IEEE802.11a Based Wireless AV Module(WAVM) with Digital AV Interface

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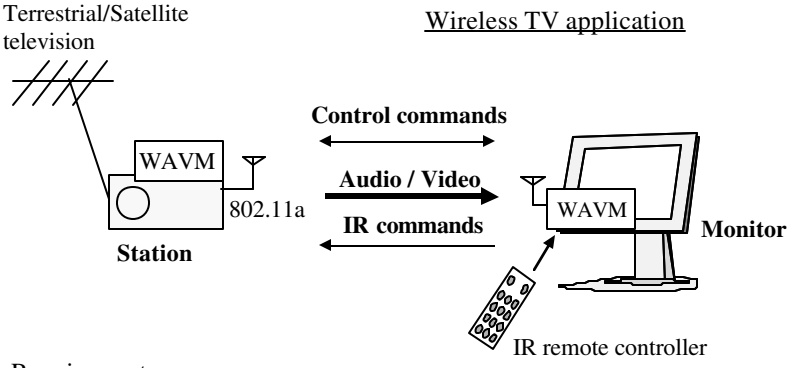
Outline

- Background
- Key techniques
  - Timing jitter removal function for MPEG2 TS data
  - IR command path-through
  - IIC I/F function
  - Status consistency control
- Block diagram
- Experiment results
- Conclusions

Background

- Enhancement of IEEE802.11 standard is continuing.
  - b, g, a, e, h, i, n and so on…
- WLAN became very popular for PC applications.
- Wireless feature is attractive for non-PC applications.
  - VoWLAN
  - Wireless Audio/Video(AV) transfer
- PC peripheral WLAN equipments are not directly applicable to the non-PC applications.
- AV application requires the AV specific capability.
- WAVM(Wireless Audio / Video Module)
  - Specific LSI equipped with AV I/Fs has been developed.
  - Proprietary protocol is defined for the AV data transmission because the standardization is not finalized yet.

Target Application



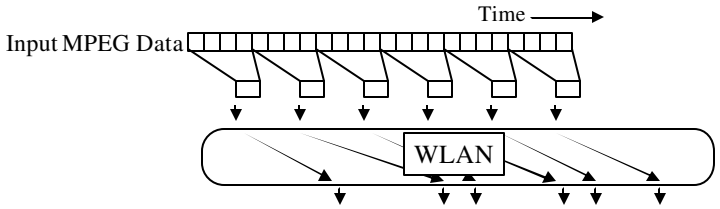
Requirements

- Robust data and low latency transmission.
- Jitter removal caused by WLAN.
- IR command pass-through function.
- Status consistency control between WAVMs.

Key Techniques of WAVM

- Jitter removal function for MPEG2 data.
- IR remote control signal pass-through.
- IIC bus interface.
- Status consistency control.
- Module partitioning.
- WAVM architecture.

Jitter Removal Function



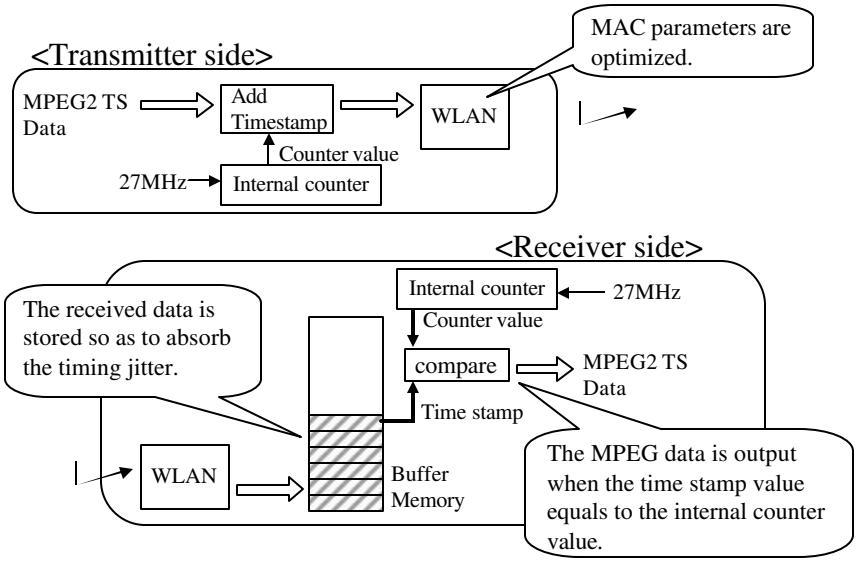
The timing jitter at the WLAN output is inevitable.

