



Spirent MEF SD-WAN Product Certification Test Report

Certification Participant: **Fortinet**

Report ID: FRTNT-P-SDWAN-20-0008-06-2020

Test Report Prepared for:
Fortinet
FortiGate 100F

Prepared by:
Vijayendra Deshpande
Spirent Communications

06-22-2020

Table of Contents

Executive Summary	1
Introduction	1
Certification Test Environment	4
Certification Testing Methodology	6
MEF SD-WAN Service Certification Success Criteria	8
MEF SD-WAN Service Certification Test Results	8
Certification Testing Highlights	8
Appendix A: List of MEF SD-WAN Certification Test Cases Passed:	9
MEF SD-WAN Passed Test Cases:	10
Certification Testing References	15
Abbreviations	15

Executive Summary

In June 2020, Spirent performed an independent certification test of the Fortinet SD-WAN product in accordance with the MEF SD-WAN Certification Test Requirements, MEF 90 Draft Standard (R1).

The certification testing was overseen by Spirent's team of engineers, in conjunction with the Certification Participant (CP) staff. The certification testing was undertaken in Spirent's SD-WAN Certification Lab in San Jose, CA.

The SD-WAN Certification Environment, described in the Certification Plan, consists of a three-SD-WAN Virtual Connection End Point (SWVC-EP), running over an emulated set of Underlay Connectivity Services (UCS).

The Fortinet SD-WAN product was successfully certified, as 100% of the required test cases passed representing 42 of the 92 MEF SD-WAN Certification Test Cases.

This certification has been added to the [MEF Technology Certification Registry](#), which is on the [MEF public website](#).

Introduction

In 2019, [MEF introduced the industry's first SD-WAN services standard, MEF 70](#).

The MEF 70 SD-WAN Service Attributes and Services Standard defines the externally-visible behavior of a standardized SD-WAN Service. The Service description is based on an agreement between an SD-WAN Subscriber (the buyer) and an SD-WAN Service Provider (the seller) that includes agreement on the values of a set of SD-WAN Service Attributes defined in MEF 70.

The [MEF SD-WAN certification program](#) verifies conformance with MEF 70, and is based on the MEF SD-WAN Certification Test Requirements specified in the [MEF 90 standard](#). At the time of publication of this test report, MEF 90 was approved as a MEF Draft Standard.

[Spirent was selected as Authorized Certification Test Partner \(ACTP\)](#), and authorized to certify SD-WAN services and products. MEF and Spirent collaborated on the SD-WAN Certification Program, resulting in new standards and specifications that are aligned and traceable to the requirements in MEF 70.

This Test Report documents the MEF SD-WAN product certification testing and includes the following sections:

- Certification methodology- which includes the certification lifecycle
- Certification testing environment
 - Certification test configuration (Lab)
 - Emulated Underlay Connectivity Services
- Hardware
 - SD-WAN Virtual Connection Endpoints
 - SD-WAN Controller/Management software
 - SD-WAN Certification Traffic Generator/Analyzer- Used to generate and analyze the test patterns
 - Network Emulator- Used to emulate the UCS
- Certification Testing Methodology- which describes the detailed testing approach.
- Certification Success Criteria- Describes all areas that must be completed in order to complete the certification
- Certification Test Results- Outcomes of each of the required test cases
- Certification Test Run- the required set of test cases that will be verified in this certification
- Certification Document References- lists the specific version for each document:
 - MEF 70 Services Standard
 - MEF SD-WAN Certification Test Requirements MEF 90, Draft Standard
 - Spirent SD-WAN Certification Test Plan, which specifies the detailed testing approach for each test requirement defined in MEF 90

Certification Methodology

The primary goal for the SD-WAN certification is to verify conformance with the MEF 70 SD-WAN service standard. While this is a step towards multi-vendor SD-WAN, the certification does not explicitly validate interoperability among multiple vendors' SD-WAN equipment.

