Ribbit

a new digital text messaging mode for HF/VHF/UHF emergency communications

GARS meeting

March 14th 2023

Pierre Deliou W4CKX

Thank you

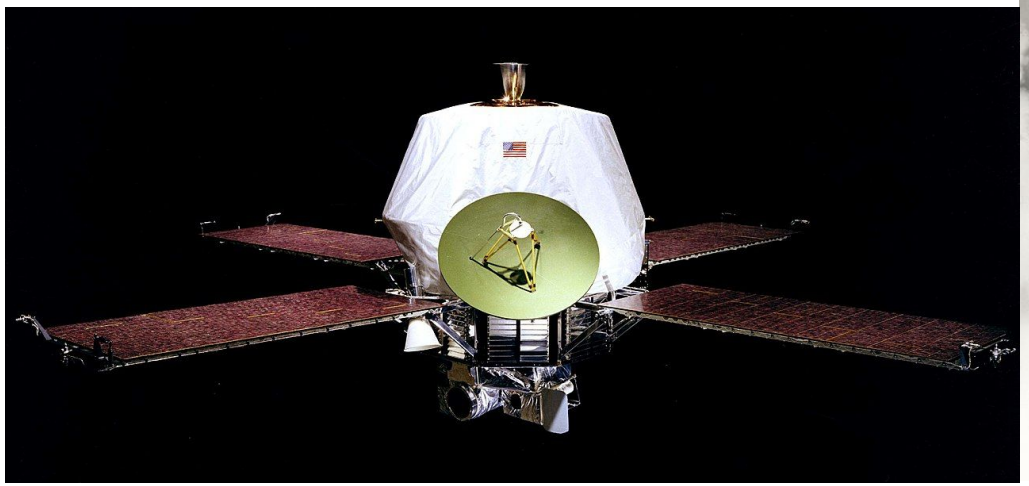
for being here

Trivia

- Do you remember **1971** ?
- Mariner 9 Mission…

…to Mars

and what it has to do with **Ribbit**??



Ribbit, *new digital text messaging mode for VHF/UHF emergency communications*

Agenda

*In this **30** min presentation:*

1. *Why Ribbit?* - *highlight the need*
2. *How we do it?* - *reveal "secret sauce"*
3. *Mode & Structure* - *the implementation*
4. *Your giveaway app* - *free tech demo app*
5. *Q&A*

What is Ribbit?

- Ribbit is a novel digital text messaging mode for HF/VHF/UHF communications for recreational and emergency use which radically increases the density of information transmitted by spectrum used.
- It leverages the computing power of the modern smartphone to increase the capabilities of any Handy Talkie without requiring any additional hardware.
- Its redundant distributed nature allows it to function even when internet connectivity is lost during emergencies.
- Ribbit is open source and currently in its early stages of development.

About me…

Pierre Deliou *Ribbit Inventor & Project Lead*

- First Ham license in 1998 as F4CKX (France) while studying physics at university
- Met my wife at **GaTech** & moved to Gwinnett in 2007
- Rejoined the hobby in 2020 as W4CKX (USA) with a focus on emergency communications
- Joined the Open Research Institute in 2022 to accelerate Ribbit development

Open Research Institute

Ribbit is a project of the Open Research Institute

Open Research Institute (ORI) is a non-profit research and development organization which provides all of its work to the general public under the principles of Open Source and Open Access to Research.

Development Team

Pierre Deliou W4CKX w4ckx@pekt.org - lead
Ahmet Inan inan@aicodix.de - codec
Jason McKee KE0CCI ke0cci@arrl.net - web