Causes of timing jitter

- Transmission retry of WLAN.
- The queue management of the MAC(Medium Access Control).
- Bit rate control according to the radio quality.

The MPEG2 TS decoder requires that the variation of delay time should be suppressed within 500nsec.

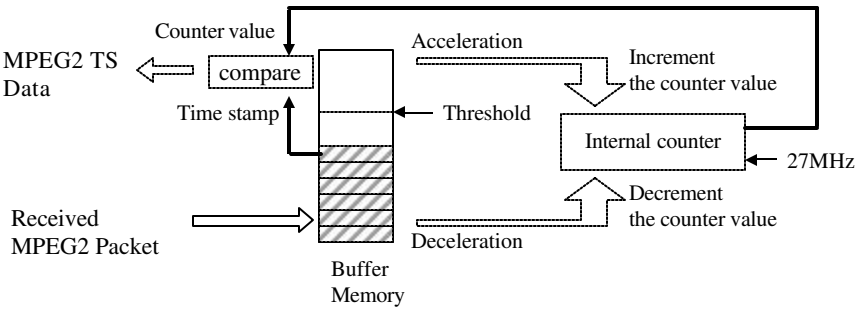
Jitter Removal Function(Cont'd)



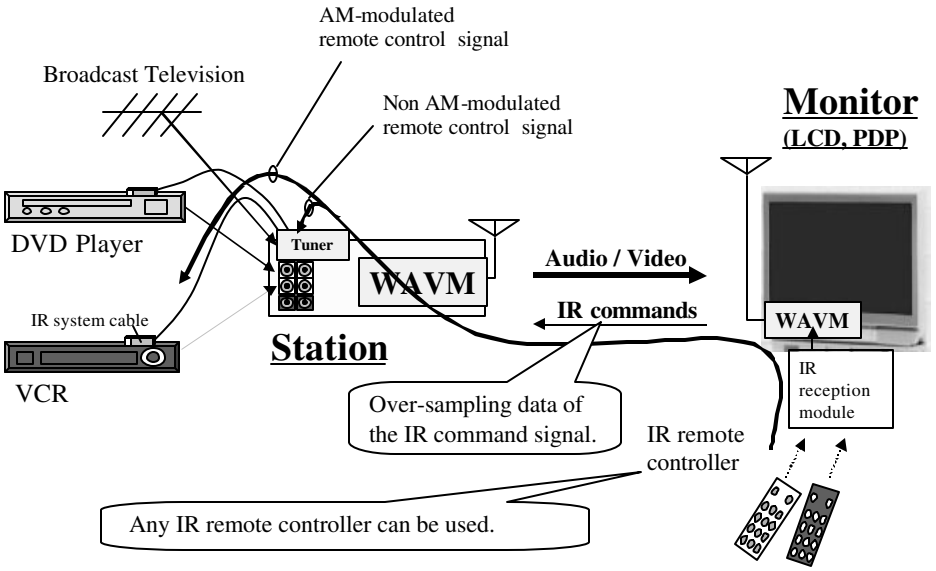
Synchronization

Because of the frequency offset between the transmitter and the receiver, the synchronization function is needed.

The acceleration / deceleration control is performed by controlling the counter value, according to the total amount of the stored MPEG2 packets.