Summarized below is a high-level lifecycle for the MEF SD-WAN certification:

- Certification planning- ACTP Spirent and CP exchange sufficient information to plan the certification
- Deploy certification test environment- Certification testing for SD-WAN products is performed in Spirent's SD-WAN certification lab in San Jose, CA. The goal for this phase is to successfully bring up the certification test environment, that enables Spirent to remotely execute and manage the test cases
- Pre-certification testing- Execute the initial Certification Run, from beginning to end, in order to:
 - Validate that the certification test environment is operational, including all management connectivity
 - Quickly assess which test cases will pass, and which will not
- Certification testing
 - Execute each of the required test case
 - For test cases that fail, the disposition could be:
 1. Test configuration is invalid
 2. Specification issue
 3. SD-WAN Endpoint and/or management issue
 4. SD-WAN Certification Test Suite issue
 - Once the problem has been troubleshooted/isolated, Spirent and CP will coordinate on the solution and then converge on a revised plan to resume the certification testing.

- Final Certification Run
 - Once all of the issues have been resolved, Spirent will execute one final Certification Test Run to verify that 100% of the required test cases pass, with no changes to the certification test environment
- Success!
 - Once the final certification test run has passed, Spirent will notify MEF of the new certification
 - MEF will issue a certificate, and update the [MEF 3.0 services certification registry](#) on MEF.net
 - Spirent will then document the certification test results in the Test Report, which remains the exclusive property of the CP

Certification Test Environment

The certification test environment is illustrated in Figure 1, and is comprised of an emulated SD-WAN Virtual Connection (SWVC) instance, consisting of three 'sites', in the configured described below:

- Live instance of the emulated SD-WAN overlay service
- User Network Interface (UNI), providing access to the emulated service
- 1 SWVC-EP FortiGate 100F appliance
- Connectivity to the SWVC-EP (for EP configuration and management)
- Two emulated UCS i.e., WAN connections); emulated UCS services are provided at Layer 3 may support IPv4. or IPv6, or both IPv4 and IPv6 addressing. In this certification, only IPv4 addressing was utilized.
- Each emulated UCS supports operational characteristics that will be tested, such as INTERNET-BREAKOUT and PUBLIC/PRIVATE
- 1 Test Generator/Test Analyzer (TG/TA)
- Local connectivity to the TG/TA (for test case management)
- Two Local Mirror Ports (required for Encryption policy test case execution, if included in the Certification Run

