

# A UML Profile for Modeling IT Infrastructures

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**Abstract.** IT infrastructures are most times informally modeled. Resulting models are ambiguous to stakeholders, cannot be checked for validity, and therefore are unable to play their important role in design, deployment and maintenance activities. This paper aims to mitigate this problem by proposing a UML profile to model IT infrastructures with more precision.

**Keywords:** Information Technology, IT Infrastructures, UML Profile

## 1. Introduction

An *IT Infrastructure (ITI)*, also known as *Technology Architecture* in most Enterprise Architecture frameworks, includes all hardware, software, networks and facilities required to develop, test, deliver, monitor, control or support IT services.

A UML profile for modeling ITIs, covering constructs at all required abstraction levels (hardware, middleware, network and software), is proposed herein, to mitigate the problems identified in existing approaches, such as: (i) the widely used ad-hoc approaches produce ambiguous models, do not facilitate knowledge reuse and cannot support validation approaches and (ii) the existing formal approaches for modeling ITIs, such as *UML Deployment Diagrams*, *TOGAF* or *ArchiMate*, do not provide abstractions with required detail and, as such, are not used in practice.

## 2. UML Profile for ITIs

A “profile” is a generic extension mechanism for customizing UML models for particular domains and platforms. A UML profile is based on a set of metamodel extension constructs (stereotypes, tagged values, and constraints) that allow refining the standard semantics in a strictly additive manner (i.e. without contradicting it). For instance, a profile may use a stereotype to refine the concept of *Node*.

Several UML profiles have been proposed in the literature and some of them have been endorsed by the OMG itself. Examples include profiles for business process modeling, requirements management, modeling real-time embedded systems and aspect-oriented software development. In the next subsections we describe our proposed profile. Due to space constraints only a subset could be included.

The proposed profile has two layers. The software layer (Yellow) has three packages: *ITI Hypervisors*, *ITI Operating Systems* and *ITI Software*, while the hardware layer (Blue) has four packages: *ITI Facilities*, *ITI Networks*, *ITI Nodes* and *ITI Storage* (see Fig. 1). Package *ITI Software* models software platforms such as antivirus, application servers, backup, database servers, directory, and email servers, among others. These ITI platforms execute upon *ITI Operating Systems*. The operating system may be deployed directly on hardware or it can be deployed on top of *ITI Hypervisors* (e.g. XEN, Hyper-v or VmWare) that execute directly on the *ITI Nodes* hardware.

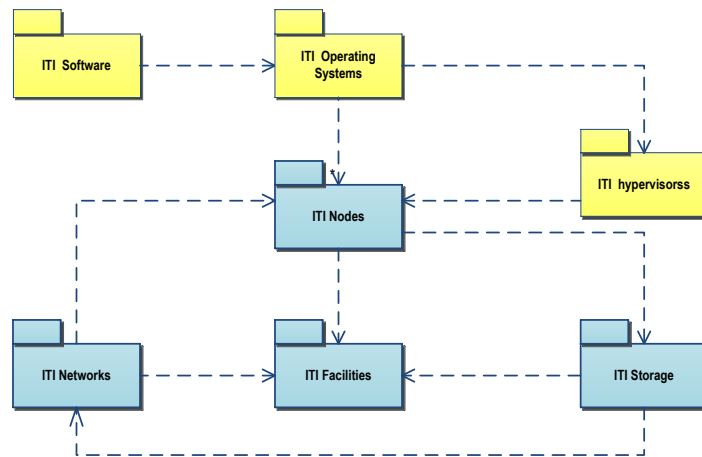


Fig. 1. ITI packages and their relationships

Package *ITI Nodes* contains the constructs used to model systems such as servers and their components. The metaclass *Host* inherits the properties of an UML2 *Node* and allows representing physical and virtual servers, mainframes or supercomputers. Metaclass *Device* is similar to *Host* but is used to represent other equipment such as phones, tablets, slates, laptops, or PDAs. The *Peripheral* metaclass represents the components that may be connected to a *Host* or *Device* and includes monitors, keyboards, mice, printers or smartcard readers, among others. A *Port* is a built-in component in a *Host* or *Device* such as a host-based adapters or a network card.

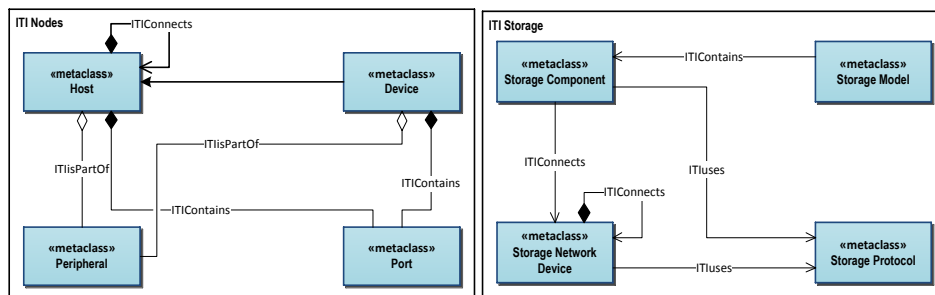


Fig. 2. ITI Nodes and ITI Storage

Package *ITI Storage* contains several types of *Storage Component* such as storage LUNs, storage arrays and pools, storage controllers and they may be configured in a given *Storage Model* such as Storage Area Network (SAN) or Network Access Storage (NAS). These storage components are connected to *Hosts* and *Devices* through *Storage Networks* using fiber channel or Ethernet routers or switches that use a specific *Storage Protocol* such as iSCSI or Fiber Channel over Ethernet (FCoE). Both *ITI Nodes* and *ITI Storage* packages and their relationships are represented in Fig. 2.

