

Grid Architecture Component Class Specification

Component Class Designation: Digital Communication Network

Summary Overview

This model describes a digital communication network as a *component class*. Normally, communication networks are treated as *structures*, but there are cases where it is useful to treat them as black boxes (or maybe more appropriately here, black clouds).

Definitions

IP – Internet Protocol; a suite of digital communication network protocols used in digital networks including but not limited to the internet

IETF – Internet Engineering Task Force

RFC – Request for Comments; this is the basic document used to specify an internet protocol standard by the IETF

PMU – Phasor Measurement Unit; a streaming sensor for power grids that measures three phase voltage and current phasors in a time-synchronized manner

Ring aggregation – use of ring topology to provide data flow aggregation in communication networks

Linear aggregation – daisy chain type aggregation, used in communication networks where ring aggregation is not practical or physically possible

Component Class Description

Purpose and function

The purpose of the digital communication network is to transport digital data among devices and digital processing systems. The functions of a modern communication network include data transport, network services, network management, and network level security.

Key externally visible properties

Network topology – interconnection schema of a communication network; there are a large number, including point-to-point, hub-and-spoke (aka star), dual hub and spoke, ring, multi-ring with ring and linear aggregation, bus, multi-hop mesh (partial or full), tree, daisy chain, and various hybrids

Bandwidth – bit level data transport rate

Latency – time it takes for a packet of data to get from one designated point to another

Throughput – bulk data transfer rate; this is not the inverse of latency

Throughput knee – point at which the number of network users causes a significant rise in response time and leveling off (saturation) of throughput

Packet loss – rate of failure of packet delivery: percentage of packets lost with respect to packets sent; may be caused by link unreliability (faulty hardware or wireless propagation problems), link congestion, or data bursting combined undersized network buffers.

Interface descriptions

Networks use a variety of (mostly) bit serial interfaces, such as EIA/TIA-232, EIA/TIA-449, V.35, X.21, DTE/DCE, EIA-530, EIA-530A, SONET, Ethernet, GigE, Fibre Channel, and others. Protocol conversion gateways may be employed where the network does not support a particular device or application protocol although better networks avoid such gateways for technical reasons.

Table of relevant standards

Standard Name	Description	Version/Date
IETF RFCs	Standards for Internet Protocol communications	various
IEC 61850	Communication standards for electrical substation automation systems – has been extended to PMUs and being extended to distribution	various
IEEE C37.118	PMU communications	2011
IEC 62056	Family of standards for electric meter communications	
IEC 60870-5	communication profile for sending basic tele-control messages between two systems, using permanent directly connected data circuits between the systems	

List of Attached Documents

	Description	Version/Date
GMLC 1.2.1 Network Topologies v0.1.vsd	Diagrams of various network topologies	v0.1 5-Jul-2016
The Emerging Interdependence of the Electric Power Grid & Information and Communication Technology	White paper on convergence of information and communication technologies with electric power grids	Final August 2015

Version History

Action	Date	Description	Author(s)
created	5-Jul-16	initial draft	jd taft