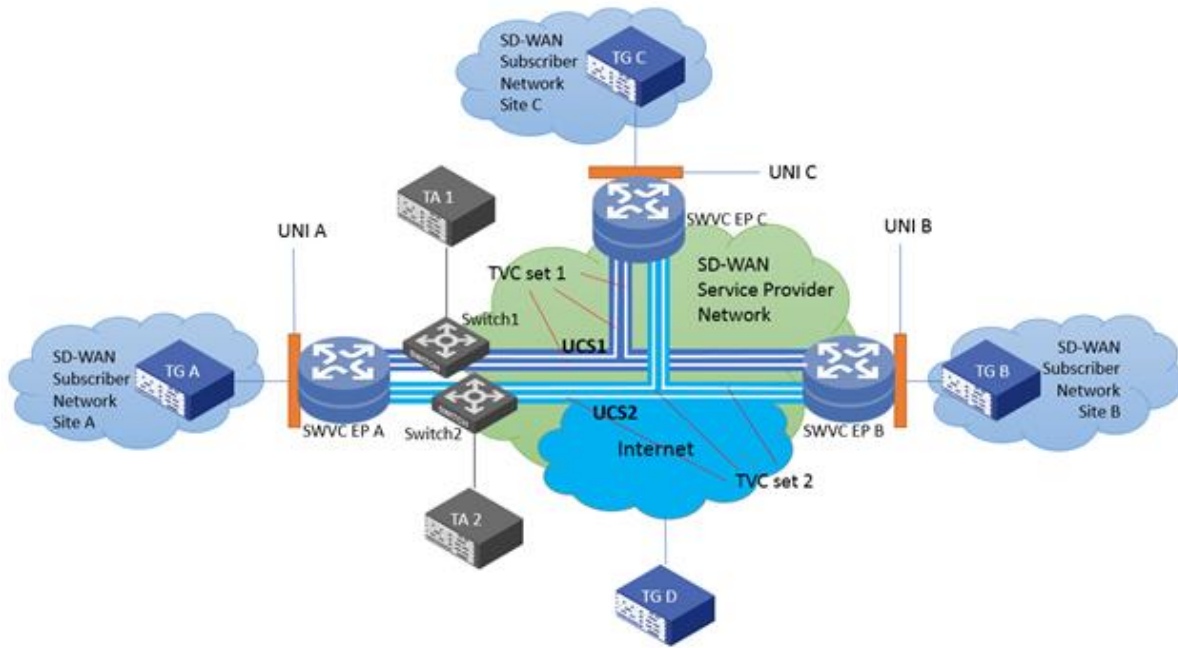


Figure 1 MEF SDN-WAN Service Certification Testbed Topology

Table 2 lists all the hardware and associated software versions used in the testbed.

Table 2: Hardware

System Under Test	Serial Number	Software Version
FortiManager-VM64	FMG-VMTM20004418	v6.2.5-build1307 200515 (GA)
FortiGate 100F	FG100FTK19015035 FG100FTK19014866 FG101FTK19002822	V6.2.3 build 5648 (interim) V6.2.3 build 5648 (interim) V6.2.3 build 5648 (interim)
Spirent TestCenter N4U SPT N4U Chassis	E16100671	5.05.8676

Certification Testing Methodology

This section describes the detailed testing methodology for the certification testing. The Spirent SD-WAN Certification Test Suite is comprised of 92 test cases, of which a subset is executed for the certification

Spirent implemented the Spirent SD-WAN Certification Test Suite, in accordance with the Spirent SD-WAN Certification Test Plan, which executes on the Spirent Test Center (STC) appliance. The STC appliance realizes the Test Generation/Test Analyzer TG/TA functions illustrated in Figure 1.

The SD-WAN certification testing is performed through the UNI, such that the SWVC appears to the test expert as a Black Box (with one exception described below).

The Spirent/MEF SD-WAN Certification testing approach is described as follows:

- Testing will be managed by Spirent certification experts, which are supported by vendor engineers
- For each test case, Spirent will configure the SWVC-EP using the vendor SD-WAN controller/manager, and manage the test case execution through the STC management interface
- Test cases have been carefully designed and automated to allow all testing to be performed through the UNI (with one exception described below for Encryption Policy verification).
- MEF 70 Policy testing requires specific configuration of the emulated UCS/TVC:
 - For Bandwidth Policy testing, one emulated UCS/TVC is configured to provide sufficient bandwidth to support the Application Flow bandwidth requirements, and the other emulated UCS/TVC is configured to provide less bandwidth than required for the test.
 - For Encryption Policy testing, direct access to the emulated UCS is required (through an Ethernet switch) to mirror the application flows (prior to encryption) to a STC TG/TA for traffic capture and analysis; this is needed because the SWVC-EP encrypts/decrypts egress/ingress traffic at the SWVC-EP, so the STC must capture the traffic before encryption/after decryption.
- Upon completion, Spirent will record and assess the test case results.

Certification Testing Environment Notes

- The Device Under Test (DUT) for this certification is the SWVC-EP
- Spirent and CP will collaborate on obtaining technical support from the vendor throughout the certification
- Application test flows are directed toward an SWVC-EP over an ingress SD-WAN service UNI and received from a SWVC-EP over an egress SD-WAN service UNI.
- The STC TG/TA accesses the service at each site at the UNI, and generates, receives, and analyzes the certification test patterns.
- Most of the test cases require only two sites, where Site A sends application flows to Site B
- Test cases for IPv4 reachability, unreachability, and longest prefix match use three subscriber sites. In these test cases, the test case verifies that application flows sent by Site A to Site B are not mis-forwarded to Site C.
- Test cases that verify isolation between multiple SD-WAN service instances also use three sites in a similar manner
- Internet breakout test cases use Site A, B and the Internet breakout site (D)
- Should a test case fail, both Spirent and the CP collaborate to determine the source of the problem
- Once the root cause of the problem has been identified, Spirent and CP will discuss:
 - Corrective action required
 - Schedule to resume testing

MEF SD-WAN Service Certification Success Criteria

For each certification, the Certification Participant will identify the subset of the MEF SD-WAN Certification Test Cases that ACTP will verify in this certification. The distinct subset of test cases is referred to as the Certification Run, which is formally documented in the Statement of Work and Certification Plan.

