RuralSync: Providing Digital Content in Remote Communities through Opportunistic Spectrum Access

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Rationale

▷ Due to the current pandemic situation, in-person classes in the Philippines are still limited and has abruptly shifted to remote mode of learning delivery.

▷ However, there are still unserved and underserved areas in the Philippines where information infrastructure is unavailable or unreliable.

▷ To address this *digital divide*, the project investigates the use of various wireless technologies operating on TV broadcast signals to provide digital educational materials in remote and rural communities

▷ UHF TV frequencies are explored since it is known to reach farther distances compared to other frequency bands

ISDB-T Datacasting

▷ Integrated Services Digital Broadcasting-Terrestrial (ISDB-T) is the digital TV standard adopted in the Philippines.

▷ Currently on test broadcast, planned Analog Shut Off in 2023

▷ Opportunity to use vacated frequencies for other applications

▷ Datacasting: Way to send auxiliary files apart from the broadcast material

ISDB-T Datacasting

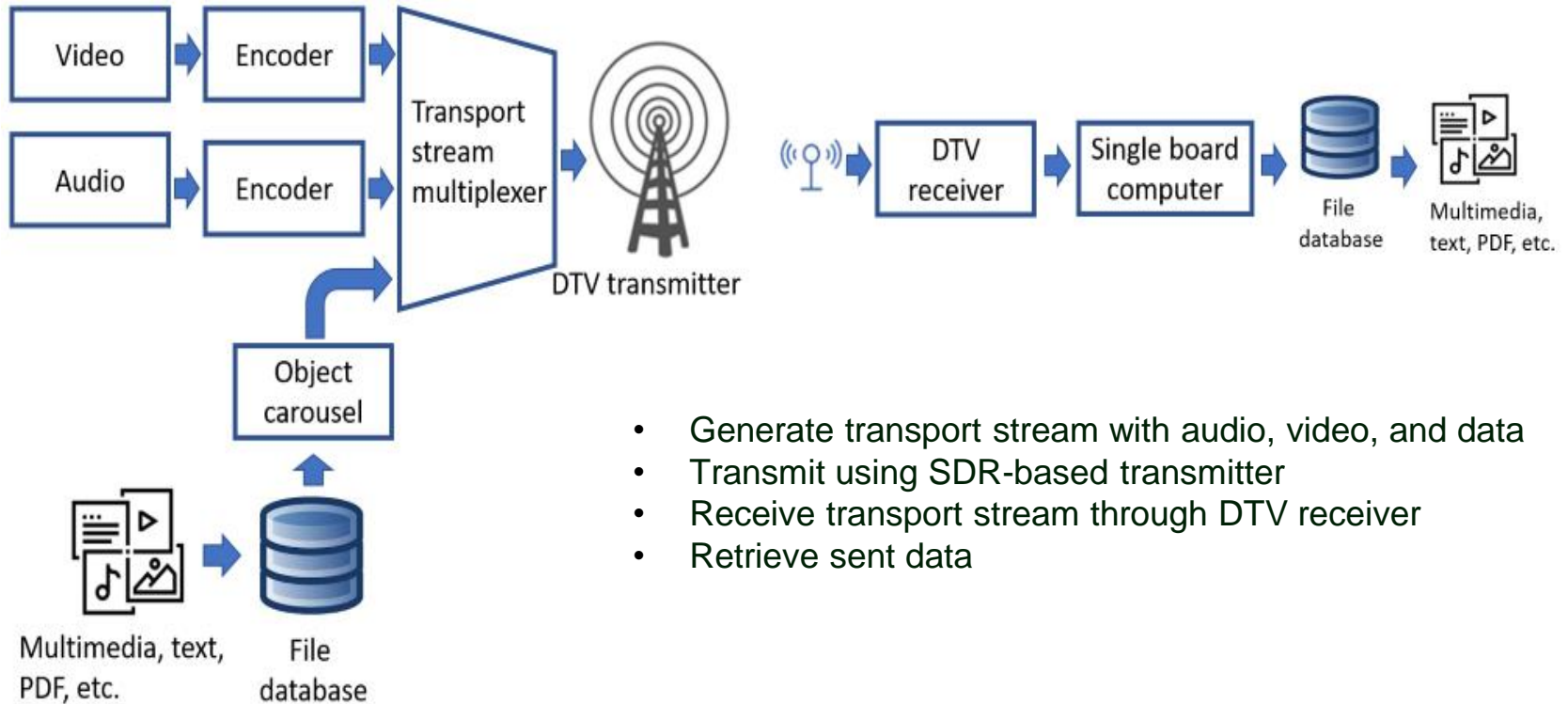▷ Digital TV transmission as a *data pipe*
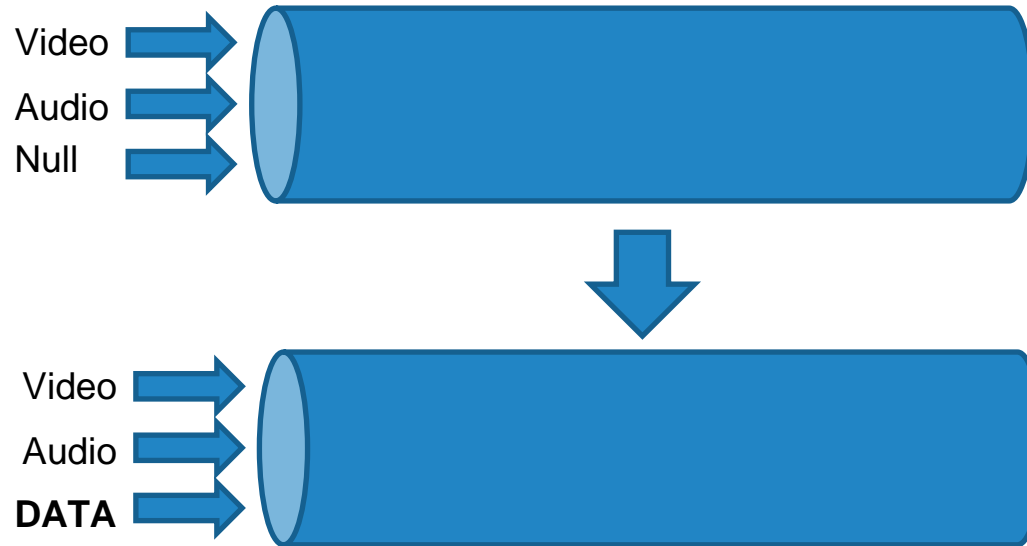
Video →
Audio →
Null →

