

Seminar on Internet Technologies

New Technologies to Connect Internet: Google Balloon & Facebook Drone



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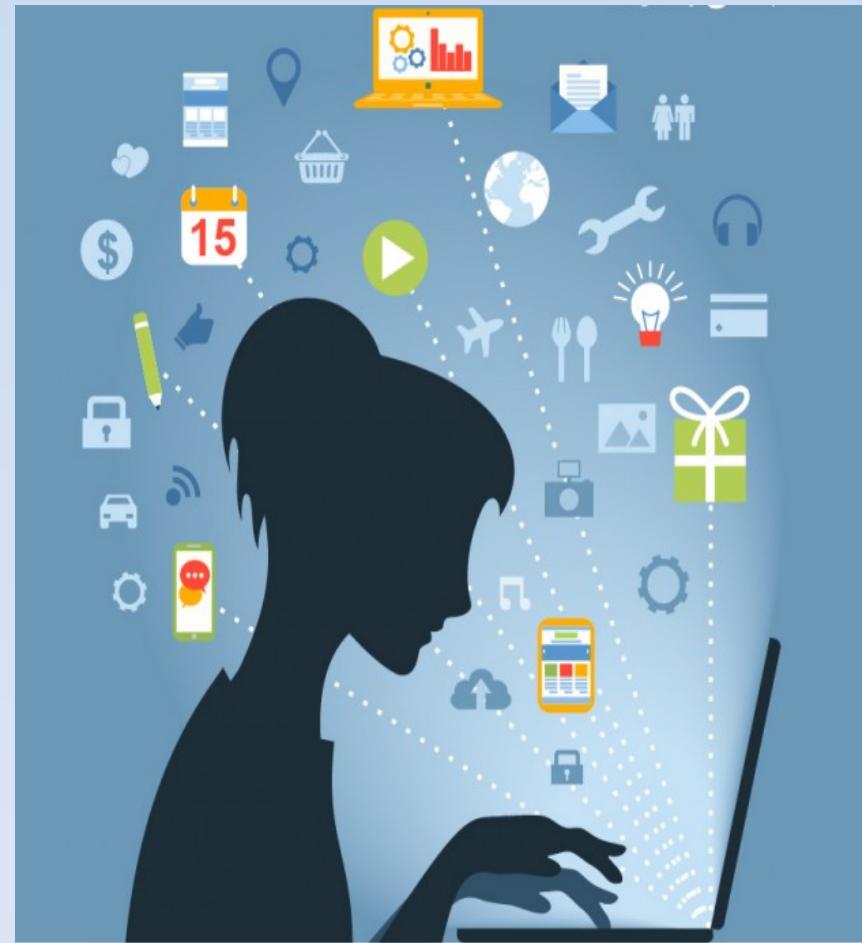
Overview

- Internet Access Challenges
- Satellite Communication
- Vs. Balloon and Drone**
- Facebook Drone
- Google Balloon
- Comparison
- Future Challenges
- Conclusion

