Car Connectivity Consortium

MirrorLink®

Core Architecture

Version 1.1.0
(CCC-TS-032)

VERSION HISTORY

Version	Date	Comment
0.9	26 April 2010	Draft public release
1.0	06 October 2010	Public release
1.0.1	22 April 2011	Release Candidate
1.0.1	26 June 2011	Approved by Board of Directors
1.1	23 January 2012	Release Candidate
1.1	31 March 2012	Approved Version

LIST OF CONTRIBUTORS

Brakensiek, Jörg (Editor) Nokia Corporation

LEGAL NOTICE

The copyright in this Specification is owned by the Car Connectivity Consortium LLC ("CCC LLC"). Use of this Specification and any related intellectual property (collectively, the "Specification"), is governed by these license terms and the CCC LLC Limited Liability Company Agreement (the "Agreement").

Use of the Specification by anyone who is not a member of CCC LLC (each such person or party, a "Member") is prohibited. The legal rights and obligations of each Member are governed by the Agreement and their applicable Membership Agreement, including without limitation those contained in Article 10 of the LLC Agreement.

CCC LLC hereby grants each Member a right to use and to make verbatim copies of the Specification for the purposes of implementing the technologies specified in the Specification to their products ("Implementing Products") under the terms of the Agreement (the "Purpose"). Members are not permitted to make available or distribute this Specification or any copies thereof to non-Members other than to their Affiliates (as defined in the Agreement) and subcontractors but only to the extent that such Affiliates and subcontractors have a need to know for carrying out the Purpose and provided that such Affiliates and subcontractors accept confidentiality obligations similar to those contained in the Agreement. Each Member shall be responsible for the observance and proper performance by such of its Affiliates and subcontractors of the terms and conditions of this Legal Notice and the Agreement. No other license, express or implied, by estoppel or otherwise, to any intellectual property rights are granted herein.

Any use of the Specification not in compliance with the terms of this Legal Notice, the Agreement and Membership Agreement is prohibited and any such prohibited use may result in termination of the applicable Membership Agreement and other liability permitted by the applicable Agreement or by applicable law to CCC LLC or any of its members for patent, copyright and/or trademark infringement.

THE SPECIFICATION IS PROVIDED "AS IS" WITH NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS, AND COMPLIANCE WITH APPLICABLE LAWS.

Each Member hereby acknowledges that its Implementing Products may be subject to various regulatory controls under the laws and regulations of various jurisdictions worldwide. Such laws and regulatory controls may govern, among other things, the combination, operation, use, implementation and distribution of Implementing Products. Examples of such laws and regulatory controls include, but are not limited to, road safety regulations, telecommunications regulations, technology transfer controls and health and safety regulations. Each Member is solely responsible for the compliance by their Implementing Products with any such laws and regulations and for obtaining any and all required authorizations, permits, or licenses for their Implementing Products related to such regulations within the applicable jurisdictions.

Each Member acknowledges that nothing in the Specification provides any information or assistance in connection with securing such compliance, authorizations or licenses**.**

NOTHING IN THE SPECIFICATION CREATES ANY WARRANTIES, EITHER EXPRESS OR IMPLIED, REGARDING SUCH LAWS OR REGULATIONS. ALL LIABILITY, INCLUDING LIABILITY FOR INFRINGEMENT OF ANY INTELLECTUAL PROPERTYRIGHTS OR FOR NONCOMPLIANCE WITH LAWS, RELATING TO USE OF THE SPECIFICATION IS EXPRESSLY DISCLAIMED. BY USE OF THE SPECIFICATION, EACH MEMBER EXPRESSLY WAIVES ANY CLAIM AGAINST CCC LLC AND ITS MEMBERS RELATED TO USE OF THE SPECIFICATION.

CCC LLC reserve the right to adopt any changes or alterations to the Specification as it deems necessary or appropriate.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

