Detecting Fires from the Sky

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1. Implementation Plan

Companies have sought for years to detect fires within minutes from the sky. After examining different technologies for offering aerial solutions, it's clear that each platform has strengths and weaknesses.

Our solution combines these private sector capital investments in new technologies with public sector support. Our "**Sky-Sharing**" model opens the whole sky for these different alternatives. As shown in Figure 1, different heights in the sky correspond to different technical solutions with different spatial and time resolutions:

(1) Geosynchronous (GEO) satellites at 35,786 km above the sea level;

(2) Low Earth orbit (LEO) satellites from 160 km to 2,000 km above the Earth;

(3) Balloons and drones at 20 km.

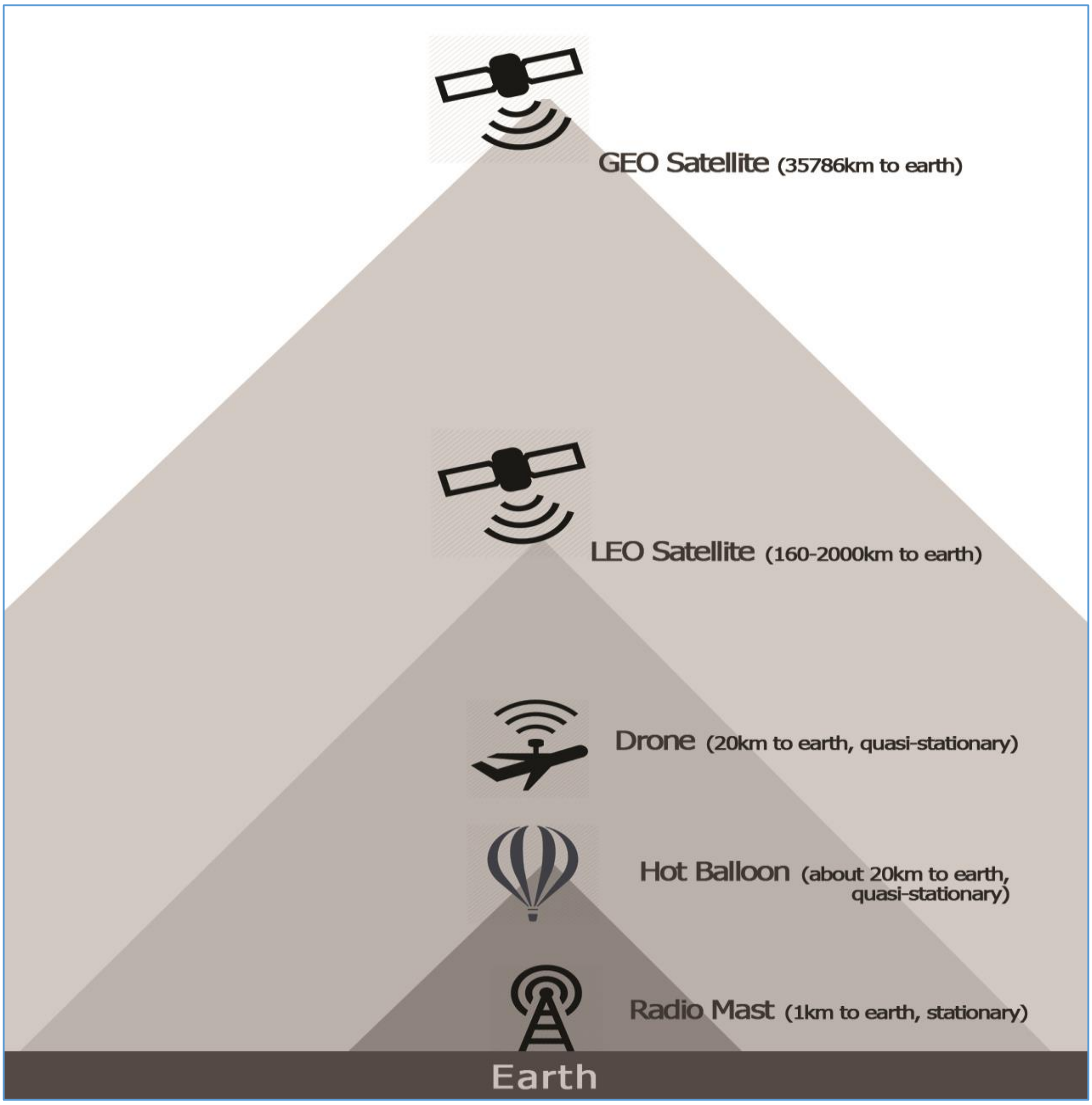

Figure 1. Our "**Sky-Sharing**" model

The adoption strategy is based on four core pillars:

(1) Illustrate demand for the service. To be specific, determining which alternative to be applied depends on the weather, climate, and terrain in different areas. One significant issue identified is whether or not remote or disconnected regions can be reached.

(2) With sufficient demand, a phased approach to the solution should then be instituted. A detailed timetable with achievable goals should be given for different aircrafts.