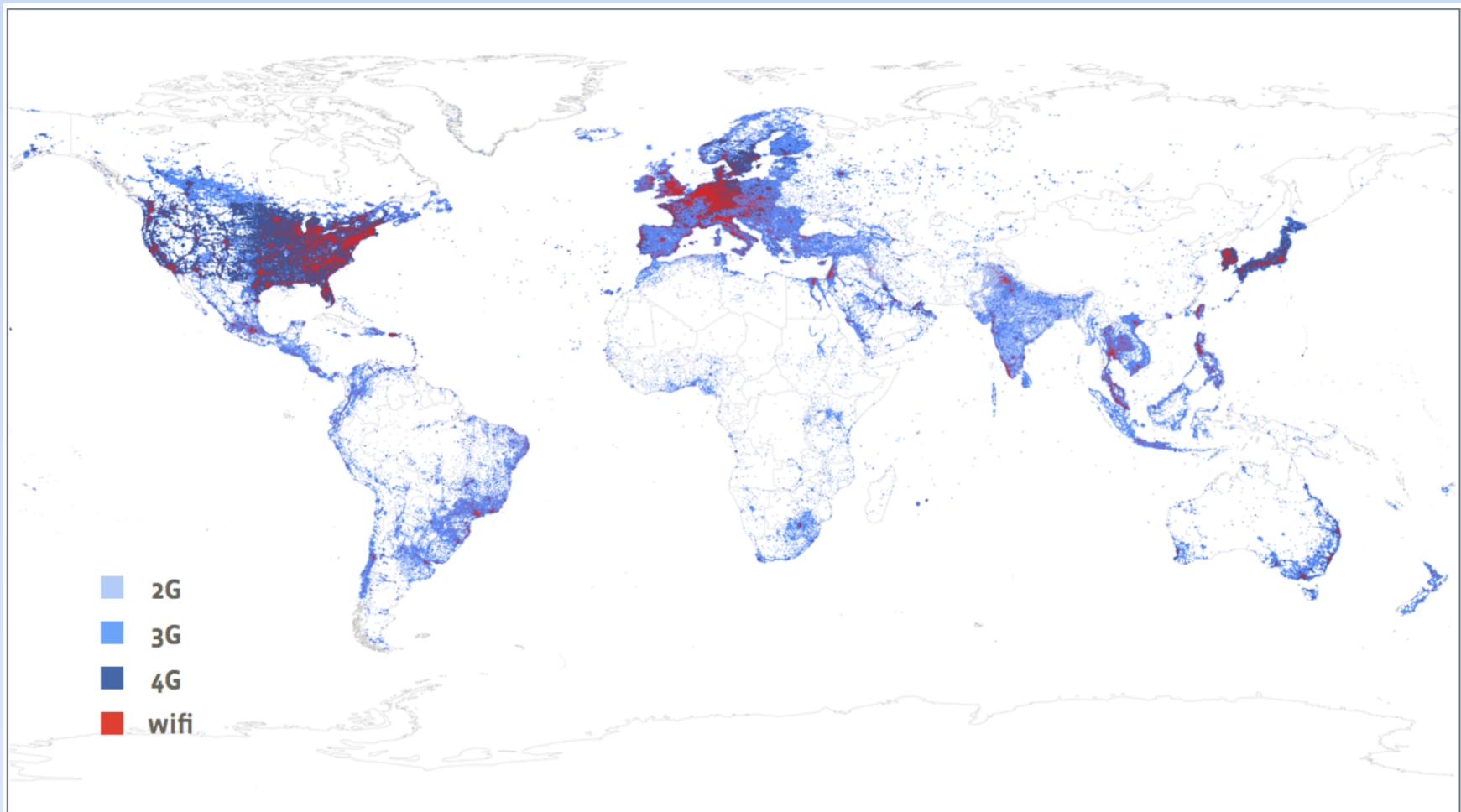


Internet Access Challenges

- Internet Access: 1/3 World's Population¹
- 80-90% People:
 - Areas with at least 2G/3G Networks
 - Still Cannot Access to the Internet
 - Economic Challenges
- Remaining 10-20% People
 - Infrastructure Challenges
 - Economic Challenges
- Providing Internet
 - 140 Million Jobs could be created
 - 160 Million Poor People could be uplifted



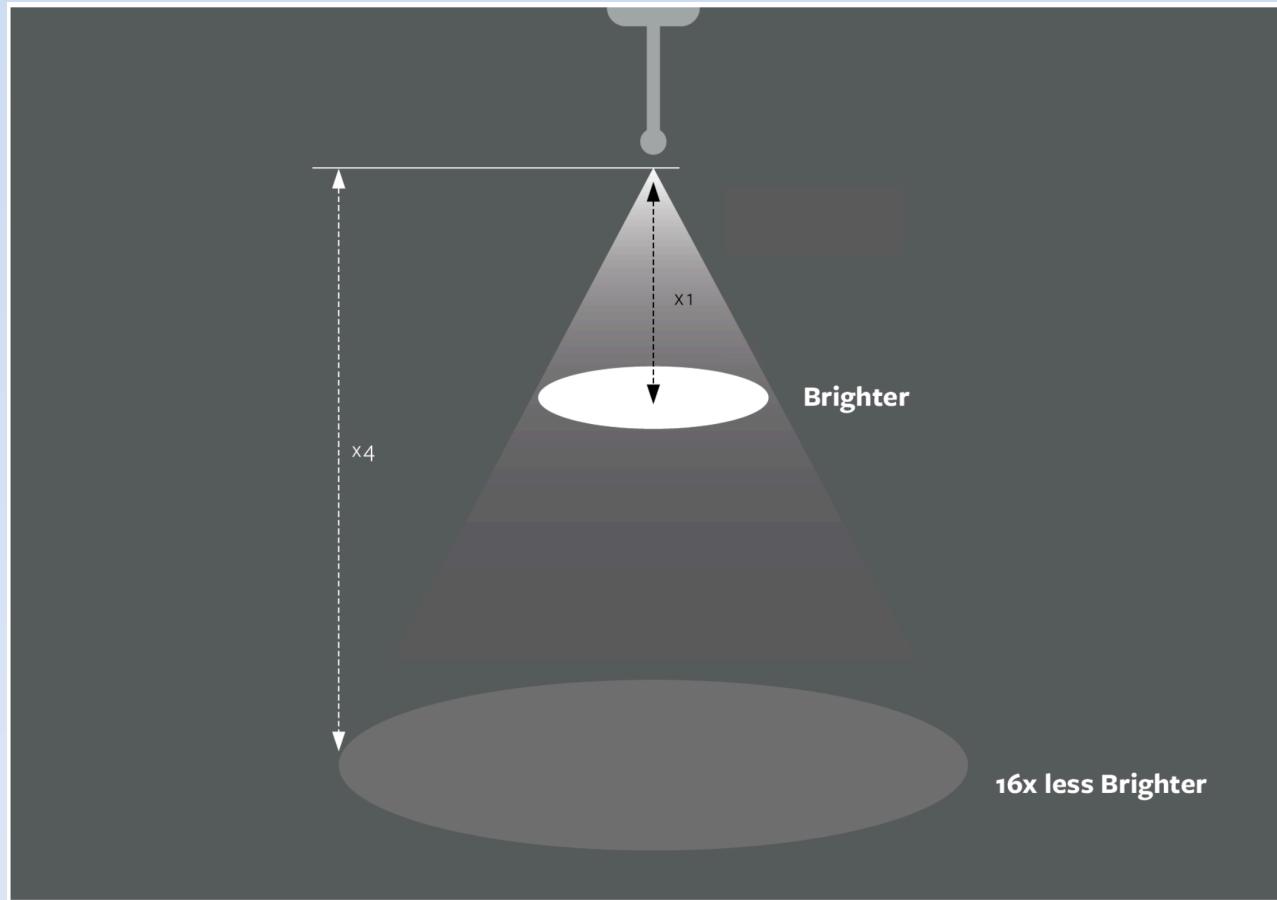
Internet Access Challenges



Coverage Heat Map

Why Not Satellite Communication?

