



**Publicly Available Specification (PAS);
Intelligent Transport Systems (ITS);
MirrorLink®;
Part 17: MirrorLink® over Wi-Fi Display (WFD)**

CAUTION

The present document has been submitted to ETSI as a PAS produced by CCC and approved by the ETSI Technical Committee Intelligent Transport Systems (ITS).

CCC is owner of the copyright of the document CCC-TS-049 and/or had all relevant rights and had assigned said rights to ETSI on an "as is basis". Consequently, to the fullest extent permitted by law, ETSI disclaims all warranties whether express, implied, statutory or otherwise including but not limited to merchantability, non-infringement of any intellectual property rights of third parties. No warranty is given about the accuracy and the completeness of the content of the present document.

Reference

RTS/ITS-98-17

Keywords

interface, ITS, PAS, smartphone

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

©ETSI 2019.

© Car Connectivity Consortium 2011-2019.

All rights reserved.

ETSI logo is a Trade Mark of ETSI registered for the benefit of its Members.

MirrorLink® is a registered trademark of Car Connectivity Consortium LLC.

RFB® and VNC® are registered trademarks of RealVNC Ltd.

UPnP® is a registered trademark of Open Connectivity Foundation, Inc.

Other names or abbreviations used in the present document may be trademarks of their respective owners.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.

3GPP™ and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

oneM2M™ logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	4
Foreword.....	4
Modal verbs terminology.....	4
1 Scope	5
2 References	5
2.1 Normative references	5
2.2 Informative references.....	6
3 Definition of terms, symbols and abbreviations.....	6
3.1 Terms.....	6
3.2 Symbols.....	6
3.3 Abbreviations	6
4 Introduction	7
5 MirrorLink over WFD Procedure.....	9
5.1 General	9
5.2 Phase 1: WFD Connection Setup	9
5.3 Phase 2: UPnP Setup	11
5.4 Phase 3: WFD Session Setup	12
5.5 Phase 4: WFD Operation.....	14
5.6 Terminating a MirrorLink over WFD Session	16
6 WFD Audio	16
6.1 Audio Links.....	16
6.2 WFD Audio Forward Channel	17
6.3 WFD Audio Back Channel.....	17
6.4 Telephony over WFD.....	17
7 WFD User Input	17
7.1 General	17
7.2 UIBC Input Body Format for MirrorLink	18
7.2.1 General.....	18
7.2.2 Key Event	19
7.2.3 Pointer Event	19
7.2.4 Touch Event.....	19
7.2.5 Sink & Source Status Events	20
7.2.6 UI Context Event	20
7.2.7 UI Blocking Event	21
7.2.8 Audio Context Event	22
7.2.9 Audio Blocking Event	22
7.2.10 Sink& Source Cut Text Events.....	23
7.3 MirrorLink Specific RTSP Data Structures.....	23
7.3.1 General.....	23
7.3.2 wfd-uibc-capability parameter	23
7.3.3 wfd-uibc-setting parameter	25
8 WFD Content Protection	25
Annex A (normative): Key Event Table.....	26
Annex B (informative): Authors and Contributors.....	28
History	29

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 17 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.1].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document is part of the MirrorLink® specification which specifies an interface for enabling remote user interaction of a mobile device via another device. The present document is written having a vehicle head-unit to interact with the mobile device in mind, but it will similarly apply for other devices, which provide a color display, audio input/output and user input mechanisms.

The present specification describes the integration of Wi-Fi Display to MirrorLink.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are necessary for the application of the present document.

- [1] ETSI TS 103 544-2 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 2: Virtual Network Computing (VNC) based Display and Control".
- [2] ETSI TS 103 544-3 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 3: Audio".
- [3] ETSI TS 103 544-18 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 18: IEEE 802.11TM Car Connectivity Consortium (CCC) Information Element".
- [4] ETSI TS 103 544-12 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 12: UPnP Server Device".
- [5] Wi-Fi Alliance® Technical Committee, Wi-Fi Display Technical Task Group: "Wi-Fi Display Technical Specification" Version 1.0.0, September 2012.