Interested? find us at: **ribbitradio.org**

1 Why we do it

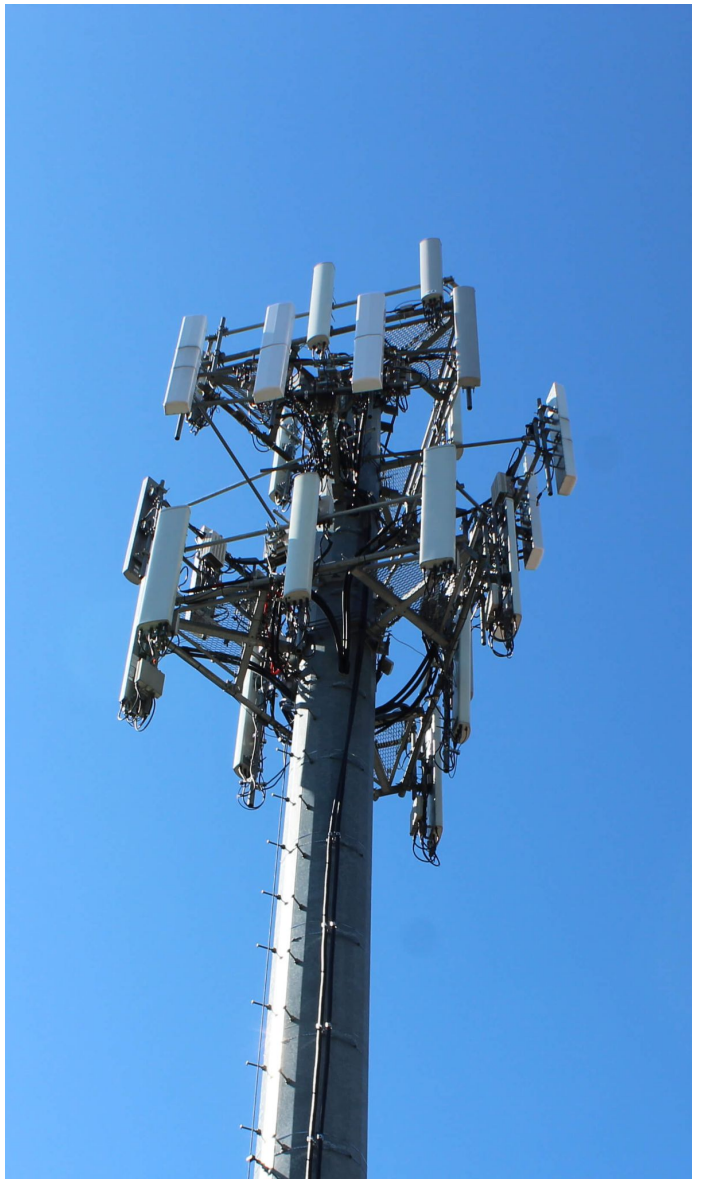
- the need

Cellular communications

Cellphones & cellular towers are the default mode of communication for citizens

- Fastest connectivity
- Superior user experience
- Multiple modes of communication:
  search/web/email/chat/text/phone & video call/pictures

Best in class… 99%+ of the time
…but, a single point of failure



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In <1% emergency, cellular can go down for weeks…

…the infrastructure can fail:
large population without communication for days & weeks

Hurricanes

- ➔ *A study from the FCC shows that about 1,000 cell towers were knocked out during Hurricane Katrina.*
- ➔ *Hurricane Maria knocked out more than 360 cell towers, 75% of Puerto Rico Cellular network*

Wildfires: Fiber optic cables melt and towers burn

- ➔ *Kincade Fire and PG&E power shutdowns, 900 of CA cell sites were not operating. In Marin County: 57% down.*

Tornadoes:

- ➔ *Full cellular restoration in tornado-ravaged Kentucky expected to take months (2021)*

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ARES Amateur Radio Emergency Service

ARES operators are on the air to assist communications

- works well for short periods: hours to 1 day
- harder to sustain over days & weeks

Maintaining flow of communication with hundreds of people over a long period of time is challenging. Need to overcome:

- operator fatigue
- handling numerous concurrent subjects/issues
- remembering earlier subjects/issues (memory over time)
- transcribing everything in writing
- transfering context/information to the next net control operator
- sharing workload among different operators
- communicating exact location of assets/message provenance

VHF/UHF voice mode has limitations

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How can we support ARES volunteers?

Provide them with modern text messaging capabilities to work alongside voice communications on the same frequencies and local repeater infrastructure.

Text messaging is:

- Complementary to voice
- Real-time tactical awareness of the situation
- Timestamped & geocoded messages
- Message history & forward capabilities
- Requires no additional hardware: It's just an app!

