1 Document Scope

This document describes interface requirements for the second-generation Play-Fi Wireless Module, also known as Caprica2L. Caprica2L is a WiFi audio module designed for wireless, multi-room audio distribution. Caprica2L streams with 16 bit resolution and 44.1 KHz sampling rate. The module may be utilized in speakers, stand-alone receivers or incorporated into other products like AVRs. This document provides guidelines for the inclusion of this module into such products.

2 Definitions

2.1 Host

Host refers to the off board MCU that processes user interactions and controls audio processing.

2.2 Play-Fi Wireless Module

Play-Fi Wireless Module refers to the Caprica2L module with integrated Wi-Fi radio.

3 Features

The Caprica2L Play-Fi Wireless module is a programmable, high-performance, encapsulated design that enables manufacturers to wirelessly distribute audio to multiple devices. Sources can include Play-Fi Applications, Play-Fi Drivers, or other sources of a manufacturer's choice, such as Bluetooth, via a I2S input. The design supports a number of interfaces that enable easy integration of the module to traditional consumer electronic designs. Caprica2L features include:

3.1 800MHz ARM-based Processor

Marvell PXA166 ARM v6/v7-compatible core:

- Up to 1848 DMIPS
- 16K/16K L1 I/D Caches

- 64K L2 Cache
- 5-8 Stage Variable Pipeline
- Retire up to 2 Instructions per Cycle
- Out-of-Order Execution
- Three-level Branch Prediction

3.2 wMMX2 DSP Support

Up to 1600 MMACS per second. Supports complex Digital Signal Processing with little CPU overhead. Audio CODECs including MP3, WMA and AAC utilize the wMMX2 engine.

3.3 802.11a/b/g/n 1x1 Wi-Fi

Dual-band design with 2.4GHz and 5GHz support. Supports transmit modes up to 150mbps.

3.3.1 20MHz and 40MHz Channels

Supported in both 2.4 and 5 GHz bands

3.3.2 Diversity Antenna Support

Caprica2L supports two antenna connections in a diversity antenna configuration (using orthogonal mounting).

3.4 128MB DDR3 Memory

High-performance memory for maximum processor and network performance.

3.5 128MB SLC Flash Memory

3.6 I2C

The I2C Interface is the port which Caprica2L communicates with the external system. The communication protocol "Play-Fi Host Communication Protocol" is described in a separate document (PHORUS-CAP-TSD-0004-Caprica-Host-Communication-Protocol). The Caprica2L Module is configured as a I2C slave with address 0x52.

3.7 I2S Output

Caprica2L outputs digital audio via an I2S port. Caprica acts as the master device. The format is MSB Left Justified.

LRCLK- 44.1 KHz

BITCLK- 2.8224 MHz (64 * Fs)

Data – 16 bits of data followed by 16 bits forced 0 on each rising/falling edge of LRCLK

This format cannot be changed.

3.8 I2S Input

Caprica2L can accept auxiliary inputs via I2S. Caprica is the slave here. The format is MSB Left Justified.

LRCLK- 8KHz, 16KHz, 22.05KHz, 32KHz, 44.1KHz, 48KHz, 96Khz. (PIN 67)

BITCLK- 2.8224 MHz (64 * Fs) (PIN 65)

Data – 16 bits of data followed by 16 bits forced 0 on each rising/falling edge of LRCLK

This format cannot be changed. (PIN 69)

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3.9 USB 2.0HS OTG

Configured as a Host in standard configurations. All Play-Fi devices require a USB Host is required for Factory USB updates.

3.10 Wi-Fi LED Control

Caprica2L controls a consumer-facing LED that gives indication as to Wi-Fi status.

4 WiFi Features

- Operate at ISM frequency Band (2.4/5GHz)
- IEEE standards support, 802.11 a/b/g/n
- Enterprise level security supporting: WEP, WPA, WPA2
- Support 1 transmission and 1 receiving, transmission rate can up to 150Mbps (Physical Rate)in downstream and upstream

5 Product specifications

5.1 Main chipset

Marvell 88W8782

5.2 Function specifications

Standard	802.11 a/b/g/n
Data Rate	802.11 b: 11, 5.5, 2, 1 Mbps 802.11 a/g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps 802.11 n: MCS 0 to 7 for HT20MHz MCS 0 to 7 for HT40MHz
Modulation	802.11 b: CCK, DQPSK, DBPSK 802.11 a/g: 64QAM, 16QAM, QPSK, BPSK 802.11 n: 64QAM, 16QAM, QPSK, BPSK
Network Architecture	Infrastructure mode
Frequency Range	802.11 b/g: 2.412 ~ 2.4835 GHz