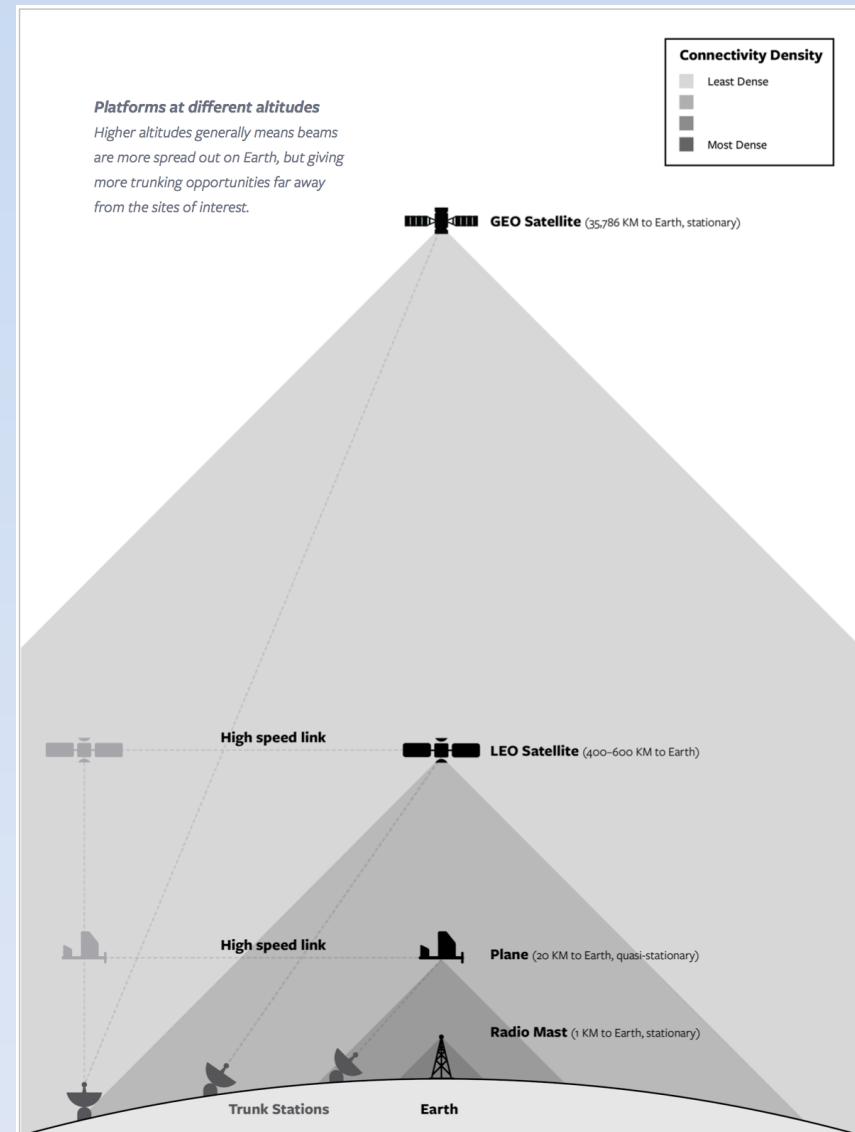
- Power of a Radio Signal weakens as square of Distance



Physics of Electromagnetic Propagation

Why Not Satellite Communication?

- Signal Power Attenuation
 - Huge, Solar Powered Satellites: Unstable
 - Nuclear Powered Satellites: Expensive
- Higher Cost of Deployment
- Low Earth Orbit(LEO) Satellite:
 - Not stationary
 - Ground Stations track Movement
 - Constellation of Satellites: 100 people/km²
- Geosynchronous Earth Orbit (GEO):
 - Stationary
 - Lesser Ground Stations
 - More Cost of Deployment
 - Weaker Signals
- Medium Population Density Areas



Platforms at different altitudes

Why Balloon or Drone?

- **Unregulated Airspace: Above 18 km**
- **Less Stronger Winds**
- **Precise Location Control**
- **Min. Energy Requirement**
- **Solar Powered Structures**
- **Cheap and Re-useable**