In order to become certified:

- Certification Participant executes Spirent- Certification Participation agreement
 - Spirent Account Manager issues a quote for the certification
 - Certification Participant issues Purchase Order in accordance with the terms specified in the Spirent- Certification Participant Agreement
- Successfully complete a Certification Run, with Spirent confirming the validation/recording of the test results
 - The SD-WAN managed service must pass 100% of the Test Cases
 - The Certification Run consisting of the subset of test cases that will be verified in this certification will be executed, from beginning to end
 - No updates and software changes are allowed
- Certification Plan updated and archived on the Certification SharePoint site
- Spirent provides a Certification Test Report to the Certification Participant

MEF SD-WAN Service Certification Test Results

The SD-WAN service passed 100% of the required test cases listed in Appendix A in a single Certification Testing Run.

Certification Testing Highlights

- Passed 42 of 92 total test cases
- Passed all IPv4 only IP forwarding test cases including all transparency test cases with ipv4 header options
- Supports all IPv4 related application flow criteria defined in MEF SD-WAN service standard that can be used to describe an application flow
- Supports three of six MEF 70 policy criteria (refer to Section 8.5), including Encryption, PUBLIC_PRIVATE and INTERNET_BREAKOUT.
- Supports all UNI Layer 2 interface attributes
- Supports IPv4 connection addressing services

Appendix A: List of MEF SD-WAN Certification Test Cases Passed:

Fortinet FortiGate 100F

This section lists the Spirent SD-WAN certification test cases passed in this certification.

The Certification Plan lists the entire list of MEF SD-WAN certification test cases, which at the time of publication of this Test Report includes 92 test cases.

Test cases are either mandatory or optional. Should a particular feature be supported, mandatory test cases must pass to certify the feature; optional test cases need not be executed.

The Certification Run describes the set of required test cases that will be verified in this certification. Required test cases include both Mandatory, Feature Mandatory, and Optional tests, depending upon the functionality that is certified.

Test Cases are broken down into the following areas:

- IP Forwarding
- SWVC Service Attributes
- Application Flows Service Attributes
- Policies Service Attributes- While no one policy attribute is required, the service must verify three of the six policies in order to be certified
- End Point Policy Map Service Attributes
- UNI L2 Interface Service Attributes
- Addressing- Either IPv4 or IPv6 or both IPv4 & IPv6 addressing must be supported

MEF SD-WAN Passed Test Cases:

Fortinet FortiGate 100F

Test Area	Test Rqmt (MEF 90)	Test Case Name	Test Case ID	Pass/Fail
IP Forwarding	R3[T]	MEF SD-WAN IP Forwarding IPv4 Destination Reachable	MEF_SD-WAN_IP_Forwarding.001	Pass
IP Forwarding	R3[T]	MEF SD-WAN IP Forwarding IPv4 Destination Unreachable	MEF_SD-WAN_IP_Forwarding.002	Pass
IP Forwarding	R3[T]	MEF SD-WAN IP Forwarding IPv4 Longest Prefix Match	MEF_SD-WAN_IP_Forwarding.003	Pass
IP Forwarding	R4[T]	MEF SD-WAN IP Forwarding IPv4 Transparency	MEF_SD-WAN_IP_Forwarding.007	Pass
IP Forwarding	R4[T]	MEF SD-WAN IP Forwarding IPv4 Transparency LSRR	MEF_SD-WAN_IP_Forwarding.008	Pass
IP Forwarding	R4[T]	MEF SD-WAN IP Forwarding IPv4 Transparency SSRR	MEF_SD-WAN_IP_Forwarding.009	Pass
IP Forwarding	R4[T]	MEF SD-WAN IP Forwarding IPv4 Transparency RR	MEF_SD-WAN_IP_Forwarding.010	Pass
Application Flows Svc. Attribute	R13[T]	MEF SD-WAN SWVC Receiver IPv4 Address Overlap	MEF_SD-WAN_SWVC.001	Pass
Application Flows Svc. Attribute	R13[T]	MEF SD-WAN SWVC Sender IPv4 Address Overlap	MEF_SD-WAN_SWVC.002	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 SA	MEF_SD-WAN_Application_Flow.002	Pass

