EclipseMob
Initial Planning for 2024

K.C. Kerby-Patel[1], L. Lukes (KK4FYT)[2], J. Nelson[2], W. Liles (NQ6Z)[3]

[1] University of Massachusetts Boston, Boston, MA

[2] George Mason University, Fairfax, VA

[3] Independent Consultant, VA

Outline

Historical collection efforts

Lessons from EclipseMob 2017 efforts

Objectives of EclipseMob 2024 efforts

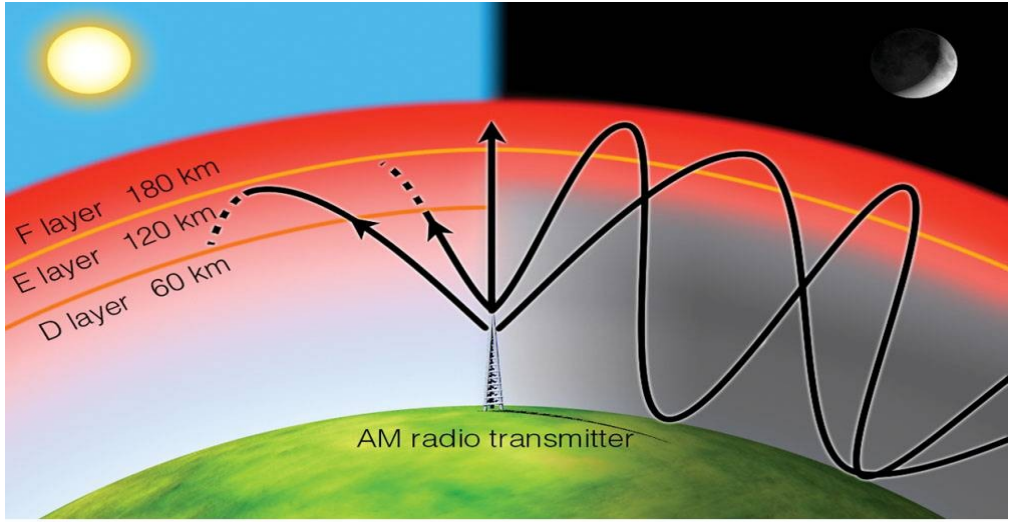
2024 receiver design

Conclusions

Why collect data during a total solar eclipse?

Solar Eclipses present on a short time and distance scale day vs night effects for RF propagation studies.

Thus enabling studies not possible during the normal course of day/night transitions.



Historical Solar Eclipse Data Collections

First collection: 1912 William Eccles in England. He did not even have a transmitter to listen to, so he listened to atmospheric noise. (5,500 meters, approximately 54.5 kHz)

Second collection: 1912 researchers in France, Denmark, Germany and Austria all used transmissions from the Eiffel Tower, but their research efforts were not coordinated or comparable. (115 kHz, approximately 2,608)

The next collection was planned for 1914, but WWI prevented a large group study.

1919 Transmitters were located at Panama Canal and Cairo. Receivers were located in Germany, Netherlands, France, Italy, Spain, UK, USA and Africa. Mixed results. (4,700 meters, approximately 63.83 kHz)

1925 Scientific American magazine and American Radio Relay League (ARRL) collected 2,000 mailed reports. Many reports were missing date, location, time and which AM station they were reporting on. ARRL received 150 reports from hams, with only 50 reports deemed usable.