TERMS AND ABBREVIATIONS

A2DP	Bluetooth Advanced Audio Distribution Profile
ARP	Address Resolution Protocol
BT	Bluetooth
CDB	Common Data Bus
CDC	Communications Device Class; specified from USB Device Working Group
CE	Consumer Electronics; CE devices are referred to as mobile devices within this specification
DAP	Device Attestation Protocol
DHCP	Dynamic Host Configuration Protocol
ECM	Ethernet Control Model; part of the CDC device class
HFP	Bluetooth Hands-free Profile
HSP	Bluetooth Headset Profile
HMI	Human Machine Interface
HU	Head-unit (this term is used interchangeably with the MirrorLink client)
HS	Head-set
IP	Internet Protocol
NCM	Network Control Model; part of the CDC device class
Pointer Event	Pointer events are used to describe touch screen action in which the user touches the screen with one (virtual) finger only at a single location.
RFB	Remote Framebuffer
RTP	Real-time Transport Protocol
SBP	Service Binary Protocol
TCP	Transmission Control Protocol
Touch Event	Touch events are used to describe touch screen action in which the user touches the screen with two or more separate fingers at different locations. Touch events are used to describe more complex touch action, like pinch-open or pinch-close.
UDP	User Datagram Protocol
UI	User Interface
UPnP	Universal Plug and Play
USB	Universal Serial Bus
VNC	Virtual Network Computing

1 ABOUT

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

This document is aimed at people going to design and develop compliant solutions. This set of documents will provide all necessary interface functionality and requirements to implement a fully compliant device, on both the mobile device and the head-unit side.

The specification lists a series of requirements, either explicitly or within the text, which are mandatory elements for a compliant solutions. Recommendations are given, to ensure optimal usage and to provide suitable performance. All recommendations are optional.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are following the notation as described in RFC 2119 [13].

1. MUST: This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
2. MUST NOT: This phrase, or the phrase "SHALL NOT", mean that the definition is an absolute prohibition of the specification.
3. SHOULD: This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
4. SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
5. MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option MUST be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option MUST be prepared to interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.)

The document will focus on the interface functionality, its parameters and protocols only. It does not provide any guidelines for implementing the protocol. If there is a reference towards an implementation, this is of informative nature only.

2 INTRODUCTION TO MIRRORLINK

MirrorLink provides a concept for integrating the mobile device (hereinafter referred to as the "MirrorLink server") and the vehicle head-unit (hereinafter referred to as the "MirrorLink client"). In a MirrorLink context, the control and interaction of applications and services running on the mobile device will be replicated into the car environment. Diverting display and audio output to the car head-unit come together with receiving key and voice control input from it are the main interaction streams, as shown in the following figure.

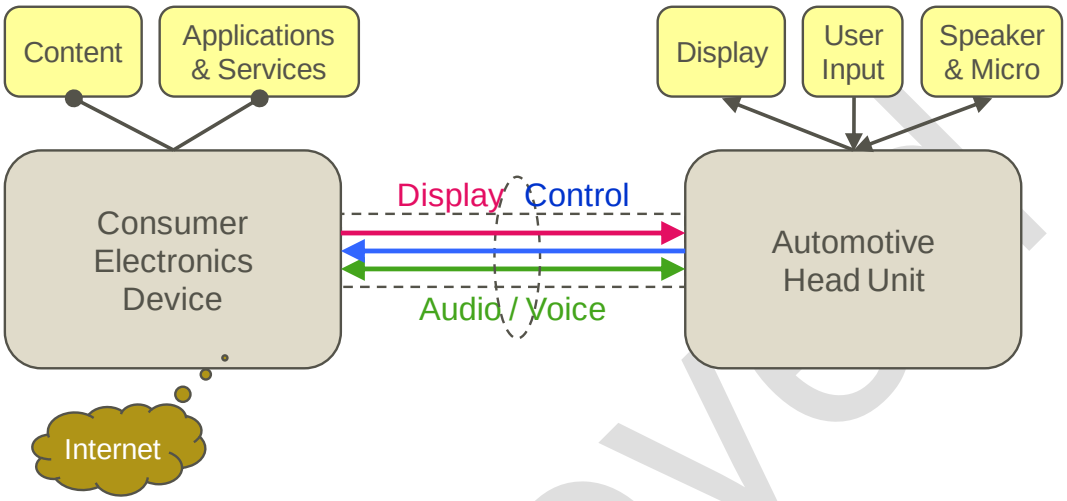

Figure 1: MirrorLink Concept

The result is a concept somewhere between running the applications natively in the mobile phone or in the car unit. From the user experience point of view it can offer "the best of the both worlds" where the large variety of mobile phone applications is complemented and enhanced by the car system providing convenient and safe means for using (i.e. controlling) these applications.

It is easier to add new consumer electronic functionalities into the vehicle environment via a mobile device than integrating them into the car infotainment system. In any case, the usage of those applications will become more convenient if the same device with the same content stored in it can be used in all the different environments from home to car, and providing Internet connectivity at the same time. On the other hand, the large displays of the car units can enhance the user experience from what the mobile device can offer by itself.

In addition the mobile device typically provides the latest technologies, from radio connectivity, to multimedia codecs. At the same time, the openness of the platforms, allows delivery of new applications and services at any time.