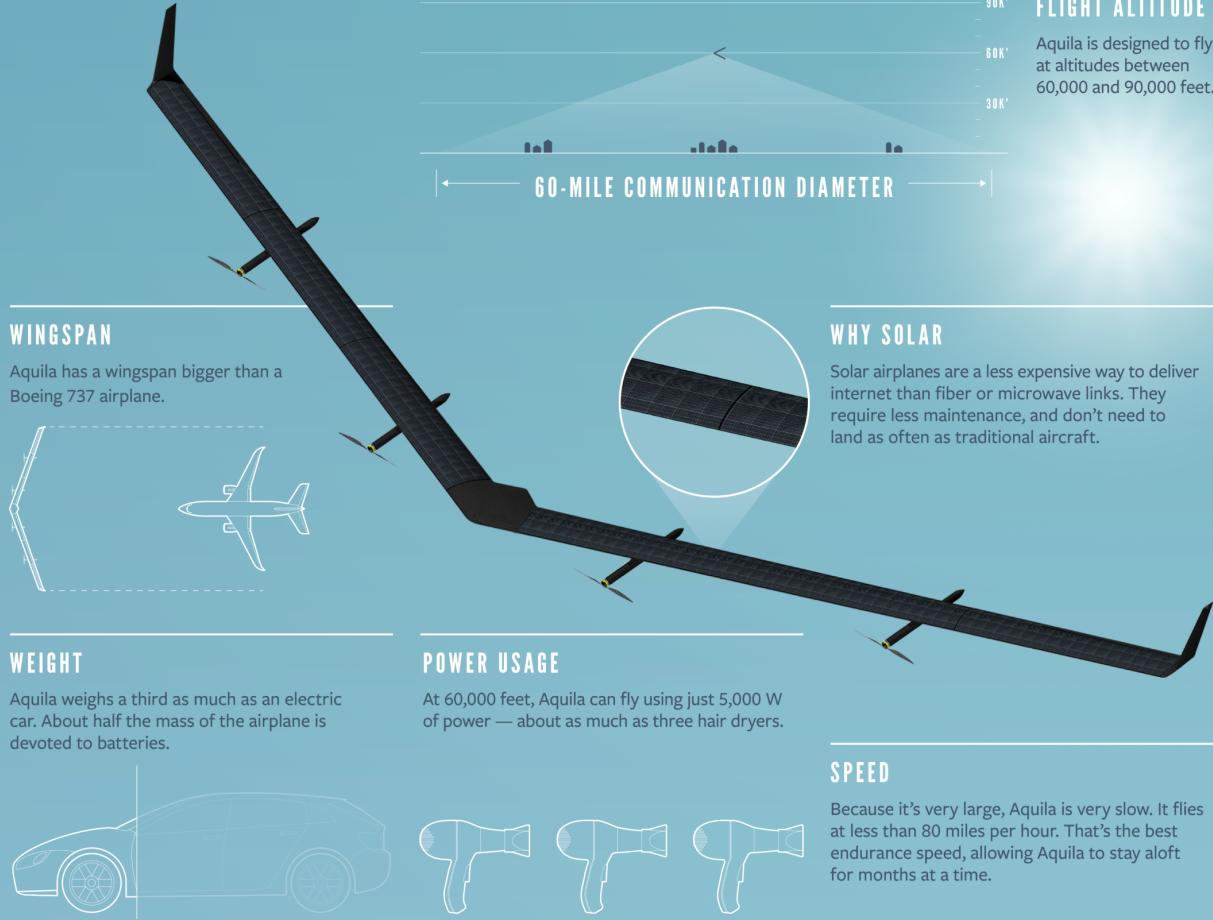


Facebook Drone

Codenamed AQUILA

AQUILA

To help bring internet connectivity to more people, Facebook is designing solar-powered airplanes that will beam internet signal to people in remote, underserved regions within a 60-mile diameter. Each aircraft is designed to be in the air for up to 90 days at a time.



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WEIGHT

Aquila weighs a third as much as an electric car. About half the mass of the airplane is devoted to batteries.



POWER USAGE

At 60,000 feet, Aquila can fly using just 5,000 W of power — about as much as three hair dryers.



SPEED

Because it's very large, Aquila is very slow. It flies at less than 80 miles per hour. That's the best endurance speed, allowing Aquila to stay aloft for months at a time.

Flight Altitude

FLIGHT ALTITUDE

Aquila is designed to fly at altitudes between 60,000 and 90,000 feet.

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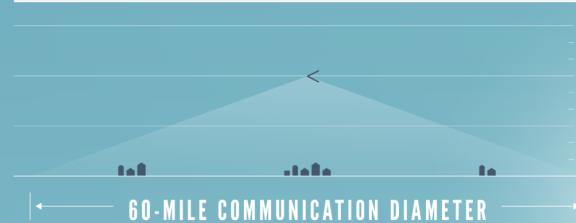
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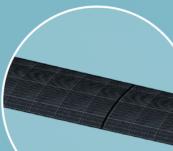
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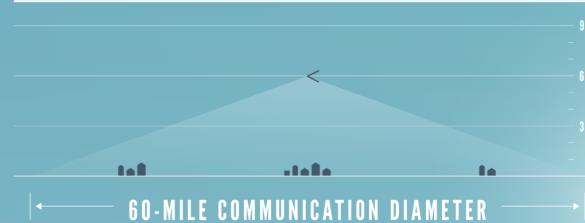
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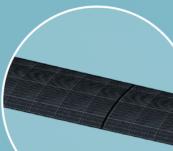
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60-MILE COMMUNICATION DIAMETER



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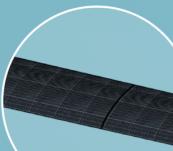
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Solar Powered

The infographic is titled "AQUILA" at the top left. It features a large image of the Aquila aircraft with a circular inset showing a close-up of its solar panel array. Below the inset, text states: "Aquila has the mass of a car. About half the mass of the airplane is devoted to batteries." To the right of the inset, another text block says: "or power — about as much as three hair dryers." At the top right, there is a section titled "FLIGHT ALTITUDE" with the text: "Aquila is designed to fly at altitudes between 60,000 - 100,000 feet." The bottom right section is titled "SPEED" with the text: "Because it's very large, Aquila is very slow. It flies at less than 80 miles per hour. That's the best endurance speed, allowing Aquila to stay aloft for months at a time." The bottom center contains the text "SIT WS 16/17" and the URL "http://www.iafrikan.com/content/images/2016/07/22-Aquila-Infographic.png".