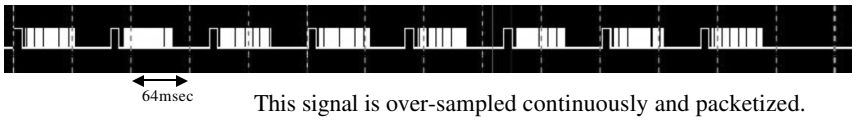


IR Remote Control Signal Pass-through

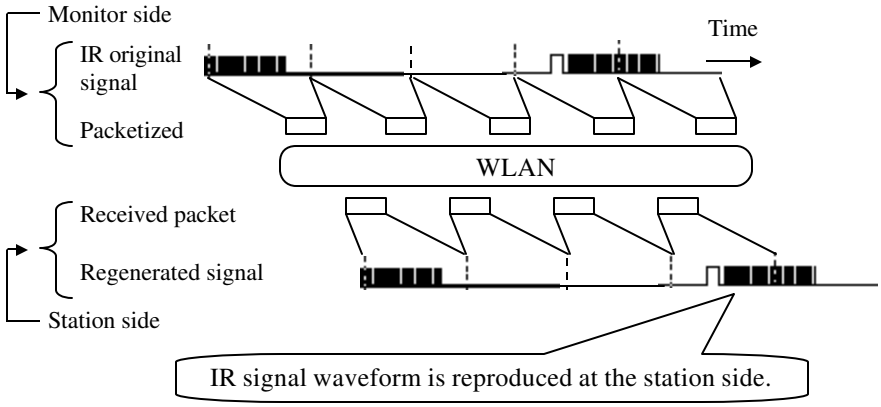


Example of IR Signal Waveform

G-code transmission (TOSHIBA VCR remote controller)

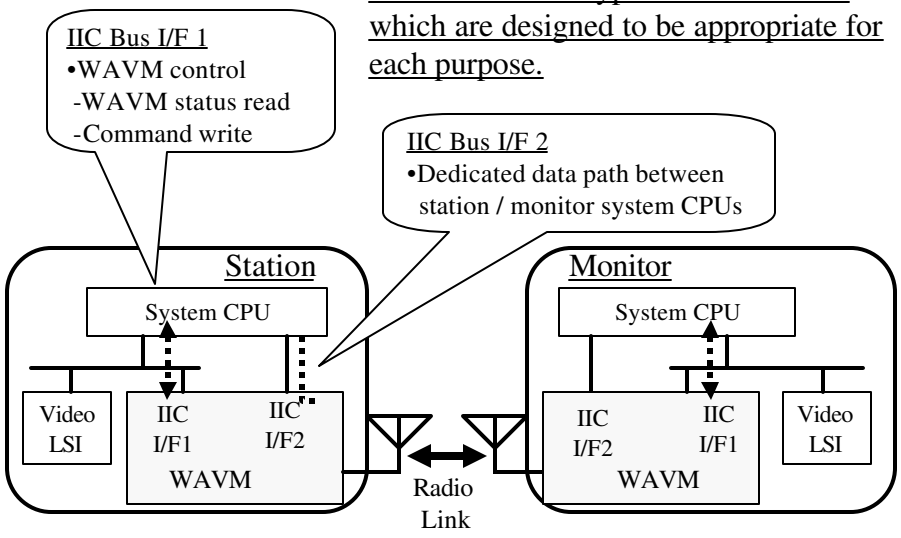


This signal is over-sampled continuously and packetized.



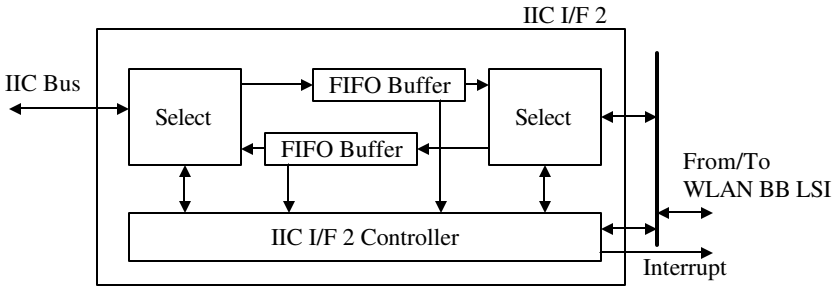
IIC Bus Interface

WAVM has two types of IIC bus I/Fs which are designed to be appropriate for each purpose.