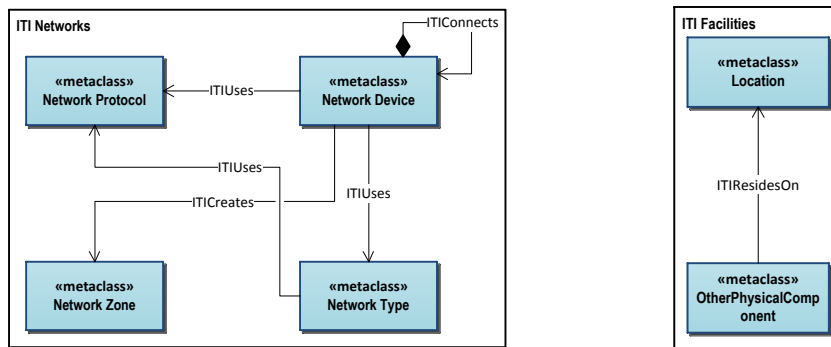


Fig. 3. ITI Networks and ITI Facilities

*Hosts* and *Devices* from the *ITI Nodes* package can be interconnected by a *Network Device* available in the *ITI Network Package*. A *Network Device* may be an access point, firewall, hub, router or a switch. Those devices are used to create a *Network Zone* such as a perimeter network, an intranet or extranet and they communicate using a specific *Network Protocol* such as frame relay or Ethernet. A *Network Device* may be associated with a *Network Type* (e.g. LAN, WAN or Wi-Fi). All aforementioned components reside in the *ITI Facilities* package. Both packages are shown in Fig. 3.

To connect multiple ITI components, we require ITI connectors that extend the metaclass *Association* or the metaclass *Composition*, as represented in Fig. 4.

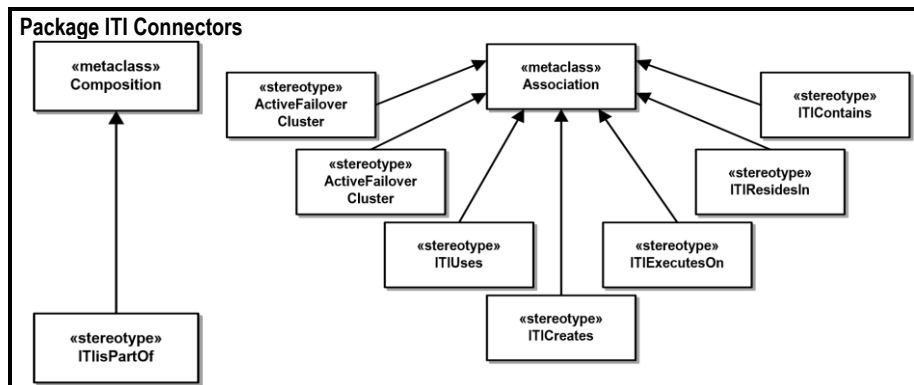
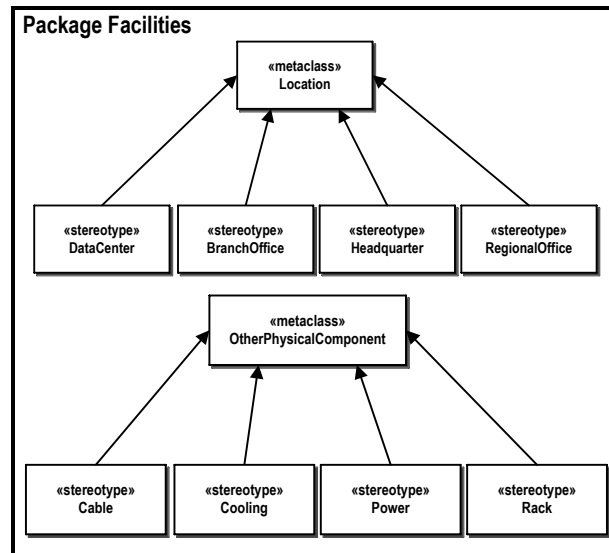


Fig. 4. IT Infrastructure Connectors Package.

Besides these two connector metaclasses, we also extended UML2 metaclass elements such as *Class*, *Location*, *Boundary*, *Device* and *Node*. An example is in the

package *ITI Facilities*, composed by the metaclass *Location* and the metaclass *OtherPhysicalComponent*. A location can be the *Headquarters*, a *Datacenter*, a *Branch Office*, or a *Regional Office*. *OtherPhysicalComponents* includes *Cable* to connect hosts, *Rack* to attach servers, *Power* supply and *Cooling* system. Both metaclasses and their extending stereotypes can be seen in Fig. 5.



**Fig. 5.** Package Facilities

We enriched each stereotype with additional attributes (aka "tagged values"), inspired on the *Common Information Model (CIM)* proposed by the *Distributed Management Task Force (DMTF)*, a worldwide initiative spearheaded by industry-leading IT companies such as AMD, Broadcom Corporation, CA, Cisco, Citrix Systems, EMC, Fujitsu, HP, Huawei, IBM, Intel, Microsoft, NetApp, Oracle, RedHat, SunGard and VMware. CIM provides a common approach to the management of systems, networks, applications or services and enables multiple vendors to exchange semantically rich management information between systems throughout the network.

### 3. Current and Future Work

We have deployed this ITI profile in a widely used modeling tool (*Enterprise Architect*). Currently we are concerned with the automatic production of profile-compliant models based on information taken from IT service management tools (e.g. Configuration Management Data Bases). Models of real-world ITIs, even in medium-sized companies, can easily reach hundreds or even thousands of modeling elements, especially when software components are considered. In such a case, a model can easily be rendered useless due to excessive detail. We plan to mitigate this problem by using zooming facilities like those available in Geographical Information Systems.