AQUILA

60K' 100K'

FLIGHT ALTITUDE

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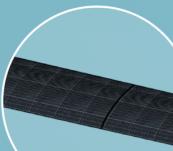
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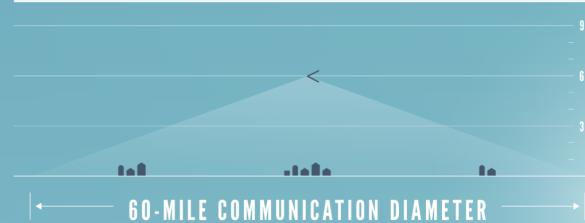
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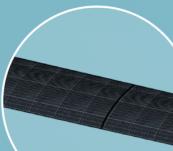
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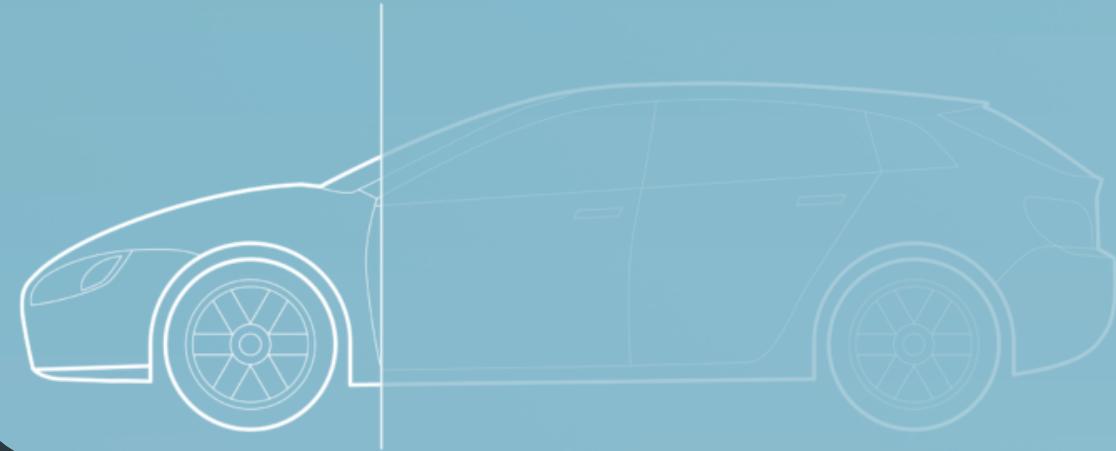
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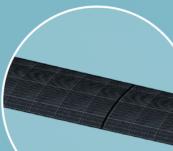
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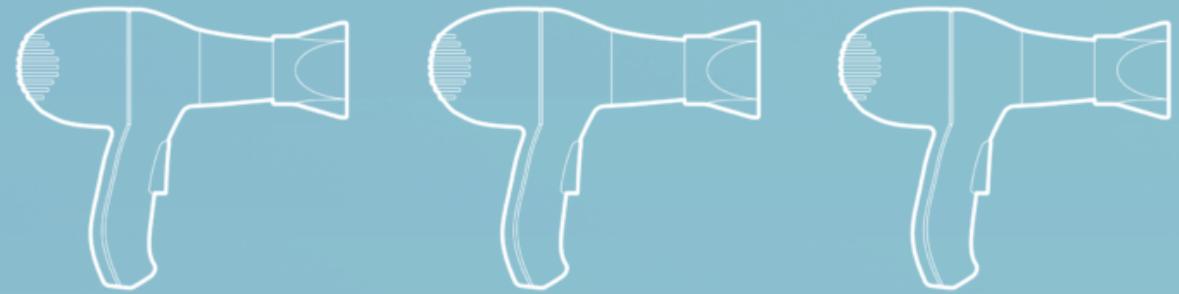
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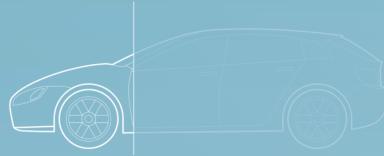
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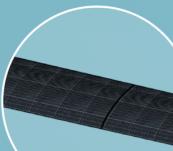
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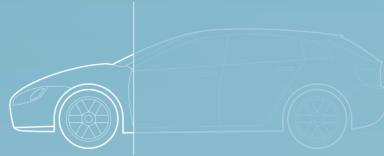
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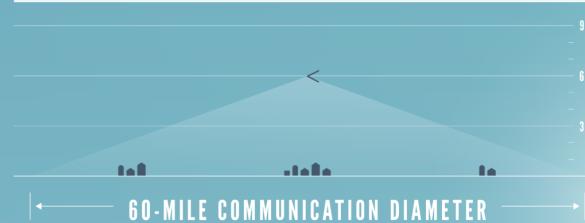
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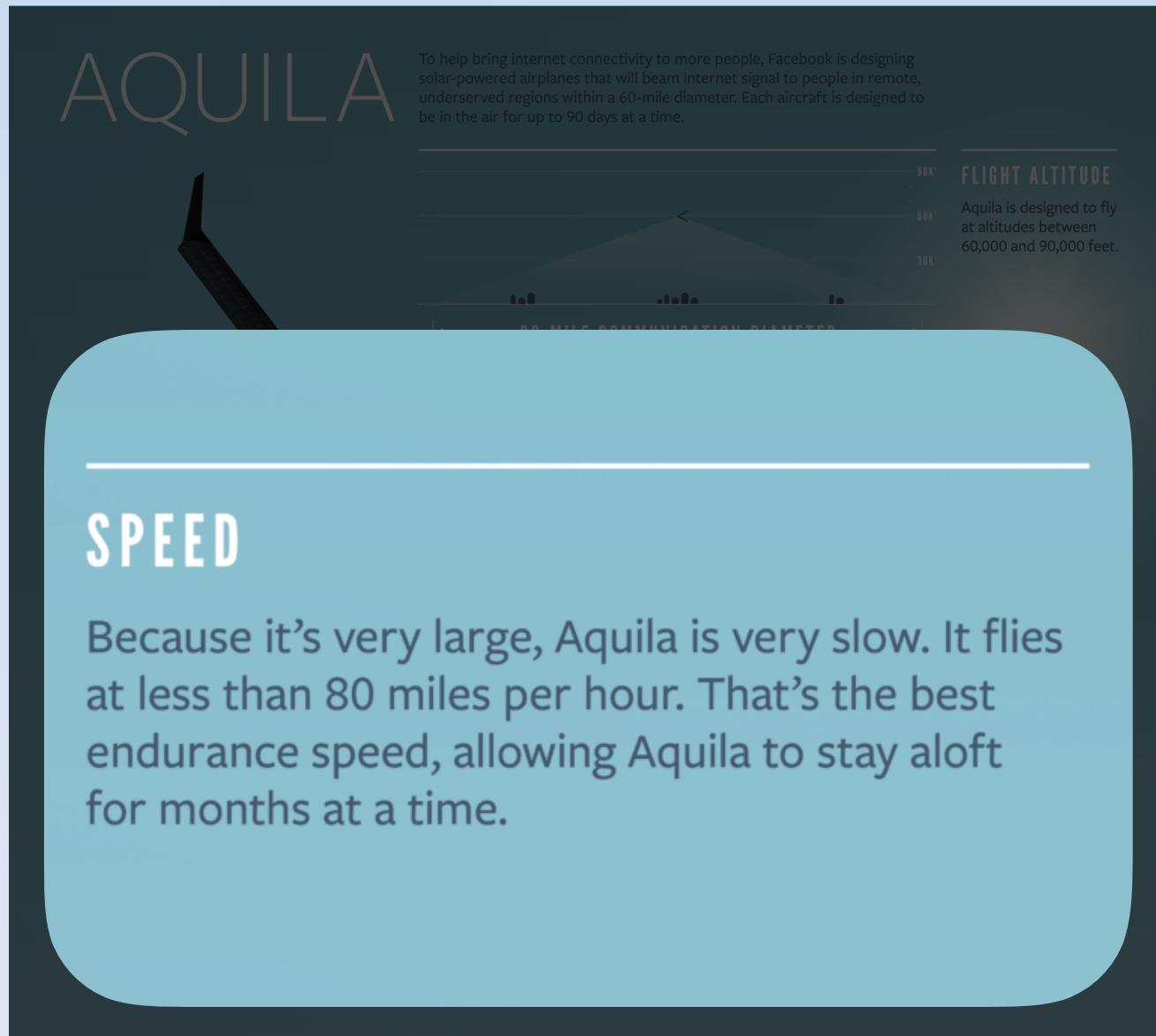