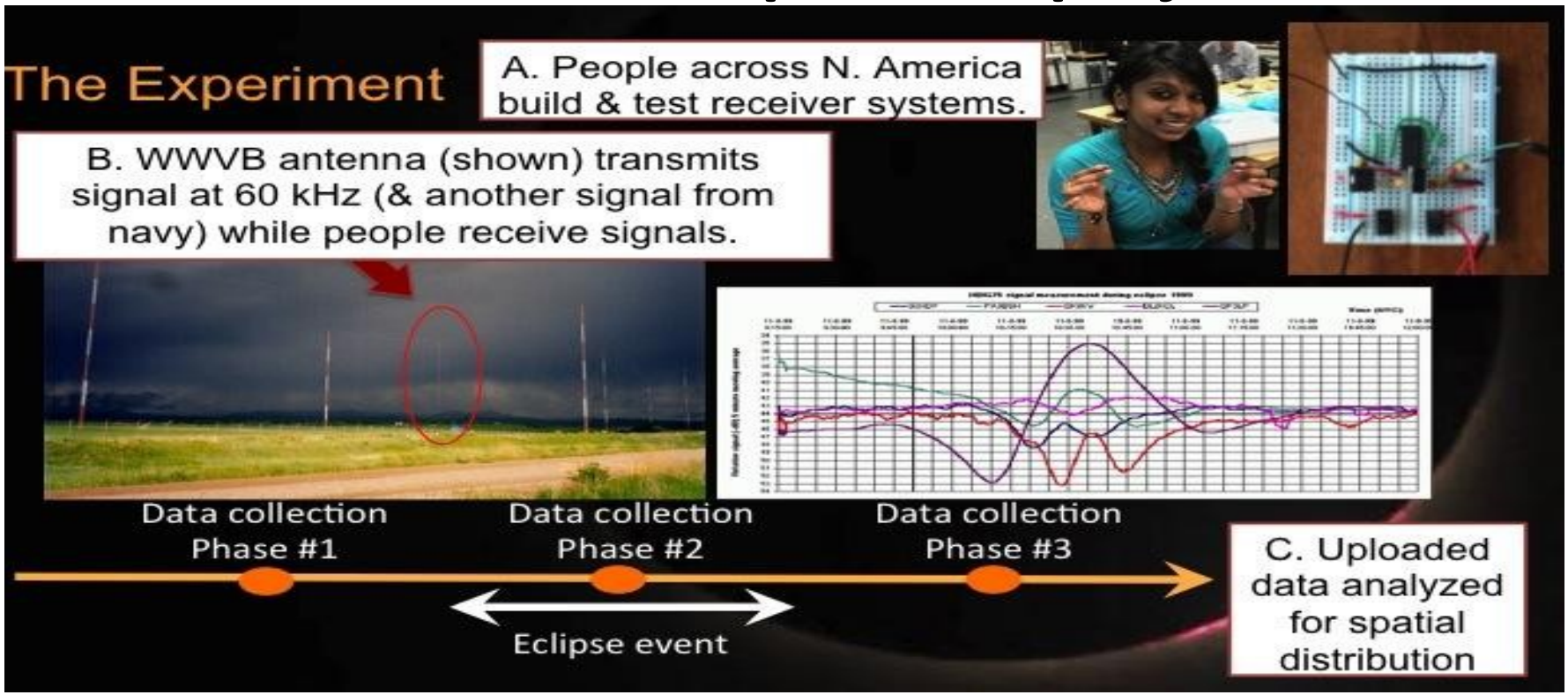
Lessons Learned from Historical Collections

Having a large number of collectors with similar reporting standards would be greatly beneficial.

This was tried with the solar eclipses of 1932, 1933 and 1934, as one large program. The report written in 1935 about those collections done in prior years stated that most of the data was unusable and that there should be a standard way of reporting from different collectors agreed upon prior to the eclipse.