Test Area	Test Rqmt (MEF 90)	Test Case Name	Test Case ID	Pass/Fail
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 SA Discard	MEF_SD-WAN_Application_Flow.003	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 DA	MEF_SD-WAN_Application_Flow.004	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 DA Discard	MEF_SD-WAN_Application_Flow.005	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 SA or DA	MEF_SD-WAN_Application_Flow.006	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 Protocol	MEF_SD-WAN_Application_Flow.007	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 Protocol List	MEF_SD-WAN_Application_Flow.008	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 SPort	MEF_SD-WAN_Application_Flow.016	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 SPort List	MEF_SD-WAN_Application_Flow.017	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 DPort	MEF_SD-WAN_Application_Flow.018	Pass

Test Area	Test Rqmt (MEF 90)	Test Case Name	Test Case ID	Pass/Fail
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 DPort List	MEF_SD-WAN_Application_Flow.019	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 Sport or DPort	MEF_SD-WAN_Application_Flow.020	Pass
Application Flows Svc. Attribute	R46[T]	MEF SD-WAN Application Flow IPv4 Sport or DPort List	MEF_SD-WAN_Application_Flow.021	Pass
Application Flows Svc. Attribute	R43[T]	MEF SD-WAN Application Flow IPv4 Criteria Matching 01	MEF_SD-WAN_Application_Flow.028	Pass
Application Flows Svc. Attribute	R43[T]	MEF SD-WAN Application Flow IPv4 Criteria Matching 02	MEF_SD-WAN_Application_Flow.030	Pass
Application Flows Svc. Attribute	R44[T]	MEF SD-WAN Application Flow Matching Order	MEF_SD-WAN_Application_Flow.032	Pass
Service Attribute	R48[T]	MEF SD-WAN Application Flow Any	MEF_SD-WAN_Application_Flow.033	Pass
Policies Service Attribute	R23[T]	MEF SD-WAN Policy Encryption Yes	MEF_SD-WAN_Policy.001	Pass
Policies Service Attribute	R24[T]	MEF SD-WAN Policy Encryption Either	MEF_SD-WAN_Policy.002	Pass

Test Area	Test Rqmt (MEF 90)	Test Case Name	Test Case ID	Pass/Fail
Policies Service Attribute	R25[T]	MEF SD-WAN Policy Private Only	MEF_SD-WAN_Policy.003	Pass
Policies Service Attribute	R26[T]	MEF SD-WAN Policy Public Private Either	MEF_SD-WAN_Policy.004	Pass
Policies Service Attribute	R27[T], R28[T]	MEF SD-WAN Policy Internet Breakout True	MEF_SD-WAN_Policy.005	Pass
Policies Service Attribute	R29[T]	MEF SD-WAN Policy Internet Breakout Criteria Ignore	MEF_SD-WAN_Policy.006	Pass
End Point Policy Map	R51[T], R54[T], R55[T]	MEF SD-WAN Policy Mapping Override	MEF_SD-WAN_Policy_Map.001	Pass
Service Attribute	R56[T]	MEF SD-WAN Policy Mapping Block	MEF_SD-WAN_Policy_Map.002	Pass
UNI L2 I/F Service Attribute	Test INF10_2.1	MEF SD-WAN L2 Interface UT PT	MEF_SD-WAN_L2_Interface.001	Pass
UNI L2 I/F Service Attribute	R60[T]	MEF SD-WAN L2 Interface Packet Length	MEF_SD-WAN_L2_Interface.003	Pass
UNI L2 I/F Service Attribute	R59[T]	MEF SD-WAN L2 Interface Packet FCS Error	MEF_SD-WAN_L2_Interface.004	Pass