TEXT can do MORE

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Benefits of Ribbit Text over VHF/UHF

Ribbit TEXT and regular VOICE cohabit
on the same frequencies

Benefits of Ribbit TEXT messages:

- ☑ high level view of all messages
- ☑ geo-location of every message
- ☑ ability to copy-paste > no transcription error
- ☑ workload sharing across multiple operators
- ☑ complete history
- ☑ respond to messages
- ☑ takes only 1 second to transmit

TEXT does MORE

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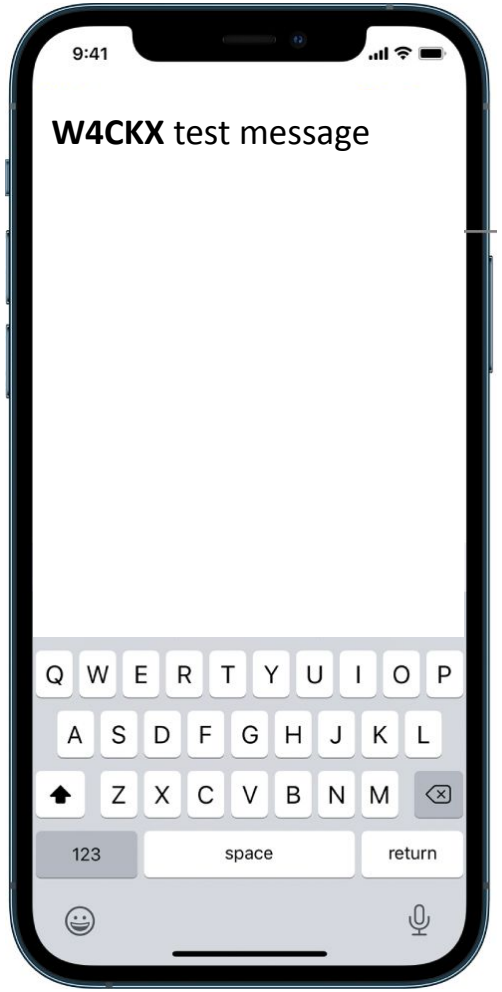
2 How we do it

- the implementation

How to use your cell… …on the VHF/UHF ham bands



Smartphone capabilities without cellular

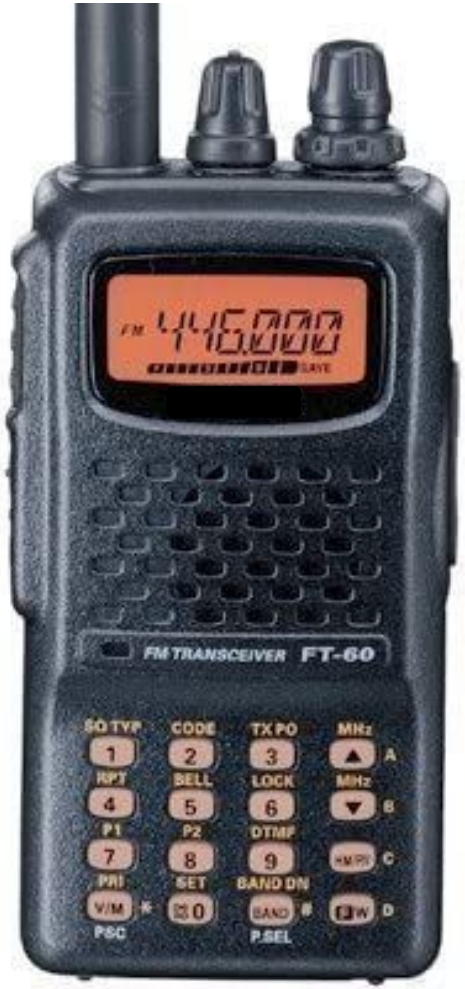
Large screen
Touch interface
Keyboard input

High compute power
Large memory
Exact time (GPS)
Location (GPS)

Handy Talkie capabilities

VHF/UHF analog transceiver

VOX mode (voice activated transmit)



Speaker
Microphone
<- Acoustic coupling ->
Speaker
Microphone

no hardware necessary (no cable!)

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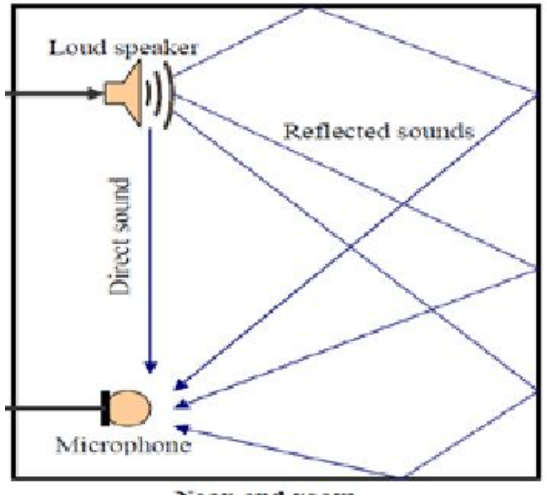
How it works - YouTube video -