NOTE: Available at <https://www.scribd.com/doc/250439511/Wi-Fi-Display-Technical-Specification-v1-0-0>.

- [6] ETSI TS 103 544-9 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 9: UPnP Application Server Service".
- [7] ETSI TS 103 544-13 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 13: Core Architecture".
- [8] IETF RFC 6143: "The Remote Framebuffer Protocol", March 2011.

NOTE: Available at <https://tools.ietf.org/html/rfc6143>.

- [9] IETF RFC 2131: "Dynamic Host Configuration Protocol", March 1997.

NOTE: Available at <https://tools.ietf.org/html/rfc2131>.

- [10] IETF RFC 2132: "DHCP Options and BOOTP Vendor Extensions", March 1997.

NOTE: Available at <https://tools.ietf.org/html/rfc2132>.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TS 103 544-1 (V1.3.1): "Publicly Available Specification (PAS); Intelligent Transport Systems (ITS); MirrorLink®; Part 1: Connectivity".
- [i.2] Wi-Fi Alliance®: "Best Practices Document for Wi-Fi CERTIFIED Miracast™ Devices", Version 1.0, September 2014.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

sink device: device that receives multimedia content from a WFD source over a Wi-Fi link and renders it

source device: device that supports streaming multimedia content to a WFD sink(s) over a Wi-Fi link

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AP	Access Point
AV	Audio-Video
BSS	Basic Service Sets
BT	Bluetooth
BVRA	Bluetooth Voice Recognition Activation
CCC	Car Connectivity Consortium
CDB	Common Data Bus
CRLF	Carrige-Return, Line Feed
DAP	Device Attestation Protocol
DHCP	Dynamic Host Configuration Protocol
HDCP	High-bandwidth Digital Content Protection
HFP	Hands-Free Profile
HIDC	Human Interface Device Class
IE	Information Element
IEEE	Institute of Electrical and Electronics Engineers
IOP	InterOPerability
IP	Internet Protocol
Miracast	Commercial denomination of WFD
ML	MirrorLink
OUI	Organizationally Unique Identifier
RFB	Remote FrameBuffer
RTP	Real-Time Protocol

RTSP	Real Time Streaming Protocol
SP	SPace
STA	STation
TCP	Transmission Control Protocol
TDLS	Tunneled Data Link Service
UI	User Interface
UIBC	User Input Back Channel
UPnP	Universal Plug and Play
URL	Universal Resource Locator
USB	Universal Serial Bus
VNC	Virtual Network Computing
WFD	Wi-Fi Display

NOTE: Which is the technology and specification being officially called "Wi-Fi Alliance Wi-Fi Display specification".

WLAN	Wi-Fi Local Area Network
XML	eXtensible Markup Language

4 Introduction

Wi-Fi Display, also known as Miracast, is a peer-to-peer wireless screen replication standard created by the Wi-Fi Alliance. Its main purpose is to let the source device project its screen to the sink device screen, and to provide the sink device with the method to control the source device.

Figure 1 shows the typical Client/Server topology for the MirrorLink over Wi-Fi Display.