MPEG transport stream broadcasting
- Constant bit rate Insert dummy or **NULL packets to maintain constant bit rate**

Video →
Audio →
DATA →

Maximize unused capacity by inserting useful data packets

ISDB-T Datacasting

- Generate transport stream with audio, video, and data
- Transmit using SDR-based transmitter
- Receive transport stream through DTV receiver
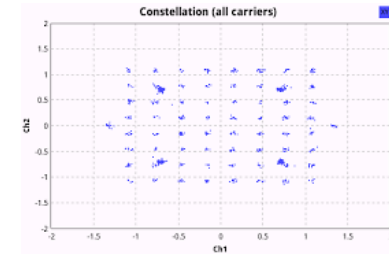- Retrieve sent data

ISDB-T Transmitter Prototype

SDR-based ISDB-T transmitter prototype
- 1 seg + 12 seg
- 10W peak RF output
- 64QAM, 16QAM, QPSK
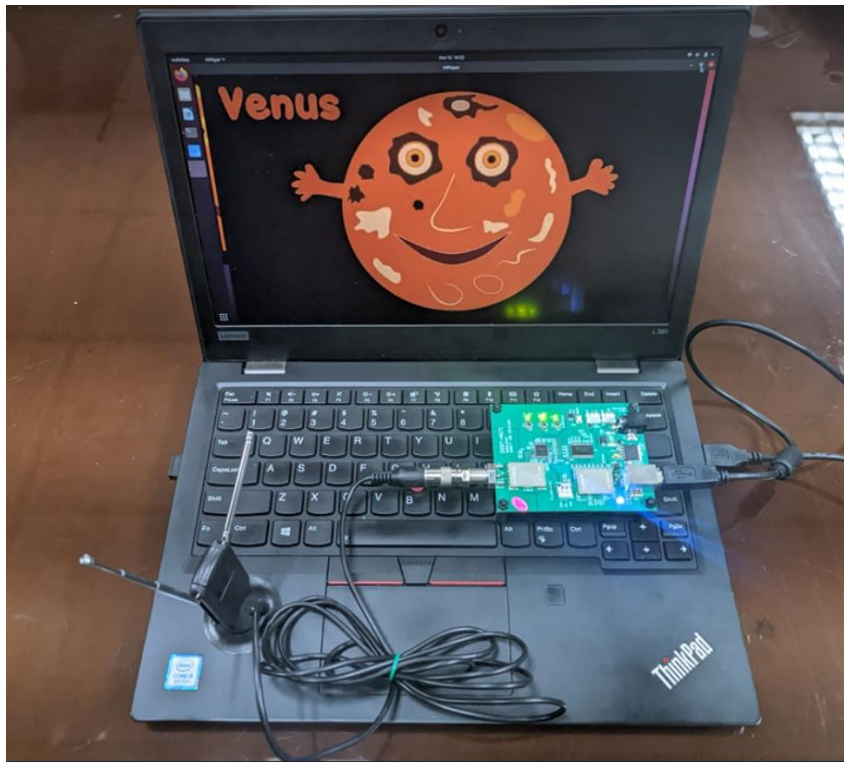- Various bit rate depending on modulation parameters
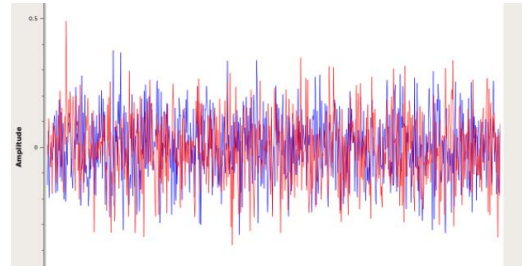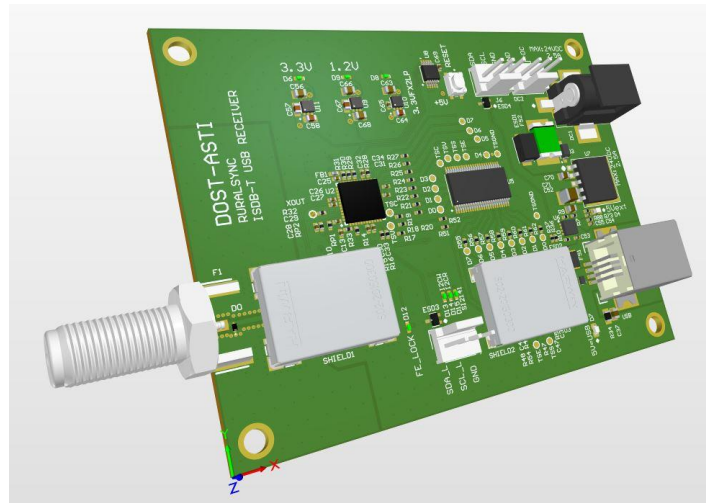