	802.11 a: 5.15 ~ 5.85 GHz
Operation Channel	2.4GHz 11: (Ch. 1-11) – United States 13: (Ch. 1-13) – Europe 14: (Ch. 1-14) – Japan 5GHz 12: United States 19: Europe 8: Japan
Transmit Output Power (Tolerance: +-2dBm	802.11 a: 13 dBm@54Mbps 802.11 b: 15 dBm@11Mbps 802.11 g: 14 dBm@54Mbps 802.11 n (2.4GHz): 13 dBm@MCS7 - **20MHz** 12 dBm@MCS7 - **40MHz** 802.11 n (5GHz): 11 dBm@MCS7 - **20MHz** 11 dBm@MCS7 - **40MHz**

Receiver Sensitivity	802.11 a: -70 dBm@54Mbps 802.11 b: -82 dBm@11Mbps 802.11 g: -71 dBm@54Mbps 802.11 n (2.4GHz): -69 dBm@MCS7 - **20MHz** -66 dBm@MCS7 - **40MHz** 802.11 n (5GHz): -66 dBm@MCS7 - **20MHz** -63 dBm@MCS7 – **40MHz**
Antenna Type	1x1 Diversity

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Cet appareil est conforme à la section 15 des réglementations de la FCC. Le fonctionnement de l'appareil est sujetaux deux conditions suivantes :
(1) cet appareil ne doit pas provoquer d'interférences néfastes, et
(2) cet appareil doit tolérer les interférences reçues, y compris celles qui risquent de provoquer un fonctionnement indésirable.

Note: This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this product does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment should be installed and operated with a minimum distance 20cm between the radiator and your body
Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et votre corps

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radioexempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

The user manual for local area network devices shall contain instructions related to the restrictions mentioned in the above sections, namely that:
(i) the device for operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;
(ii) the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall comply with the e.i.r.p. limit; and
(iii) the maximum antenna gain permitted for devices in the band 5725-5825 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.

(i)Les dispositifs fonctionnant dans la bande 5150-5250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux.
(ii) le gain d'antenne maximal autorisé pour les appareils dans les bandes 5250-5350 MHz et 5470-5725 MHz doivent respecter le pire limiter; et
(iii) le gain d'antenne maximal autorisé pour les appareils dans la bande 5725-5825 MHz doivent respecter le pire limites spécifiées pour le point-à-point et l'exploitation non point à point, le cas échéant.

(iv)Users should also be advised that high-power radars are allocated as primary users (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

Les utilisateurs de radars de haute puissance sont désignés utilisateurs principaux (c.-à-d., qu'ils ont la priorité) pour les bandes 5250-5350 MHz et 5650-5850 MHz et que ces radars pourraient causer du brouillage et/ou des dommages aux dispositifs LAN-EL.

(v) the worst-case tilt angle(s) is compliant with the e.i.r.p. elevation mask requirement set forth in Section 6.2.2(3).

(iv) les pires angles d'inclinaison sont conformes à l'exigence de p.i.r.e. applicable au masque d'élévation énoncée à la section 6.2.2 (3).

Information for the OEM Integrators

This device is intended for OEM integrators only. Please see the full grant of equipment document for restrictions.

Label Information to the End User by the OEM or Integrators

If the FCC ID of this module is not visible when it is installed inside another device, then the outside of the device into which the module is installed must be label with "Contains FCC ID: XCO-PLAYFI0754 and IC: 7756A-PLAYFI0754".

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Gain of antenna: 2.4GHz - 2.5GHz 4.2dBi maximal; 5GHz - 5.875 GHz 4.5dBi maximal.
Type of antenna: 50ohm, (FPCB)
Or,
Gain of antenna: 2.4GHz - 2.5GHz 3.0dBi maximal; 5GHz - 5.875 GHz 2.7dBi maximal.
Type of antenna: 50ohm, (FPCB)
Or,
Gain of antenna: 2.4GHz - 2.5GHz 1.1dBi maximal; 5GHz - 5.875 GHz 2.9dBi maximal.
Type of antenna: 50ohm, (Dipole)

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Gain d'antenne: 2.4GHz - 2.5GHz 4.2dBi maximal; 5GHz - 5.875 GHz 4.5dBi maximal.

Type d'antenne: 50 ohm, (FPCB)

Or,

Gain d'antenne: 2.4GHz - 2.5GHz 3.0dBi maximal; 5GHz - 5.875 GHz 2.7dBi maximal.

Type d'antenne: 50 ohm, (FPCB)

Or,

Gain d'antenne: 2.4GHz - 2.5GHz 1.1dBi maximal; 5GHz - 5.875 GHz 2.9dBi maximal.

Type d'antenne: 50 ohm, (Dipole)