Rattlegram is the name of our tech demo:

Wireless Text Messages without Cables or Modems: Rattlegram (OFDM) - 13m 03s
https://www.youtube.com/watch?v=ubPP48ojJ3E

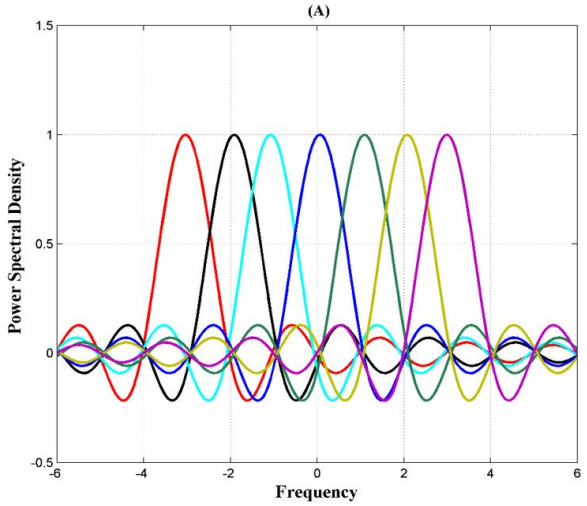
How to transmit data reliably via Acoustic Coupling? (1/2)



The environment (room) creates multiple paths for the sound to propagate which causes multiple echo in the microphone.

- Multipath echo creates **ISI** Inter-Symbol Interference
- to deal with multipath, we use **OFDM** (Orthogonal Frequency-Division Multiplexing) multi-carrier modulation .

  one drawback: it gives us a lesser than ideal **PAPR** (Peak-to-Average Power Ratio) compared to a single carrier system



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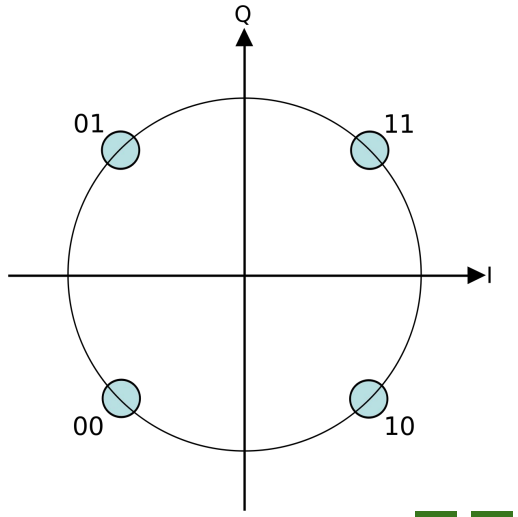
How to transmit data reliably via Acoustic Coupling? (2/2)



Workaround:

- We leverage **QPSK** (Quadrature Phase-Shift Keying) to modulate the carriers and slightly manipulate the amplitude of each carrier to improve PAPR to the point of making the whole system robust & practical.

Unlike voice transmission where Noise is without consequences, in a digital transmission, noise is detrimental.

- We use **FEC** (Forward Error Correction) code
  - HAD (Hadamard) code for the callsign header
  - SP (Systematic Polar) code for the text payload

Benefits of our implementation

the digital text audio transmission survives the path:

Smartphone-1 > HT-1 > Analog VHF/UHF transmission
Analog Repeater > HT-2 > Smartphone-2

- AM modulation
- FM modulation
- SSB

…but also

- survives Bluetooth audio compression and transcoding
- survives YouTube audio compression and transcoding

Some of Ribbit strengths

- Free as Freedom (open-source software), Free as Free Beer!, $0 App.
- No cables necessary, no TNC or other hardware to manufacture or buy.
- Zero (monetary) barriers to entry, potential for mass user adoption
- Leverages common Smartphone hardware
- Every App is a digipeater, Every App is an iGate
- Interoperable across all Ham frequencies + GMRS, MURS, FRS, PMR446, and works on HF too!
- Carriers cut through noise & Strong FEC Forward Error Correction