Test Area	Test Rqmt (MEF 90)	Test Case Name	Test Case ID	Pass/Fail
UNI L2 I/F Service Attribute	R59[T]	MEF SD-WAN L2 Interface Packet Runt	MEF_SD-WAN_L2_Interface.005	Pass
UNI L2 I/F Service Attribute	R59[T]	MEF SD-WAN L2 Interface Packet 64bytes Tagged	MEF_SD-WAN_L2_Interface.006	Pass
UNI L2 I/F Service Attribute	R59[T]	MEF SD-WAN L2 Interface Packet 64bytes Untagged	MEF_SD-WAN_L2_Interface.007	Pass
UNI L2 I/F Service Attribute	D2[T]	MEF SD-WAN L2 Interface Packet Giant	MEF_SD-WAN_L2_Interface.008	Pass
IPv4 Connection Addressing	R62[T], R63[T]	MEF SD-WAN IPv4 Addressing DHCP	MEF_SD-WAN_IPv4_Address.001	Pass

Certification Testing References

No.	Reference	Version	Web Link
1	MEF 70 SD-WAN Service Attributes and Services	R1 (7/29/2019)	https://www.mef.net/resources/technical-specifications/download?id=122&fileid=file1
2	MEF W90 SD-WAN Certification Test Requirements	MEF 90 Draft Standard (R1), January, 2020	MEF 90 SD-WAN Certification Test Rqmts
3	Spirent SD-WAN Certification Test Plan	WD 0.3	Requires MEF permissions to access Wiki Page: https://wiki.mef.net/display/CECX/SD-WAN+Certification+Test+Plan

Abbreviations

No.	Acronym	Description
	ACTP	Authorized Certification Testing Partner
	CP	Certification Participant
	LTE	Long Term Evolution (4G)
	MEF	Metro Ethernet Forum
	MPLS	Multi-Protocol Label Switching
	MSP	Managed Service Provider
	SD-WAN	Software Defined Wide Area Network
	SD-WAN TA	SD-WAN Traffic Analyzer
	SD-WAN TG	SD-WAN Traffic Generator
	SP	Service Provider
	STC	Spirent Test Center
	SWVC	SD-WAN Virtual Connection
	SWVC-EP	SD-WAN Virtual Connection Endpoints
	TVC	Tunnel Virtual Connection
	UCS	Underlay Connectivity Service
	UNI	User Network Interface

About Fortinet

Fortinet (NASDAQ: FTNT) secures the largest enterprise, service provider, and government organizations around the world. Fortinet empowers its customers with intelligent, seamless protection across the expanding attack surface and the power to take on ever-increasing performance requirements of the borderless network—today and into the future. Only the Fortinet Security Fabric architecture can deliver security without compromise to address the most critical security challenges, whether in networked, application, cloud, or mobile environments. Fortinet ranks number one in the most security appliances shipped worldwide and more than 450,000 customers trust Fortinet to protect their businesses.

<https://www.fortinet.com/>

About Spirent Communications

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks.

We help bring clarity to increasingly complex technological and business challenges and assure your SD-WAN journey. As an active partner in developing many industry standards and testing protocols, Spirent is uniquely positioned as a trusted advisor. With Spirent SD-WAN testing solutions, you can expedite innovation, accelerate time-to-market of new products and services, tap into new revenues and savings, improve customer experiences, and fulfill your promise of assured performance.

For more information, visit: www.spirent.com/sd-wan

Contact Us

For more information, call your Spirent sales representative or visit us on the Web at www.spirent.com/ContactSpirent.

www.spirent.com

Americas 1-800-SPIRENT
+1-800-774-7368 | sales@spirent.com

Europe and the Middle East
+44 (0) 1293 767979 | emeainfo@spirent.com

Asia and the Pacific
+86-10-8518-2539 | salesasia@spirent.com

© 2020 Spirent Communications, Inc. All of the company names and/or brand names and/or product names and/or logos referred to in this document, in particular the name "Spirent" and its logo device, are either registered trademarks or trademarks pending registration in accordance with relevant national laws. All rights reserved. Specifications subject to change without notice.