

C.3.4 Virtual Network and Communication Requirements

[Go to C.3 Functional Requirements](#)

This section identifies the requirements governing [Virtual Networks](#) and communication among [Nodes](#), [Twin Realizations](#), management components, and other entities participating in distributed verification and testing.

The requirements establish the network relationships and [Communication Characteristics](#) required to represent and exercise distributed systems without prescribing a particular network technology, communication middleware, deployment substrate, or product.

A [Virtual Network](#) provides a logical communication environment through which participating entities communicate during testing, simulation, or training. The physical resources supporting those entities may be colocated or geographically distributed.

The communication environment may represent characteristics of a corresponding real-world distributed system, including [Network Topology](#), physical or logical separation, communication latency, communication protocols, and [Quality of Service](#) characteristics.

Virtual Network and communication requirements remain distinct from the requirements governing the lifecycle and behavior of individual Nodes, Twin Realizations, Test Execution, State and Time Control, Security, and Interoperability assessment.

The requirements in this section derive from the source documents identified in Annex B.

The U.S. Patent Application describes a DIDO-TE Virtual Network that communicatively couples distributed virtual Nodes and permits communication without regard to the physical distance separating those Nodes. The source further describes configuration of a Virtual Network to represent distances, latencies, and communication protocols used by corresponding real-world distributed systems.

The patent also describes communication with geographically remote Nodes, cooperation between Virtual Networks and [Real-World Nodes](#), interaction with real-world devices and systems, interface testing between Nodes, and interoperability testing under differing communication conditions.

The DIDO-TE BAA material extends this concept to distributed interoperability testing involving virtual and real-world systems and identifies testing under [Degraded Communication Conditions](#) or contested communication conditions.

The DIDO Reference Architecture provides the broader distributed-system, DDS publish-subscribe, and DDS Quality of Service concepts used to interpret communication requirements without requiring DIDO-TE to prescribe DDS or another specific communication implementation.

A Virtual Network and Communication requirement may be represented by an individual leaf requirement or by a non-leaf requirement group containing subordinate independently verifiable obligations.

Requirements

Requirement ID	Requirement Title	Primary Source Basis
NET-001	Establish a Virtual Network	[DTE1], Virtual Network definition and configuration; [DTE2], Virtual Networks and Communication
NET-002	Define Virtual Network Topology	[DTE1], Virtual Network and network topography concepts; [DTE5], inter-node topology source requirements
NET-003	Connect Nodes Through a Virtual Network	[DTE1], network communicatively coupling virtual Nodes and management systems
NET-004	Configure Communication Characteristics	[DTE1], distance, latency, and communication-protocol representation; [DTE9], DDS Quality of Service concepts
NET-005	Reproduce Degraded Communication Conditions	[DTE2], degraded or contested communications environments; [DTE3], testing in degraded or contested environments
NET-006	Connect Real-World Nodes Through a Virtual Network	[DTE1], real-world Node cooperation and interaction with a Virtual Network
NET-007	Support Geographically Distributed Nodes	[DTE1], geographically remote Nodes and distance-independent communication; [DTE5], geographically distributed deployments

Contents

- [NET-001 — Establish a Virtual Network](#)
 - [NET-002 — Define Virtual Network Topology](#)
 - [NET-003 — Connect Nodes Through a Virtual Network](#)
 - [NET-004 — Configure Communication Characteristics](#)
 - [NET-005 — Reproduce Degraded Communication Conditions](#)
 - [NET-006 — Connect Real-World Nodes Through a Virtual Network](#)
 - [NET-007 — Support Geographically Distributed Nodes](#)
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- [NET-004 — Configure Communication Characteristics](#)
 - [NET-001 — Establish a Virtual Network](#)
 - [NET-002 — Define Virtual Network Topology](#)
 - [NET-003 — Connect Nodes Through a Virtual Network](#)

Source

- [\[DTE1\] U.S. Patent Application US20220237111A1](#), Virtual Network configuration, communication among distributed Nodes, network distance and latency, communication protocols, interface testing, interoperability testing, geographically remote Nodes, and interaction with real-world systems
- [\[DTE2\] Non-Traditional BAA Submission](#), Virtual Networks and Communication, geographically distributed systems, interoperability testing, and degraded or contested communications environments
- [\[DTE3\] Broad Agency Announcement White Paper](#), Virtual Networks and Communication, distributed interoperability testing, and degraded or contested environments

- [\[DTE5\] DIDO-TE Requirements Register](#), Virtual Networks and Communication, inter-node topology, and geographically distributed deployments
- [\[DTE9\] Distributed Immutable Data Object Reference Architecture \(DIDO-RA\)](#), distributed-system, DDS publish-subscribe, and Quality of Service concepts

Rationale

Distributed systems depend upon communication relationships among Nodes rather than upon the behavior of isolated Nodes alone.