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Google Balloon

Design

- **Polyethylene Sheets**
- **Survives:**
 - Wind Speed: 100 km/hr
 - Temperature: upto -90°C
 - UV Radiation
- **Lifetime: 100 Days**



Google Balloon

Launching

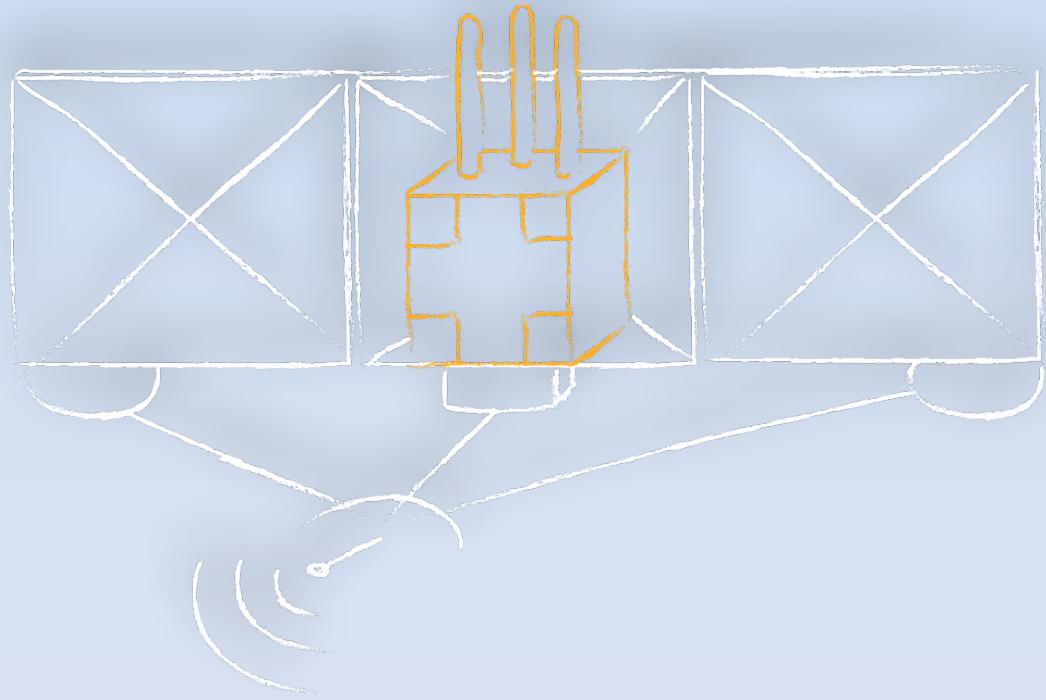
- Autolauncher Crane
- Side Panels for Wind Protection
- Launching capacity:
1 Balloon / 30 Minutes



