote shell commands)
  - Application launch

```
zf-mpi> add ft_mpi user1-sun@{lab6a,lab6b,lab6c,lab6d,compute}
zf-mpi> add ft_mpi user2-linux@{wembley,gobo,emily,sprocket}
zf-mpi> ft_mpi setNS compute //nameserver host
zf-mpi> ft_mpi add ALL
zf-mpi> ft_mpi console conf
zf-mpi> sync ~/NPB3.2.1/NPB3.2-MPI ~/zf-mpi/
zf-mpi> cd ~/zf-mpi/NPB3.2-MPI
zf-mpi> make bt NPROCS=8 CLASS=B
zf-mpi> mv bin/bt.B.8 $HARNESS_BIN_DIR/$HARNESS_ARCH/
zf-mpi> ft_mpi ftmpirun compute -np 8 -o bt.B.8 > log
zf-mpi> cat log | grep "Time in seconds"
zf-mpi> ft_mpi console haltall
```

Dynamic Conditioning



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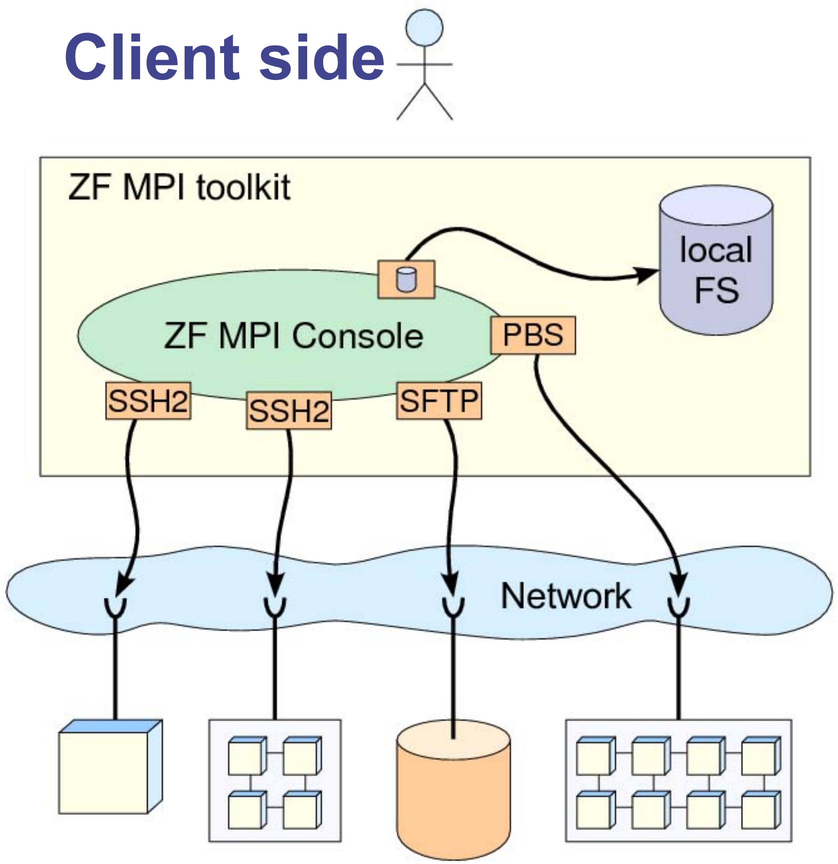
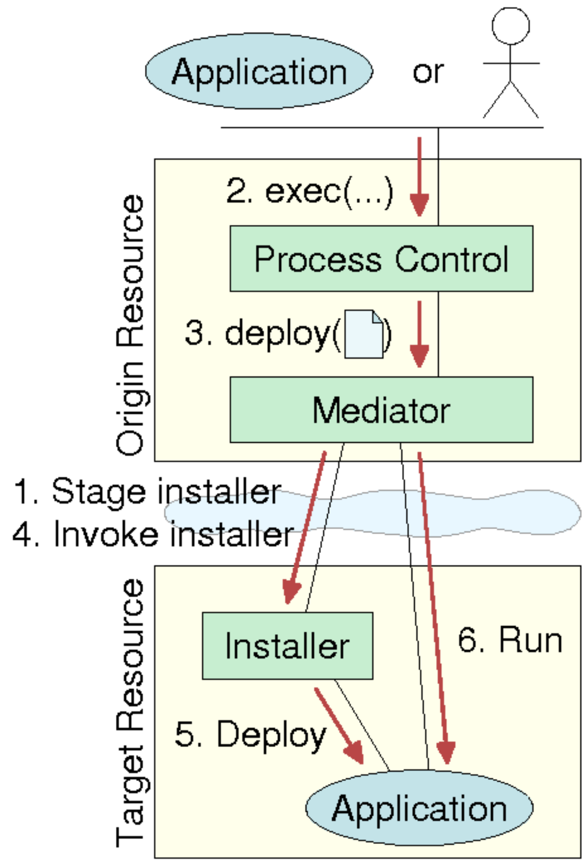
Generalizing Automated Deployment