A DIDO-TE [Test Environment](#) therefore requires a controlled communication environment in which the [Network Topology](#) and [Communication Characteristics](#) relevant to a test can be established independently of the physical infrastructure hosting the participating entities.

The [Virtual Network](#) represents the communication relationships required by the distributed system under test. Those relationships may involve virtual Nodes, [Real-World Nodes](#), Twin Realizations, management components, or other participating entities.

Separating the Virtual Network from its physical realization permits DIDO-TE to represent distributed systems whose participating entities are colocated, geographically separated, virtualized, physical, or distributed across heterogeneous infrastructure.

[Communication Characteristics](#) form part of the test conditions. Latency, communication protocol, Quality of Service, and [Degraded Communication Conditions](#) can affect distributed-system behavior even when the participating Nodes and application software remain unchanged.

These requirements define the capabilities required to establish and control those communication conditions. They do not prescribe a particular networking product, overlay technology, service mesh, DDS implementation, container-network implementation, cloud provider, or physical network.

Network-oriented Security requirements remain governed by C.4 Security Requirements. State and timing behavior that extends beyond Communication Characteristics remains governed by C.3.5 State and Time Control Requirements. Test actions that exercise interfaces or interoperability remain governed by the governing [Test Definition](#) and Test Execution requirements.

Applies To

- [DIDO-TE](#)
- [Virtual Network](#)
- [Network Topology](#)
- [Node](#)
- [Real-World Node](#)
- [Twin Realization](#)
- [Test Environment](#)
- [Test Definition](#)
- [Test Execution](#)
- [Configuration](#)
- [Communication Characteristic](#)
- [Communication Parameter](#)

- [Degraded Communication Condition](#)
- [Quality of Service](#)
- [DDS](#)

Traceability

- [NET-001 — Establish a Virtual Network](#)
- [NET-002 — Define Virtual Network Topology](#)
- [NET-003 — Connect Nodes Through a Virtual Network](#)
- [NET-004 — Configure Communication Characteristics](#)
- [C.3 Functional Requirements](#)
- [Annex C: Requirements](#)

ConOps Relationship

This requirement family supports establishment and control of the communication environment used during distributed Test Execution.

The ConOps describes how Nodes, Twin Realizations, Real-World Nodes, and other participating entities are connected through a Virtual Network and how configured Communication Characteristics and Degraded Communication Conditions are applied during testing.

The requirement family remains product-neutral. A realization may use physical networks, virtual networks, overlays, container networking, software-defined networking, DDS, other middleware, or combinations of these mechanisms.

Delivery Phase

TBD

Requirement Status

Draft

Notes for Editors

Virtual Network and Communication requirements use the NET requirement prefix.

The explicit links under Contents remain while the Virtual Network and Communication requirement pages are being created and reviewed. After all planned requirement pages exist, you may remove the explicit links because the `indexmenu` automatically discovers them.

Apply the requirement identification, decomposition, source and derivation, normative-language, quality, status, and page-structure rules defined by Annex C.

NET-004 is a non-leaf requirement group because independently verifiable Communication Characteristics should be decomposed into separate leaf requirements. Candidate subordinate requirements include communication latency, communication protocols, and Quality of Service. Add other Communication Characteristics only when an authoritative source or approved architectural derivation establishes the requirement.

Do not infer packet loss, jitter, bandwidth constraints, routing behavior, firewall behavior, or other specific network impairments solely from a [Degraded Communication Condition](#) or the source phrase degraded or contested communications. Derive such requirements separately when their source and required semantics are established.

Do not prescribe DDS, Kubernetes networking, a service mesh, a software-defined network, a cloud virtual network, or another implementation technology in a canonical NET requirement unless the governing source explicitly requires that technology.

Network Security requirements belong under C.4 Security Requirements unless the requirement specifically defines functional Virtual Network behavior.

Interoperability assessment belongs under the applicable Interoperability, Test Definition, Test Execution, Baseline and Comparison, or Validation requirement family. C.3.4 provides the communication conditions under which those assessments occur.

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<https://wiki.didosolutions.com/dido/03-dido-te/99-annexes/annex-c-requirements/03-functional-requirements/03-04-virtual-network-and-communication-requirements/start>

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