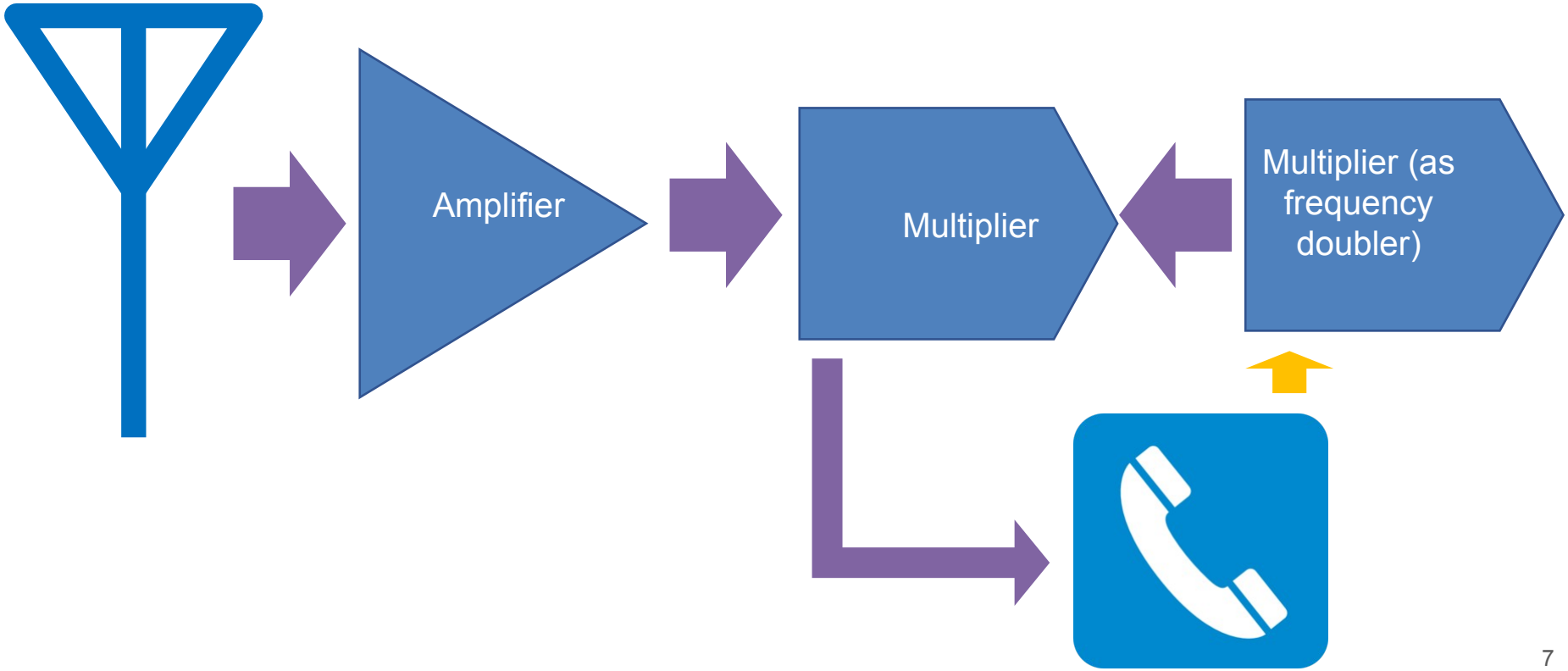
Today, with the advent of inexpensive hardware and GPS receivers, that is possible. Missing location, date and time data will no longer be a problem.

What is the EclipseMob project?



Desired result: new information about the location and geometry dependence of ionization and recombination behavior in the D and E layers of the ionosphere

EclipseMob 2017 Receiver



Collection Goals of the 2017 EclipseMob Efforts

Collect LF propagation data from two transmitters: WWVB at 60 kHz (Fort Collins, CO) and NRTF (Dixon, CA) at 55.5 kHz before, during, and after the eclipse.

Have many participants spatially diverse (had over 150).

Engage the participants with building the receiver/antenna and collecting data.

Offer educational opportunities for teachers and the general public.

Lessons from the 2017 EclipseMob Efforts

Folks are willing to help build and collect data (150+ kits requested, 102 requested certificates), motivated by a desire to contribute to the experiment and the challenge of figuring it out (n=34, response rate of 33%) and many chose to participate with others (~60%), rather than alone.

Need to start earlier. A complete working receiver system is needed before recruiting efforts begin. We had to ship kits before they were tested with custom software on smartphones. Significant participant technical support was needed.

Project and Participant Outreach/Communication Management are full time endeavors (need dedicated staff to meet participant needs).

Since people will be working in groups, a Train-the-Trainer model is likely a better approach than a central lead team.

The receiver system had a flaw which made the data collected unusable.

The process used to help debug assembled kits does not scale to 1,000s of receivers.

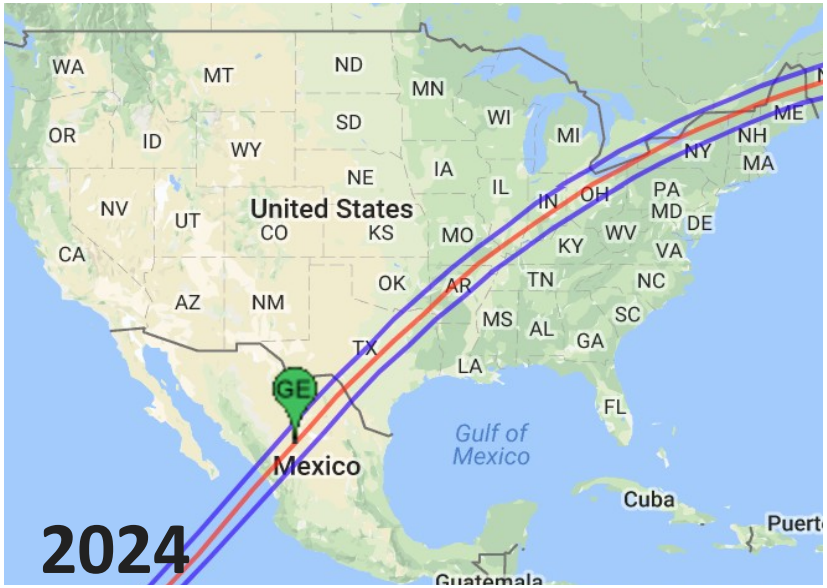
Goals for 2024 EclipseMob 2.0: Similar w/upgrades