3 Mode & Structure

- the implementation

Tech demo release & feedback

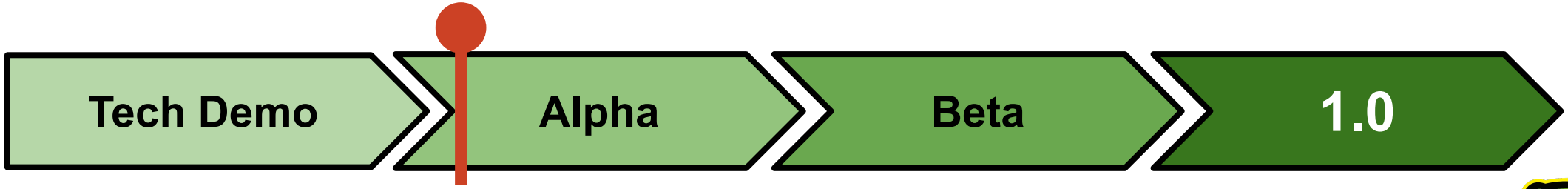
Rattlegram - codec tech demo

- Downloaded by 1000 users+
- Enthusiastic & positive support

It just works, on VHF/UHF

…but also tested on SSB, HF 12m band

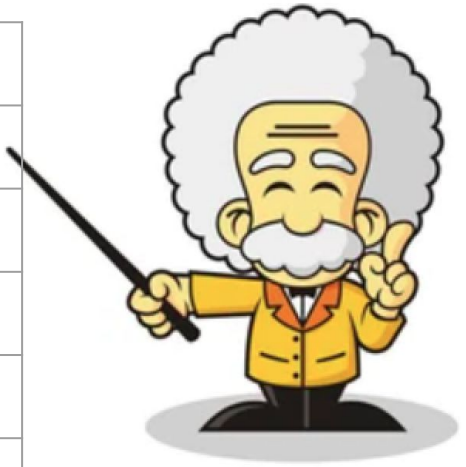
6 months of field-testing: Aug 2022 to Jan 2023



Planned Ribbit alpha phase: At least 6 months: Feb 2023 to July 2023
Planned Ribbit beta phase: TBD
Tentative 1.0 release: TBD

Ribbit modes (1/3)

Comparison Chart	Rattlegram ‘mode14’	NEW Ribbit ‘mode1’	
Audio Center Frequency	1450Hz	1500Hz	
Audio Bandwidth	1.6kHz [650 to 2250Hz]	2kHz [500 to 2500Hz]	+25%
Number of carriers / Width	256 carriers, 6.25Hz	64 carriers, 31.25Hz	+500% width
Modulation	D-QPSK	D-QPSK	
Raw data per symbol	512 bits / 64 Bytes	128 bits / 16 Bytes	-50%
Synchronization Symbols	1 symbol / 180ms	2 symbols / 68ms	-62%
Preambule length / size / duration	1 symbol / *71bit* / 180ms	1 symbol / 8bit / 36ms	-80%
Preambule FEC / Code rate ratio	BCH (Bose-Chaudhuri-Hocquenghem) / 28%	Augmented Hadamard / 6%	
Message length / duration	4 symbols / 720 ms	32 symbols / 1152 ms	+60%
Message Size	1360 bits / 170 Bytes	2048 bits / 256 Bytes	+50%
Message FEC / Code rate ratio	Systematic Polar / 67%	Systematic Polar / 50%	
AWGN noise	-19 dB	-15 dB	4dB better
Total message duration	1080 ms	1255 ms	+16%