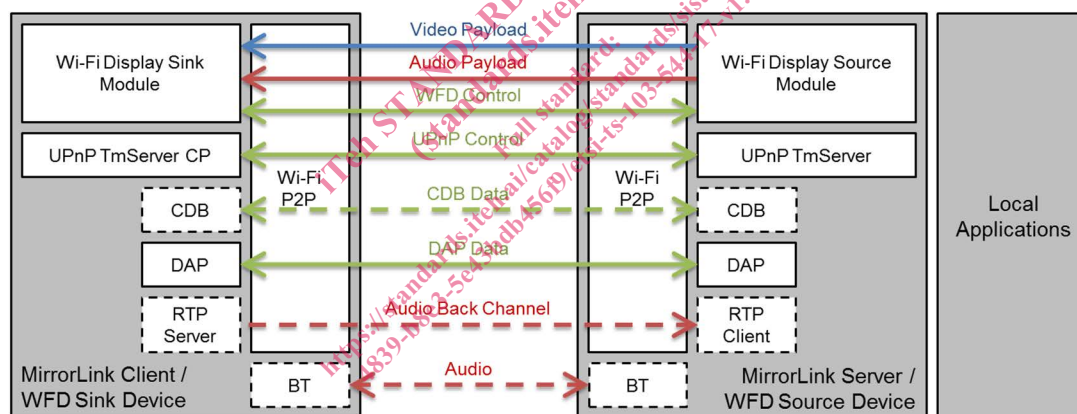


Figure 1: High Level Topology

The present document specifies the integration of Wi-Fi Display into MirrorLink, providing an alternative video link to VNC. The specification of the other MirrorLink components, like UPnP, CDB, DAP etc. is done in their respective documents.

The MirrorLink Client, providing WFD functionality, shall implement the WFD Sink functionality.

The MirrorLink Server, providing WFD functionality, shall implement the WFD Source functionality.

NOTE: The term "Sink" used in the present document refers to a WFD Primary Sink device as defined in [5].

Figure 2 displays the layered architecture diagram for the integration of WFD into MirrorLink. WFD stack is added to MirrorLink stack. The diagram applies to both Client and Server devices, which shall apply it according to their roles.

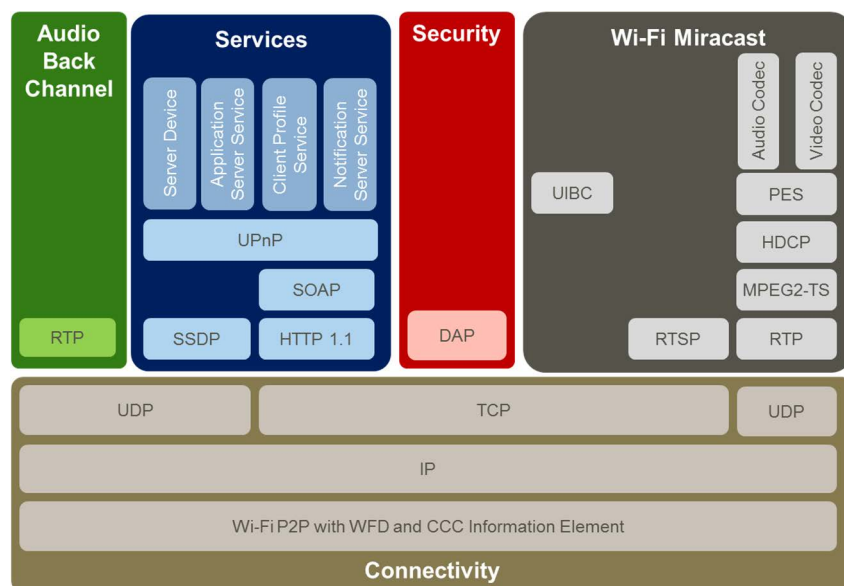


Figure 2: MirrorLink over Wi-Fi Display Architecture

Through Wi-Fi Display, MirrorLink Server and Client discover each other with the Wi-Fi Device Discovery procedure, which exchange the Information Element. WFD UIBC is integrated into MirrorLink stack for User Input.

MirrorLink Client and Server shall support all Wi-Fi Display mandatory functions and services, as described in [5], Table 3-1. This includes the following functions and services:

- WFD Device Discovery with IE for CCC
- WFD Connection Setup
- WFD Capability negotiation
- WFD Session establishment
- Encoding and packetization of the captured Display
- Transport of multiplexed audio and video payload
- De-multiplex, de-packetization and decode of received audio and video payload
- Rendering of decoded video on local display panel
- Power Save mechanisms
- Session termination
- Encode and packetization of captured audio
- Multiplex video and audio payload
- Rendering of decoded audio on local speakers
- AV Stream Control using RTSP

The MirrorLink Client and Server shall support the following optional Wi-Fi Display functions:

- User Input Back Channel (UIBC)

Use of BT HFP in accordance with the MirrorLink Audio Specification [2] shall be possible for the MirrorLink over WFD implementation as well.