Scaling up: Same crowdsource and expanded frequency data collection, but this time over 1,000 spatially diverse collectors.

Equipment Upgrade: Have the collectors engage in construction again, but this time using high level components (Raspberry Pi) instead of low level parts.

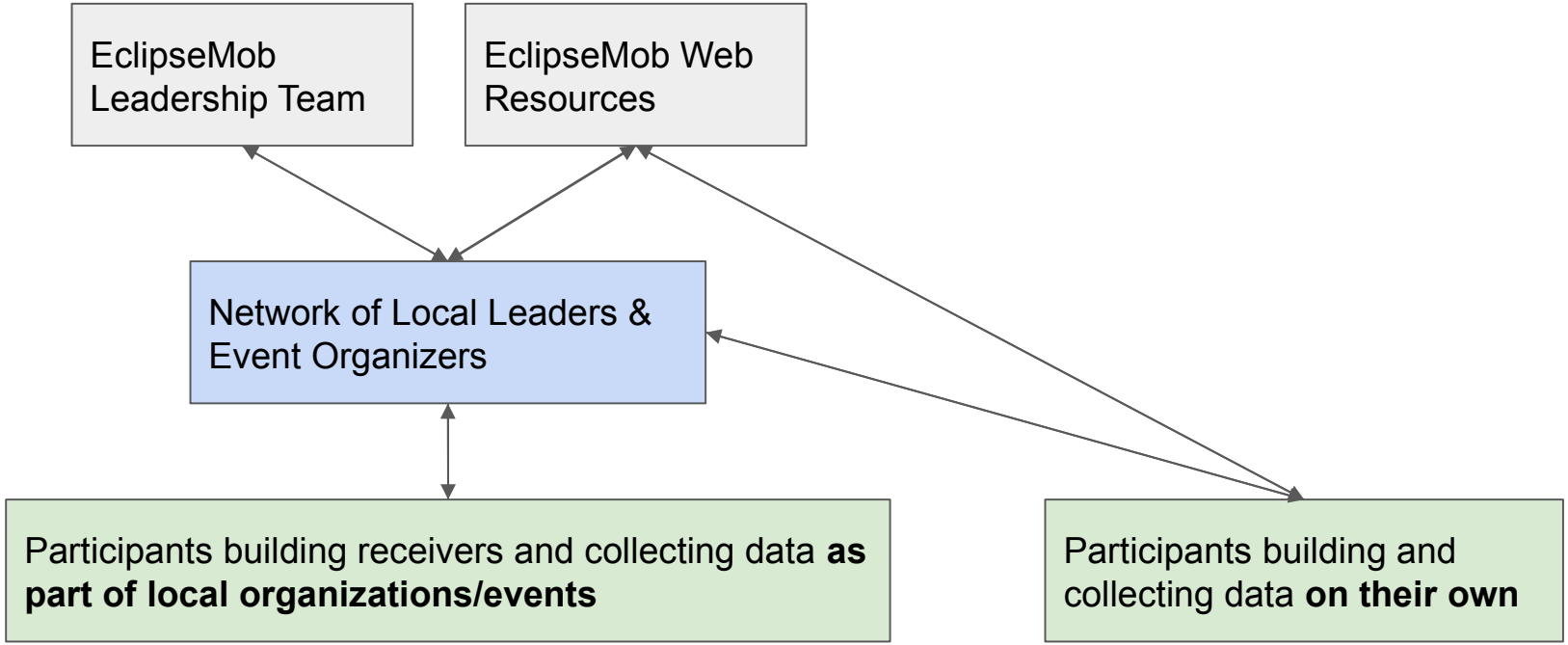
Changes to signal target: Collect raw signals for VLF and LF just above WWVB at 60 kHz including.