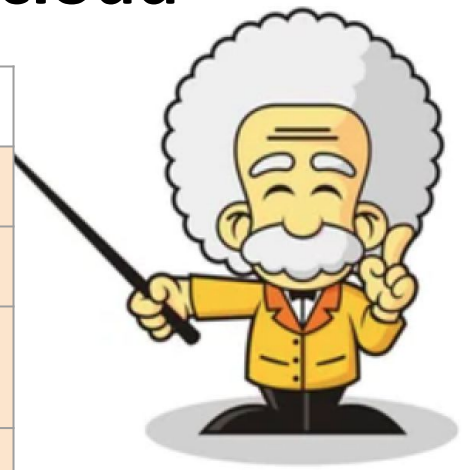


Ribbit message metadata (1/2) transmitted by sender

Bits	Bytes	Metadata
24	3	{Epoch} time counter (sync from NTS and GPS) - numerical - ~>1Year, 2sec precision
64	8	Originator ID {Phone Number/Callsign} (non-Hams/Hams)
8	1	Offline counter (since last internet connection) - non-linear table, ~max at 57 days.
40	5	Gridsquare locator (from GPS) 5Bytes
8	1	Sent counter: '0'-first try, '255'-stay at max for 255 or more.
24	3	(mandatory on 1st & subsequent repeat) Re-sent Epoch time
64	8	(mandatory on 1st & subsequent repeat) Repeated-by ID {Phone Number/Callsign}
8	1	Data Profile (0 = none defined/plain message)
240	30	====SUBTOTAL=======
88	11	(optional) respond to message {Epoch}+{ID}
48	6	(optional) tactical group hashtag #xxxxxxxx (8char) / FormID
1672	209	Message (remainer), (Greater than a SMS, TikTok or legacy Tweet)

Ribbit message metadata (2/2) by receiver sent to cloud

Bits	Bytes	Metadata
24	3	Received time {Epoch} time counter (useful to sort-out messages encoded in YouTube)
64	8	Received by ID {Phone Number/Callsign} (non-Hams/Hams)
8	1	Received Offline counter (since last internet connection) - non-linear table, ~max at 57 days.
40	5	Received at location Gridsquare (from GPS) 5Bytes
8	1	Mode of message received
8	1	Level of FEC encoded
8	1	Quality of reception (FEC % use at reception) - 255 = decoding failed
160	20	====SUBTOTAL=======



Conclusion

Where we are today:

- We have an implementation for digital text over analog audio
- We are still at an early stage of development;

Next Steps:

- focus on Mobile app development (both Android & iOS)
- Implement geolocation
- Implement Cloud statistics

Later:

- Implement ARES Net template/Log
- Implement FEMA forms

4 Demo app

- free tech demo download

Ribbit tech demo app (free)

Try Ribbit today! ***ribbitradio.org***

Transmit text messages over VHF/UHF

Tech demo published as ‘Rattlegram’
on Google Play Store:

DOWNLOAD link - Scan QR code —>

{why is app not called ‘Ribbit’? > we reserve the ‘ribbit’ name when the app will be ready for general release}

Ribbit, *new digital text messaging mode for VHF/UHF emergency communications*

Thank you

& get in touch!

find us at:

ribbitradio.org

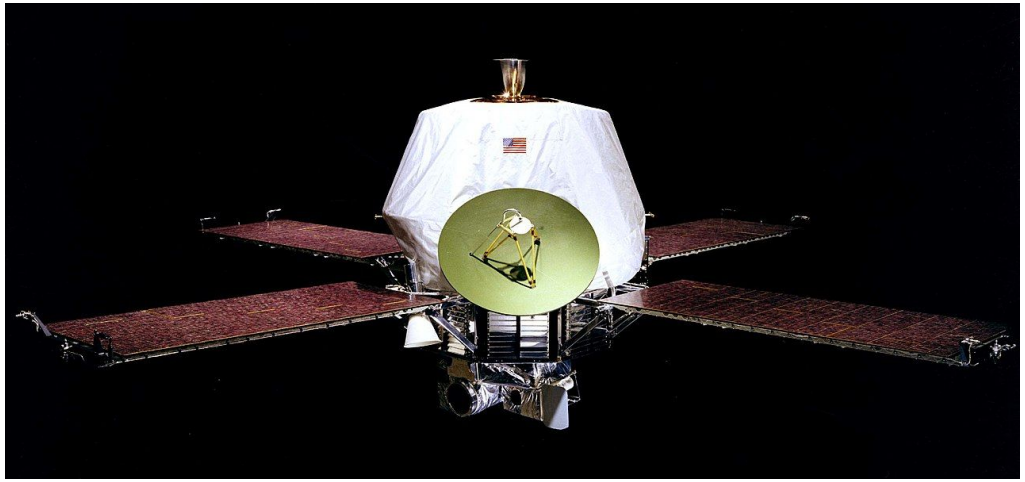
Pierre,
Ahmet
& Jason

Trivia

…and about that Mariner 9 mission to mars??

- it was the first spacecraft to orbit another planet
- it transmitted 7,300 images, covering 85% of mars surface.
- to successfully transmit data over radio with a low signal-to-noise ratio,
- Hadamard FEC was implemented!

Ribbit use Hadamard FEC
in it's preambule
to transmit even in low SNR conditions!



Questions and Answers

Find us at:
ribbitradio.org

DOWNLOAD link
Scan QR code —>