5 MirrorLink over WFD Procedure

5.1 General

MirrorLink over Wi-Fi Display (WFD) connection between MirrorLink Server acting as WFD source device and MirrorLink Client acting as WFD sink device shall take place in the 4 following phases, as depicted in Figure 3.

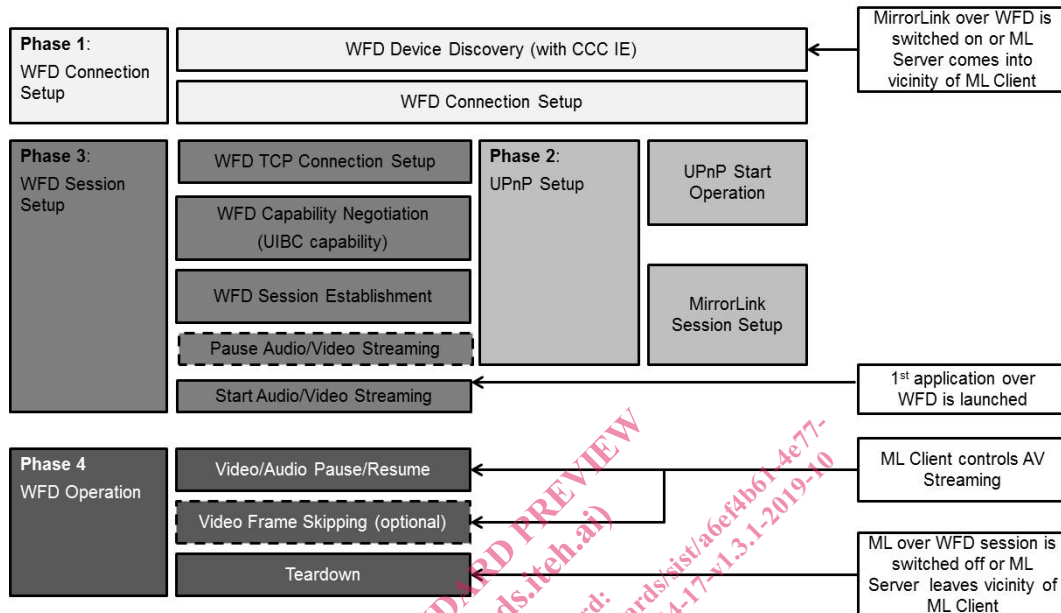


Figure 3: MirrorLink over Wi-Fi Display Diagram

5.2 Phase 1: WFD Connection Setup

Phase 1 shall start when MirrorLink over Wi-Fi Display is switched on. In addition, if persistent WFD Group for MirrorLink exists, it is recommended that WFD Connection setup proceeds automatically without user interaction such as re-selection of WFD & CCC capable device.

The following requirements apply to the phase 1:

WFD Device Discovery:

To establish a MirrorLink over Wi-Fi Display connection, Wi-Fi P2P device discovery with WFD IE (Information Element) shall be used. Wi-Fi Display devices shall advertise the WFD IEs defined in Wi-Fi Display specification.

In addition to the WFD IEs, the MirrorLink devices shall include the CCC Information Element that shall contain the MirrorLink UPnP Device Information sub-element and may contain the Internet Accessibility sub-element, as specified in [3], into all beacon, probe request and probe response frames. The MirrorLink devices shall detect other MirrorLink devices through CCC IE.

Detection of the CCC Information Element, together with the WFD Information Element, is sufficient for a Wi-Fi P2P device to determine that the sending Wi-Fi P2P device is supporting MirrorLink over WFD. In case Tunneled Data Link Service (TDLS) is used, the CCC Information shall also be tunneled through the Wi-Fi Access Point.