IIC Bus I/F 2

The IIC bus I/F2 is designed so as to fit the packet data transmission.

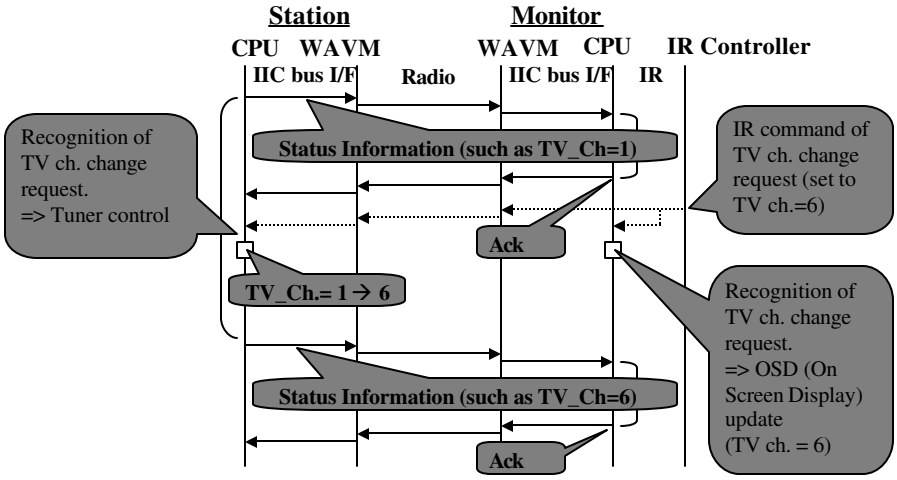


•By using IIC bus I/F2, the transmission efficiency is improved.

•Large capacity data transmission is possible.

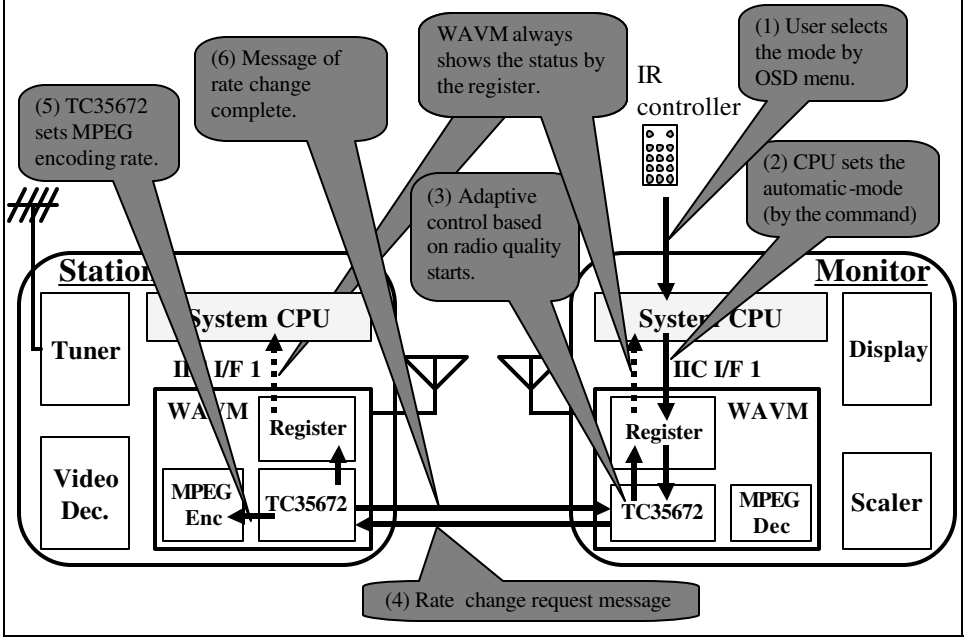
•The packet size is defined by the register of the IIC I/F1.