There are no standard methods currently defined for MirrorLink connectivity. However, when creating the required solutions, technologies provided by existing open, non-proprietary standards - like USB, TCP/IP, VNC, UPnP etc. - SHOULD be used as the basis. The needed additional elements SHOULD then be developed and agreed in cooperation between the related industry sectors.

The car systems comprise of several different methods for user interaction, like individual keys, rotating knobs, touch screen and even voice-activated control. For proper interoperability, the control method towards the mobile device SHOULD be the same regardless of the actual input mechanism on the car side. Furthermore, to ensure that MirrorLink does provide interoperability independent of any application, even legacy ones, it hooks into low-level abstraction.

3 MIRRORLINK ARCHITECTURE

The MirrorLink high-level architecture is shown in the following figure.

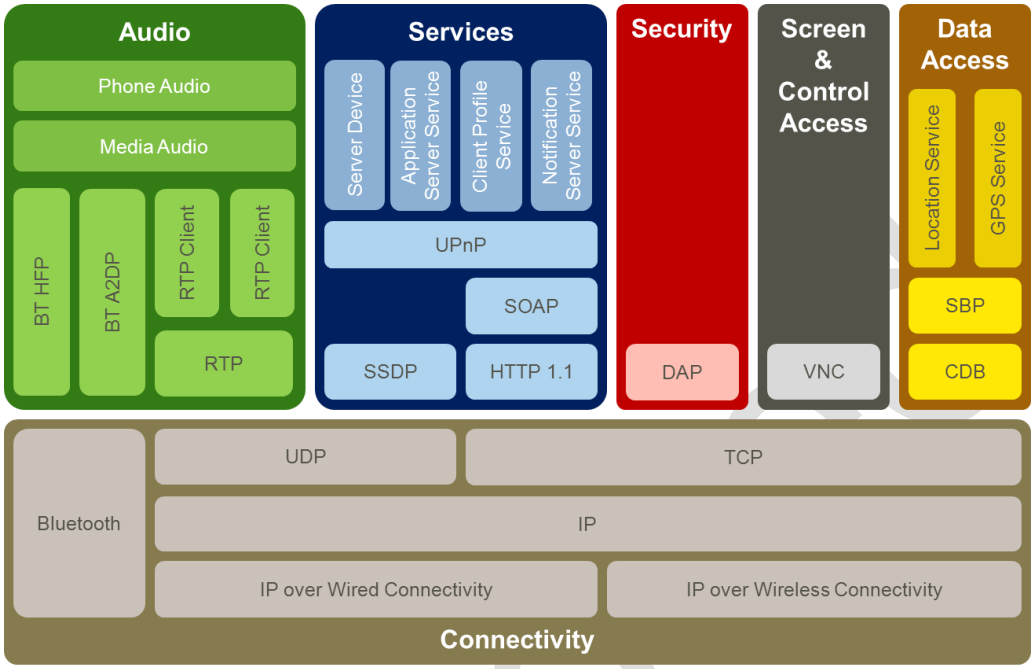

Figure 2: MirrorLink Architecture

MirrorLink Architecture consists of a set of protocols, providing the following features:

1. Connectivity, as specified in [1], providing
   a. Wired and wireless IP based connection-oriented and connection-less connectivity, and
   b. Dedicated Bluetooth connectivity
2. UPnP based Services, providing
   a. Mechanisms for advertisement of MirrorLink enabled Server devices as specified in [12]
   b. Mechanisms for application notifications, as specified in [11],
   c. Mechanisms for MirrorLink client profiles, as specified in [10], and
   d. Mechanisms for advertisement and control of MirrorLink server based applications and their certification information, as specified in [9]
3. Access to Screen and Control, as specified in [2], providing
   a. Replication of the MirrorLink Server's display content to the MirrorLink Client,
   b. Control Channel of Key, Pointer and Touch events back to the MirrorLink Client, and
   c. Exchanging display and event related information and notifications
4. Audio, as specified in [3], providing
   a. RTP audio streaming, for different payload types, outputting the MirrorLink Server
   b. RTP audio streaming, for different payload types, inputting the MirrorLink Server
   c. BT HFP based legacy phone audio
   d. BT A2DP based legacy media audio
5. Access to Data Services, providing
   a. Simple multiplexed, shared bus, hosting services, as specified in [5],
   b. Binary protocol framework for implementing various services, as specified in [6],
   c. GPS data service using the binary protocol framework, as specified in [7], and
   d. Location data service, using the binary protocol framework, as specified in [8]
6. Security mechanisms, as specified in [4], providing
   a. Attestation of MirrorLink Server devices and their main MirrorLink protocol components

4 MIRRORLINK FEATURES

The following table specifies the requirements for the different MirrorLink features for the MirrorLink Server and Client.