In case a MirrorLink Server is a Wi-Fi P2P concurrent device, i.e. connected to the MirrorLink Client's Access Point as a WLAN STA and implements a Wi-Fi P2P device, both interfaces will belong to different Basic Service Sets (BSS). In this case the MirrorLink Client and Server should use regular Wi-Fi P2P connection setup to establish the WFD session.

Wi-Fi P2P defines 2 phases for device discovery (refer to [5] for details). In the *Scan* phase, P2P devices collect information about surrounding devices or networks by scanning all supported channels. Devices may actively send Probe Request frames to look for Legacy AP or P2P Group Owners. The *Find* phase has two states, a *Search* and a *Listen* state. Within the *Search* state, P2P devices go through a fixed set of channels and send Probe Requests. Within the *Listen* state, P2P devices wait on a fixed channel and respond to received Probe Requests.

In case of an existing P2P Group, an existing P2P GO, or an existing Legacy AP (using TDLS), successful discovery is possible in *Scan* phase, assuming that all devices are operational. In case no P2P Group exists, one device has to be in *Find/Search* state, while the other device has to be in *Find/Listen* state to ensure successful device discovery.

Typically, most MirrorLink Servers will only be in *Scan* phase in regular intervals. Additionally, a MirrorLink Server may only go into *Scan* phase after a user interaction. Therefore, establishment of a MirrorLink over WFD connection may need manual interaction from the consumer, at least for the initial connection setup.

The MirrorLink Client, supporting MirrorLink over WFD, should switch on Wi-Fi P2P and start the WFD Device Discovery, latest when the MirrorLink Client gets powered on, otherwise the MirrorLink Client shall provide a consumer accessible mechanism, which will enable WFD Device Discovery.

The MirrorLink Server, supporting MirrorLink over WFD, shall provide a consumer accessible mechanism, which will enable the Wi-Fi P2P Device Discovery. This mechanism may only be usable, after the consumer has switched on the Wi-Fi radio.

The mechanism to enable WFD Device Discovery will only ensure the Wi-Fi P2P connection setup. This should not automatically start the WFD stream.

WFD Connection Setup

A WFD connection setup using Wi-Fi P2P shall be supported. A WFD connection setup using TDLS should not be used.

The MirrorLink devices shall follow the process of Wi-Fi P2P/WFD as specified in [5].

The MirrorLink devices shall connect to a device, which includes a WFD IE and a CCC IE. To establish a P2P connection for a WFD connection setup, the MirrorLink devices shall also include the CCC Information Element that shall contain the MirrorLink UPnP Device Information sub-element and may contain the Internet Accessibility sub-element, as specified in [3], when transmitting the P2P Invitation Request, P2P Invitation Response, GO Negotiation Request, GO Negotiation Response, GO Confirmation, Association/Reassociation Request and Association/Reassociation Response frames.

The Persistence WFD Group allows automatic WFD connection through caching the information for the Group. To establish a Persistence WFD Group, the MirrorLink devices should follow the process of WFD as specified in [5].

WFD Automatic Re-Connection

The MirrorLink Server and Client should allow for automatic reconnection, in case the devices are known, and known to have used MirrorLink over WFD recently.

In case automatic reconnection is supported, the MirrorLink Client shall either automatically switch on Wi-Fi P2P and start the WFD Device Discovery or shall automatically switch on Bluetooth. In case it recognizes a known MirrorLink Server to which it had previously connected via MirrorLink over WFD, it shall automatically attempt to reconnect, unless automatic reconnection is disabled from the consumer.

In case automatic reconnection is supported, the MirrorLink Server shall either automatically switch on Wi-Fi P2P and start the WFD Device Discover or shall automatically switch on Bluetooth. In case it recognizes a known MirrorLink Client to which it had previously connected via Mirror MirrorLink over WFD, it shall automatically attempt to reconnect, unless automatic reconnection is disabled from the consumer.

MirrorLink Clients and Servers supporting automatic reconnection should implement Persistent WFD Group over P2P.