Status Consistency Control



Even though the command packet is lost, the status of the monitor is synchronized to the status of the station because the status information is periodically transmitted.

MPEG Rate Setting (Automatic-mode)

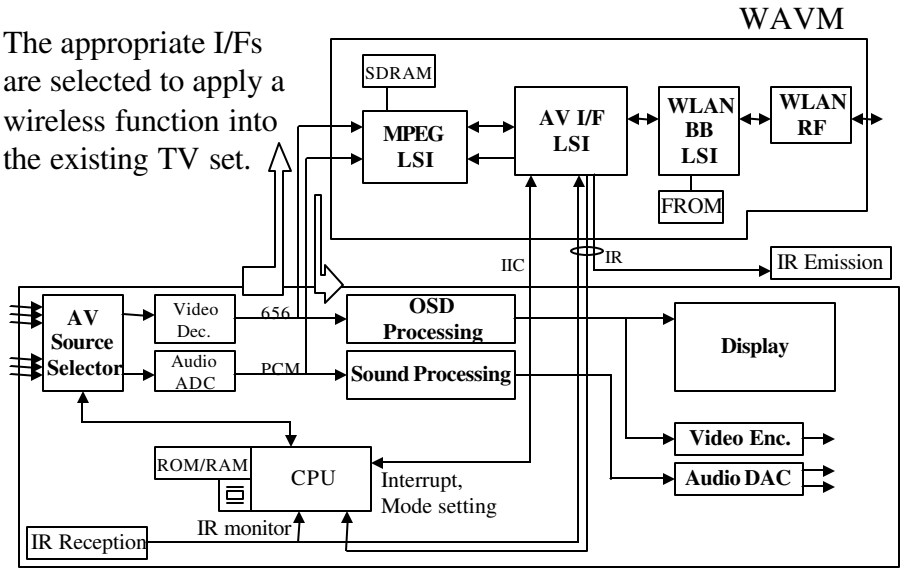


Key Techniques of WAVM

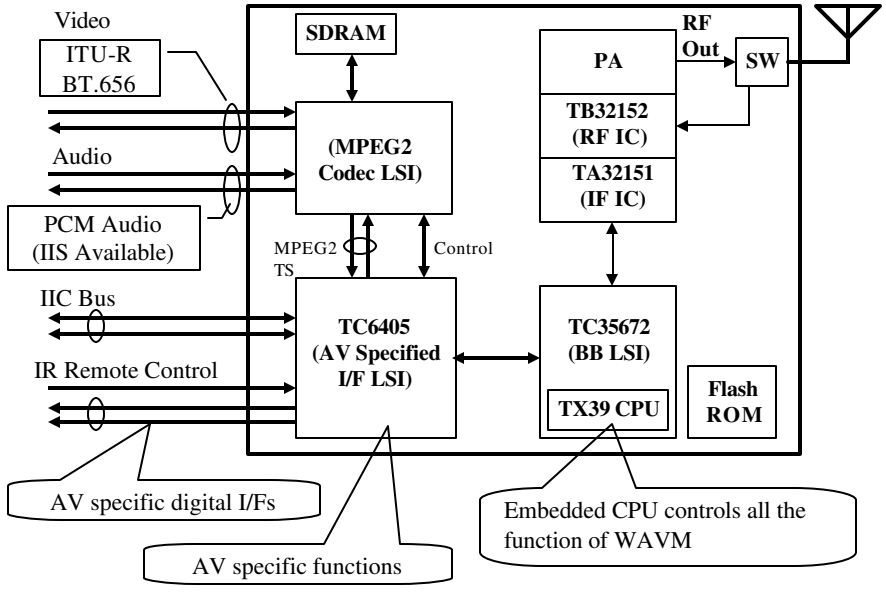
- Jitter removal function for MPEG2 data.
- IR remote control signal pass-through.
- IIC bus interface.
- Status consistency control.
- Module partitioning.
- WAVM architecture.