Change to a "Train-the-Trainer" Participant Support Model: Engage with teachers and other educators, hams, librarians and science centers/museums staff members to further their education and train them to be trainers of others (to scale up participant support).



(Eclipse map courtesy Fred Espenak, NASA/Goddard Space Flight Center, from eclipse.gsfc.nasa.gov.)

Participant Engagement



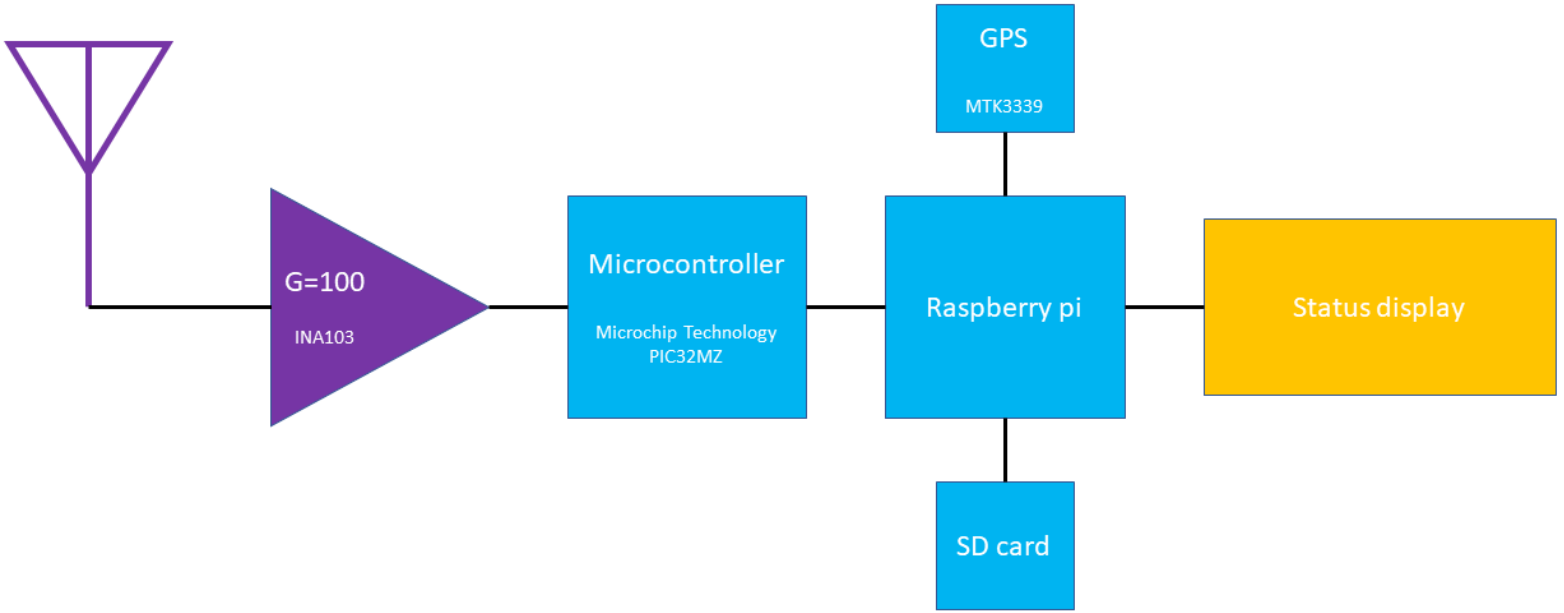
2024 Receiver Design

Smartphones are being manufactured without microphone and headphone jacks

GPS subsystems and single board computers are readily available at low cost

Large storage on SD cards is inexpensive

EclipseMob 2024 receiver



Antenna Design - Balanced Non-Resonant Loop

Conclusions

We are starting much earlier.

We will demonstrate working receiver with software this year.

We plan to hire professionals for some tasks, instead of students.

We plan to create and leverage a network of local leaders to facilitate scaling of participants and participant support to ensure a positive and successful experience for participants.

Acknowledgements

John Rockway, who coordinated with us so that the NRTF transmitter at Dixon, CA would be on 55.5 kHz during the eclipse event.

George Lemaster, WB5OYP, who was instrumental in all aspects of the 2017 EclipseMob effort.

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Join EclipseMob 2.0!

Complete the interest form to join our mailing list to receive the latest updates!

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