ISDB-T I and Q plots

ISDB-T constellation plot

ISDB-T Receiver Prototype

Integrated Tuner (RF) +
Demodulator (MPEG_TS)

USB Interface for control of x86 SBC/Laptop

Preliminary Testing

▷ Scenario: Low-Power Transmitter located in school, measure signal strength and confirm reception of stream, attempt to retrieve PDF File (6MB Size)
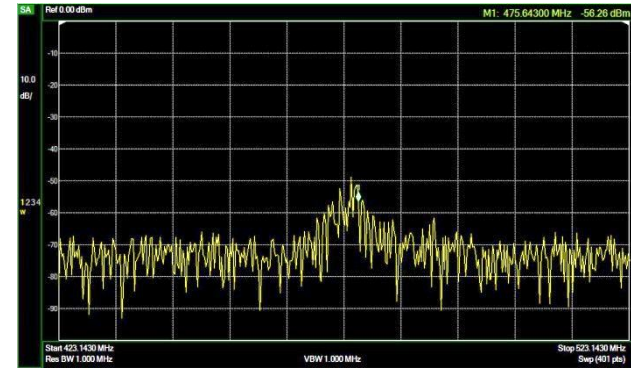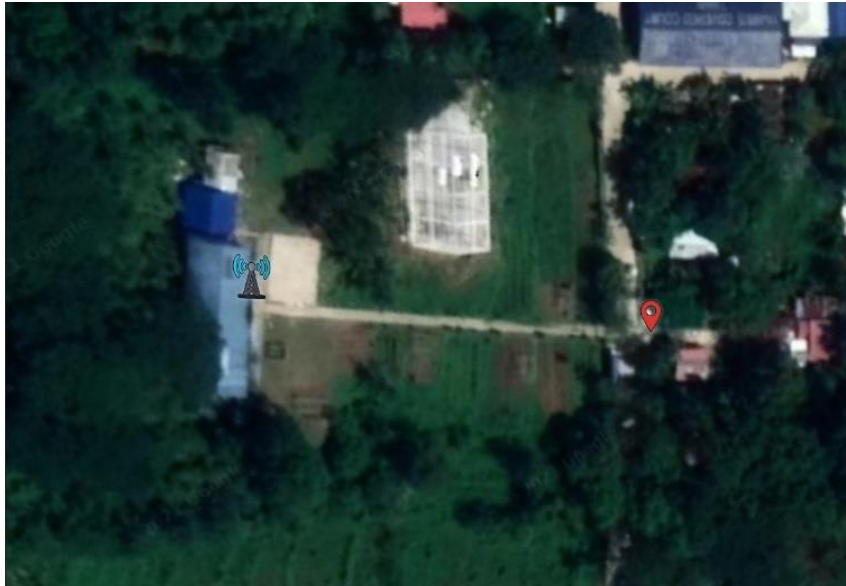

Transmitter Side

Receiver Side

Preliminary Testing

▷ Preliminary Result: Able to receive stream and retrieve 6MB PDF file at 80m away from transmitter

Signal Level at Receive side

Future Opportunity

▷ Tests using other kinds of file formats with different file sizes

▷ More testing scenarios

▷ Opportunity to explore on BML (Broadcast Markup Language) and interactive TV

▷ Opportunity to work on an integrated receiver device.

Thank You!