Client side





Provider side

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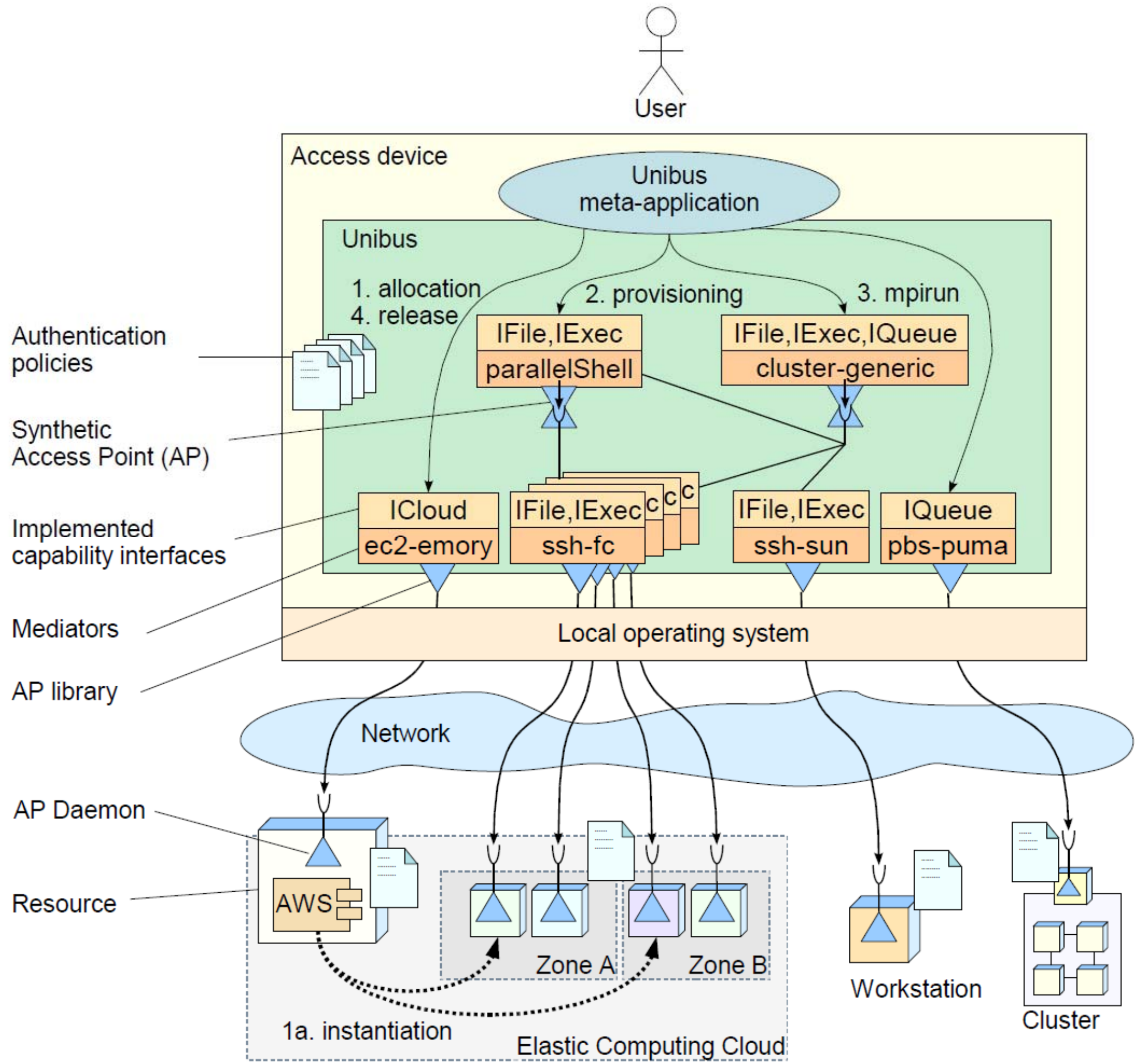
Unification and Aggregation