Module Partitioning

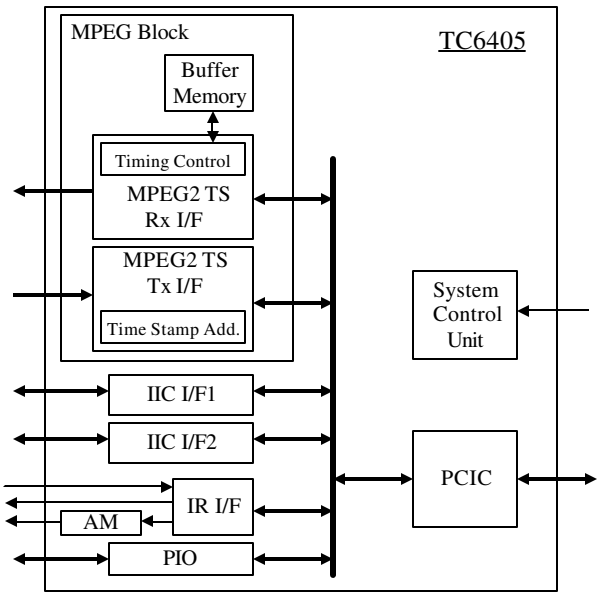
The appropriate I/Fs are selected to apply a wireless function into the existing TV set.



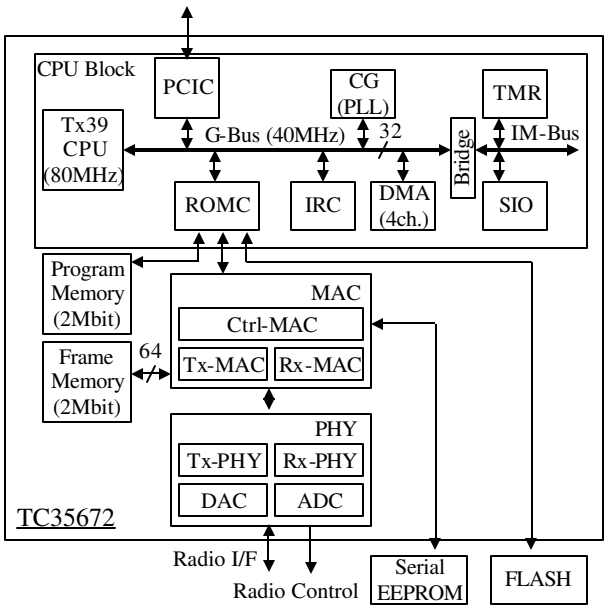
WAVM Block Diagram



Block Diagram of AV I/F LSI



Block Diagram of WLAN BB LSI



Chip Features

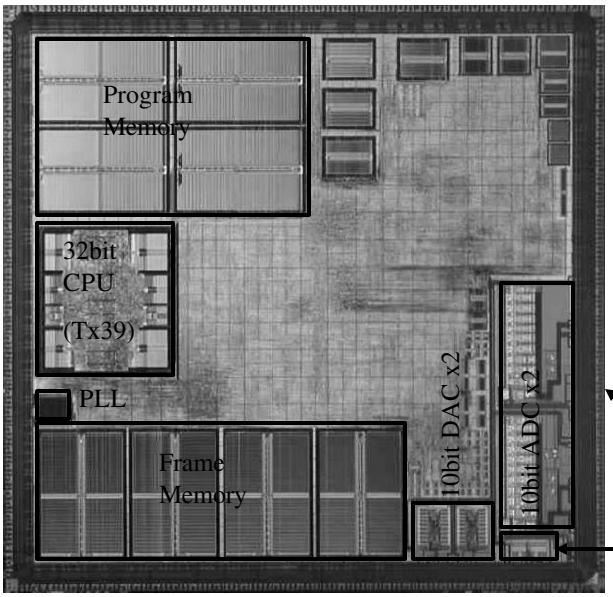
WLAN LSI(TC35672)