Google Balloon

Equipment

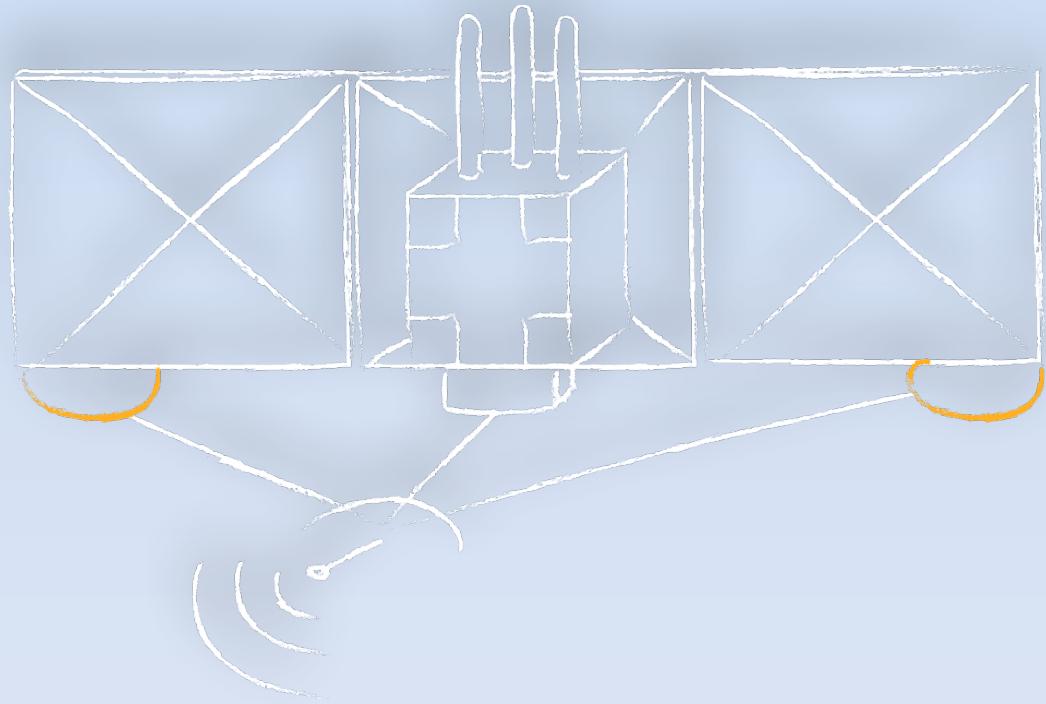
- Flight Capsule
- Transceivers
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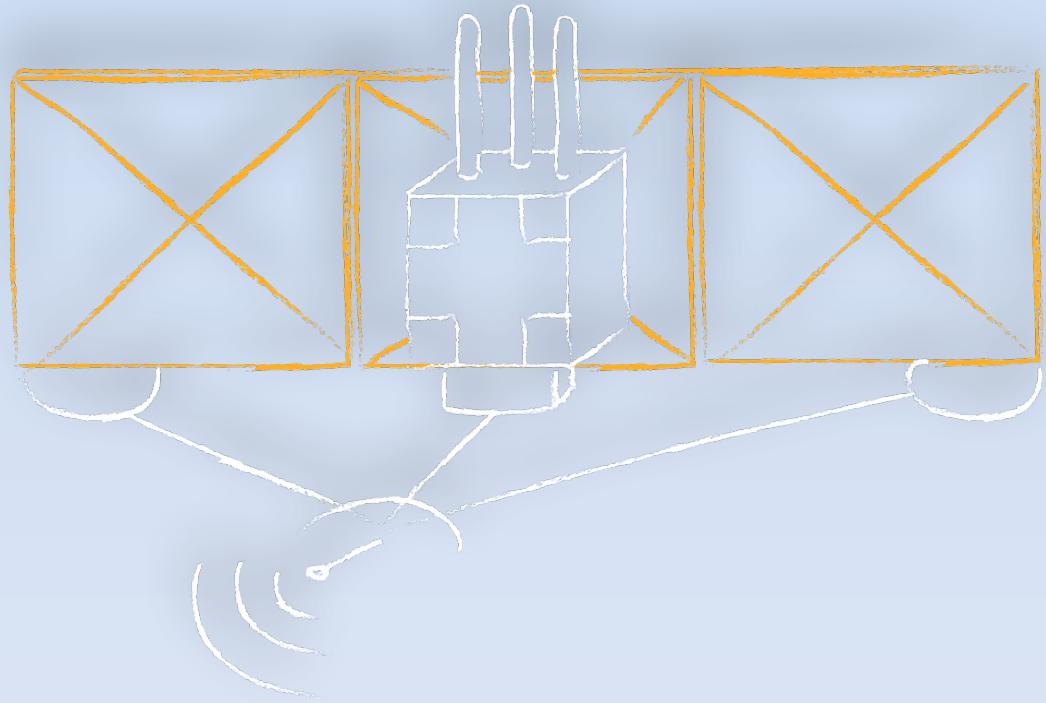
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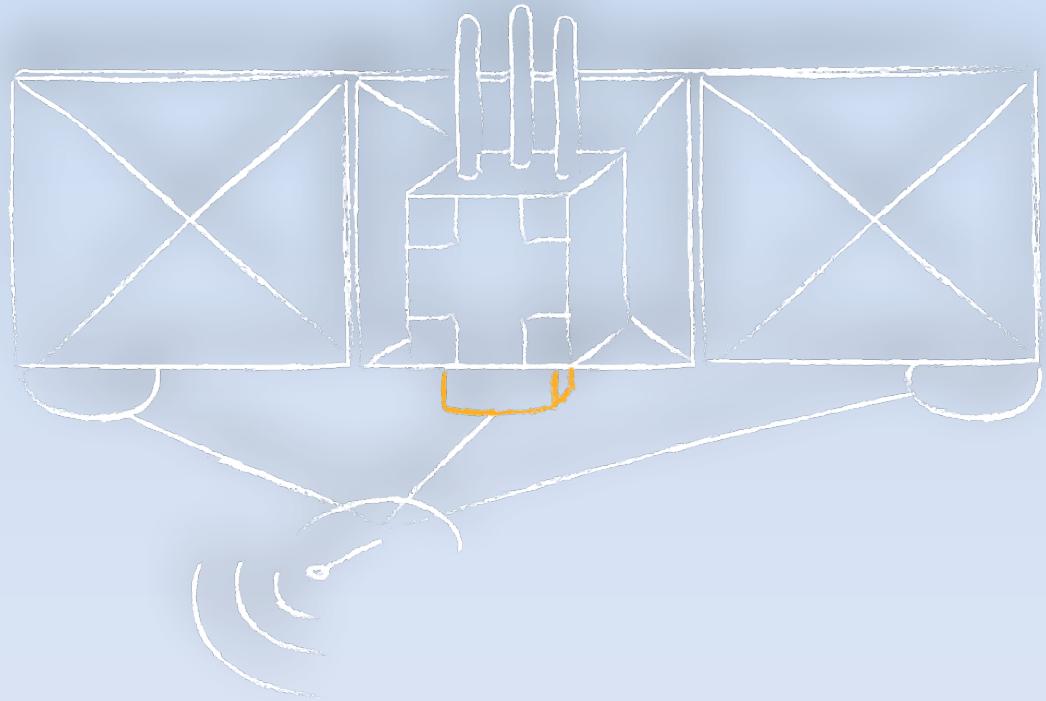
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Navigation