Feature			Version	MirrorLink Server	MirrorLink Client
Connec-tivity	USB	USB Host	1.0.1, 1.1	N/A	MUST
		USB Device	1.0.1, 1.1	MUST	N/A
	WLAN	Access Point	1.0.1, 1.1	MAY	MAY
		Device	1.0.1, 1.1	MAY	MAY
		WiFi-Direct P2P	1.1	MAY	MAY
	Bluetooth		1.0.1, 1.1	MAY	MAY
UPnP based Ser-vices MirrorLink implements 2-Box pull model	UPnP Server Services Provided	Server Device	1.0.1, 1.1	MUST	N/A
		Application Server Service	1.0.1, 1.1	MUST	N/A
		Client Profile Service	1.0.1, 1.1	MUST	N/A
		Notification Server Service	1.0.1, 1.1	SHOULD	N/A
	UPnP Control Point Services Supported	Server Device	1.0.1, 1.1	N/A	MUST
		Application Server Service	1.0.1, 1.1	N/A	MUST
		Client Profile Service	1.0.1, 1.1	N/A	SHOULD
		Notification Server Service	1.1	N/A	SHOULD
Screen & Control	VNC Server		1.0.1, 1.1	MUST	N/A
	VNC Client		1.0.1, 1.1	N/A	MUST
Audio	RTP	RTP Server	1.0.1, 1.1	MUST	SHOULD
		RTP Client	1.0.1, 1.1	SHOULD	MUST
	BT	BT HFP	1.0.1, 1.1	SHOULD	SHOULD
		BT A2DP	1.0.1, 1.1	MAY	MAY
Access to Data	Common Data Bus	Server Endpoint	1.1	SHOULD	N/A
		Client Endpoint	1.1	N/A	SHOULD
	Service Binary Protocol		1.1	CONDI-TIONAL[1]	CONDI-TIONAL[2]
	GPS Data Service		1.1	SHOULD	SHOULD
	Location Data Service		1.1	SHOULD	SHOULD
Security	DAP	Server Endpoint	1.0.1, 1.1	MUST	N/A
		Client Endpoint	1.0.1, 1.1	N/A	SHOULD

Table 1: MirrorLink Feature Requirements

[1] If Common Data Bus Server Endpoint implemented

[2] If Common Data Bus Client Endpoint implemented

5 REFERENCES

[1] Car Connectivity Consortium, "MirrorLink – Connectivity", Version 1.1, March 31, 2012. CCC-TS-008.

[2] Car Connectivity Consortium, "MirrorLink – VNC based Display and Control", Version 1.1, March 31, 2012. CCC-TS-010.

[3] Car Connectivity Consortium, "MirrorLink – Audio", Version 1.1, March 31, 2012. CCC-TS-012.

[4] Car Connectivity Consortium, "MirrorLink – Device Attestation Protocol ", Version 1.1, March 31, 2012. CCC-TS-014.

[5] Car Connectivity Consortium, "MirrorLink – Common Data Bus", Version 1.1, March 31, 2012. CCC-TS-016.

[6] Car Connectivity Consortium, "MirrorLink – Service Binary Protocol", Version 1.1, March 31, 2012. CCC-TS-018.

[7] Car Connectivity Consortium, "MirrorLink – GPS Data Service", Version 1.1, March 31, 2012. CCC-TS-020.

[8] Car Connectivity Consortium, "MirrorLink – Location Data Service", Version 1.1, March 31, 2012. CCC-TS-022.

[9] Car Connectivity Consortium, "MirrorLink – UPnP Application Server Service", Version 1.1, March 31, 2012. CCC-TS-024.

[10] Car Connectivity Consortium, "MirrorLink –UPnP Client Profile Service ", Version 1.1, March 31, 2012. CCC-TS-026.

[11] Car Connectivity Consortium, "MirrorLink – UPnP Notification Server Service", Version 1.1, March 31, 2012. CCC-TS-028.

[12] Car Connectivity Consortium, "MirrorLink – UPnP Server Device", Version 1.1, March 31, 2012. CCC-TS-030.

[13] IETF, RFC 2119, Keys words for use in RFCs to Indicate Requirement Levels, March 1997. http://www.ietf.org/rfc/rfc2119.txt