Process	0.18um CMOS 6layer metal
	(Random: 1.27Mgates, Memory: 4.29Mbits)
Chip Size	10.9 x 10.9 mm
Package	361pin PFBGA(Plastic Fine pitch Ball Grid Array)
Supply Voltage	Core: 1.5V, Analog: 2.5V, I/O: 3.3V
Frequency	20/40/80MHz

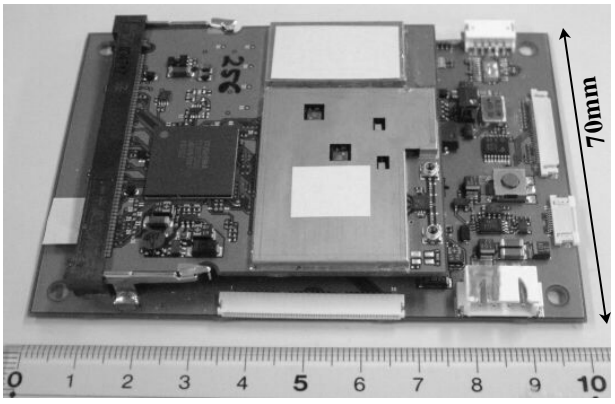
AV I/F LSI(TC6405)

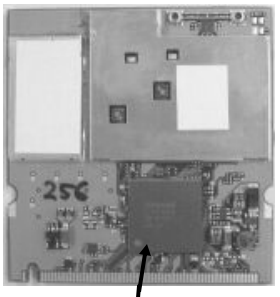
Process	0.18um CMOS 5layer
	(Random: 251Kgates, Memory: 1.63Mbits)
Chip Size	7.1 x 7.1 mm
Package	217pin PFBGA (0.8mm pitch)
Supply Voltage	Core: 1.5V, I/O: 3.3V
Frequency	27/33MHz

WLAN BB LSI Photograph



WAVM Photograph



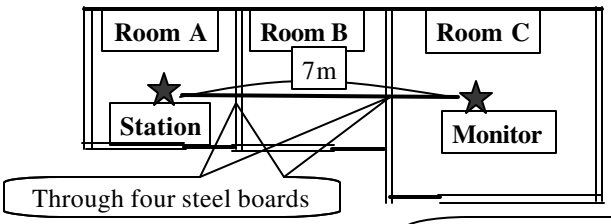


WAVM Features

- Wireless audio/video transmission
  - Timing jitter removal to satisfy MPEG2-TS delay spread
  - WLAN parameters are optimized for AV data transmission.
  - Using clear 5GHz band WLAN (suitable to the home application)
  - Packet by packet selection antenna diversity.
  - High performance super heterodyne radio architecture.
- Easy-add-on to an existing TV system.
- All-in-one module including an MPEG2 encoder/decoder LSI
  - Embedded CPU in BB LSI controls all the function of WAVM.
    - No additional CPU is used in WAVM.
  - AV I/F LSI equipped with the AV specific function and I/Fs.
  - Status consistency control.
- Small size
  - 70 x 100 x 11 mm

Air-transmission Examples

•Measurement Condition (closed meeting room)



Tx power is reduced for severe condition (set to 0dBm).

•Results

Radio PHY Rate	MPEG Encoding Rate	Normal condition	Severe condition
24 Mbps	14.4 Mbps	○	×
12 Mbps	6.0 Mbps	○	○
6 Mbps	2.7 Mbps	○	○

Even the 24Mbps result under severe condition, the result may be improved if antenna arrangement is optimized.

Conclusions

- WAVM achieved all the necessary features for home AV application.
  - Simplest wireless function extension into the conventional TV set.
  - All-in-One module including an MPEG2 Encoder/Decoder LSI.
  - Provides AV specific function.
  - Rapid wake up.
  - Short latency control (Ex. tuner ch. change time).
- Future plan
  - Digital HD (High Definition) stream transmission with secure content protection.
  - AV transmission protocol standardization.

Pier5 LSI