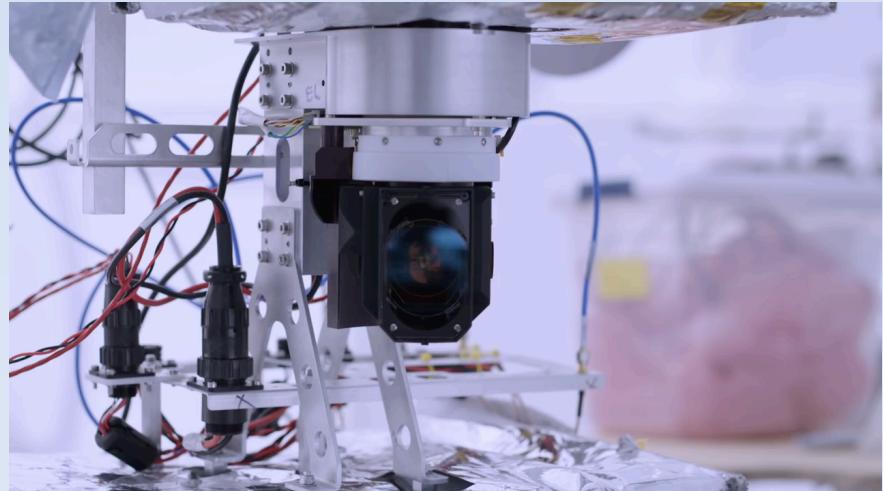
- Movement in Stratosphere
- Each Wind Layer : Different Direction
- To move Left or Right: Move Balloon Up or Down
- Decision Making Algorithms & Navigation Models



Connectivity: Drone & Balloon

Free Space Optics (FSO)¹

- Invisible IR Laser Beams
- Features:
 - High Bandwidth and Capacity
 - Less Power than Microwaves
 - Focus Power more precisely
 - Hit a coin from 10 miles away
- FSO Spectrum Remains Unregulated at Present



Comparison



AQUILA



PROJECT LOON

Cost

- **Greater Manufacturing and Deployment Costs**

- **Comparatively very cheap to manufacture and deploy**

Navigation

- **Precise and Easier Location Control**

- **More Difficult**
- **Climate Data by NOAA (National Oceanic & Atmospheric Administration)**

Comparison



AQUILA



Endurance	<ul style="list-style-type: none">• 2 Weeks World Record⁴• 90 Days in final models	<ul style="list-style-type: none">• 190 Days World Record³• 100 Days per Balloon
Accident Risks	<ul style="list-style-type: none">• Higher when compared to Google Balloon	<ul style="list-style-type: none">• Emergency Parachute Deployment• Lesser Risks & Damage when compared to Drone

Future Challenges

- FB Drone Deployment: Plane or Balloon
- FB Drone Prototype tested ran on heavy Batteries, final version without batteries yet to be built
- Endurance still a problem for FB Drone, Prototype: 90 Minutes flight time
- Safety still remains a Concern
 - Landing Accident for FB Drone at Yuma, Arizona⁶
 - Google Balloon crash in home yard in Los Angeles⁷
- Dealing with Local Governments
 - Google Balloon may face ban in India⁸
 - FB [internet.org](#): Banned in India, Net-Neutrality Issues⁴

Conclusion

- Technologies with Potential to Connect Millions across World
- More cost-effective than Satellite Communication
- Weight, Cost and Endurance still pose major challenge for FB Drone
- Risk of accidents
- Radio Spectrum, Airspace Usage and Other Concerns need to be solved with Local Governments
- Ban across countries might make these technologies not foreseeable in near future

References

- [1] https://fbcdn-dragon-a.akamaihd.net/hphotos-ak-ash3/t39.2365-6/851574_611544752265540_1262758947_n.pdf
- [2] <https://x.company/loon/>
- [3] <https://plus.google.com/+ProjectLoon/posts/2vGeQAXF4Qo>
- [4] <http://www.theverge.com/a/mark-zuckerberg-future-of-facebook/aquila-drone-internet>
- [5] <https://www.facebook.com/notes/mark-zuckerberg/the-technology-behind-aquila/10153916136506634/>
- [6] <http://bgr.com/2016/11/22/facebook-drone-project-aquila-crash/>
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- [8] <http://www.telegraph.co.uk/technology/google/12051080/Googles-Project-Loon-balloons-may-face-ban-in-India.html>

Thank You!