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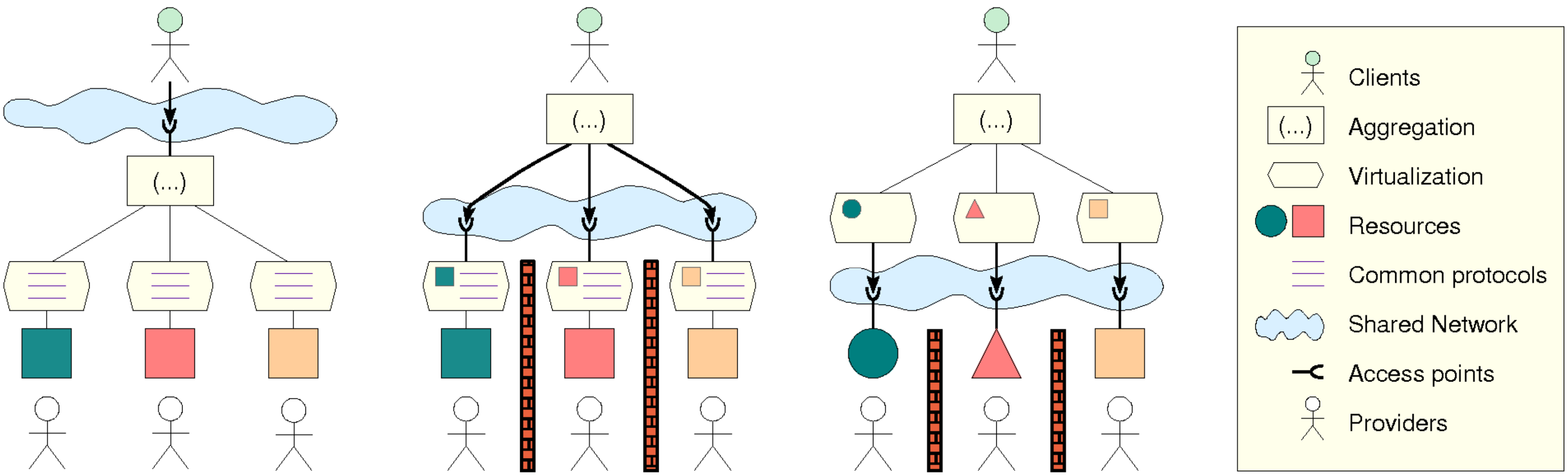
Summary

- Client-side virtualization and aggregation
  - Complete freedom and flexibility for providers
  - Dynamic conditioning & unification -> effective shared access to remote heterogeneous multidomain resources



(a) Virtual Organization Model (b) Public Infrastructure Model (c) Proposed Client-Side Overlay Model