(3) We further propose that NASA serves as anchor tenants and expedite regulatory processes. This will help ensure resolution of any legal hurdles, while the government assists in the development of the system. Having local and regional governments assist and be part of the process can ensure smoother transition to commercial operations. Risks surrounding regulatory filings, market access, and other fundamental barriers to entry can be mitigated with the help of the governments.

(4) To ensure commercial sustainability, Social Media Providers should be considered as potential distribution partners for the system. Once the service has been established and the reliability of the system has been confirmed, the service can be deployed to commercial Social Media Providers to cater for a wider population through increased service subscriptions.

2. Different Aircrafts

a. Balloons

Deploying balloons might be the most efficient and cost effective choice to detect fires. Using balloons floating in the sky twice as high as airplanes, the signal is passed across the balloon network and back down to the global Internet on Earth (Figure 2).

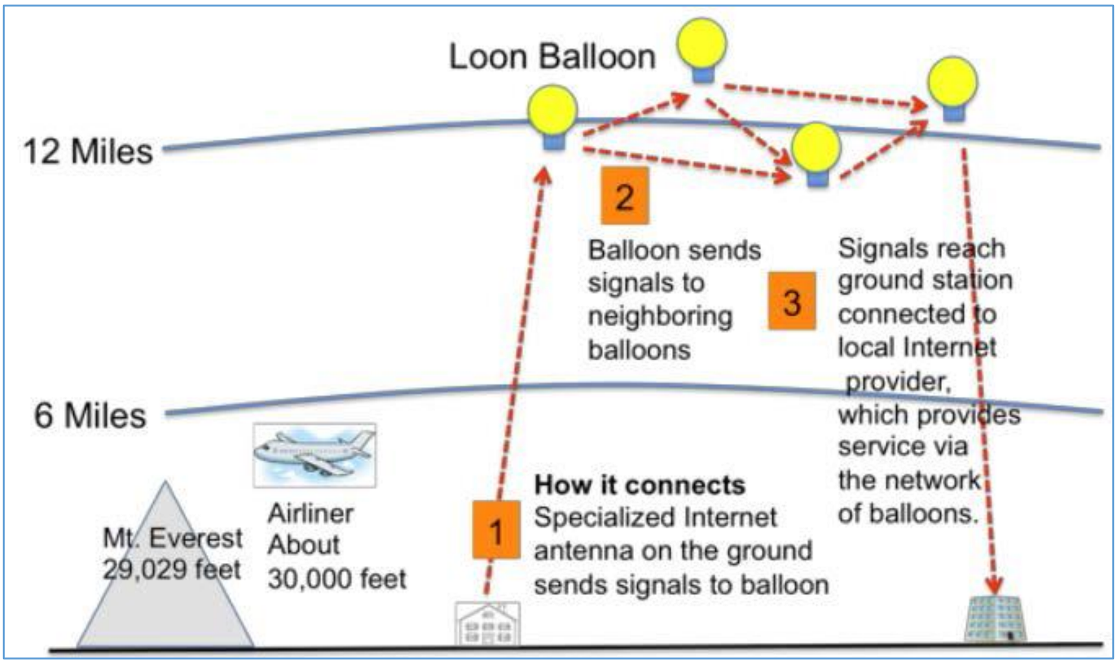

Figure 2. How Balloon connects everyone.

Strength: Balloons are a cheap option. There is potential for balloons to cover a wide area at a lower cost than drones and to be available with a shorter lead-time than satellites. Balloons can be deployed in a variety of locations, although they do require fortuitous wind conditions to fly over the desired location. Less infrastructure would be required than for drones, without the need for airports and maintenance facilities, as shown in Figure 3.

Weakness: Wind can be a limiting factor on the way that balloons can fly at certain latitudes. In the stratosphere, there are many layers of wind, and each layer of wind varies in direction and speed. Balloons go where they're needed by rising or descending into a layer of wind blowing in the desired direction of travel. Using fleet control algorithms, we forge ahead with plans to fly across remote areas with certain latitudes.

Figure 3. Balloon launching in New Zealand.

b. Drones

Drones can be launched to detect wildfires from the sky. The power is generated through its solar panels during the day and stored in its batteries for overnight use. The prototype is present in Figure 4.

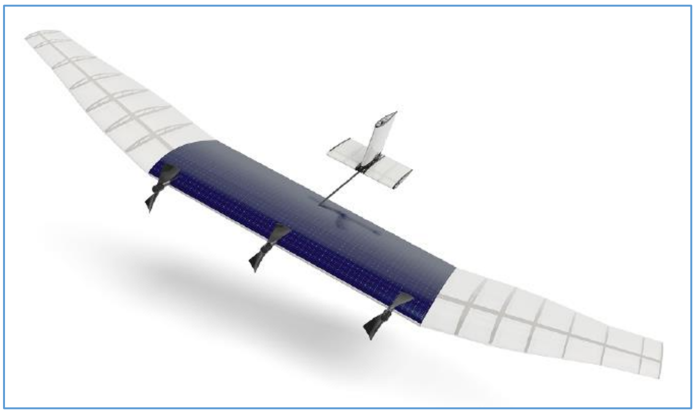

Figure 4. Facebook's drone.

Weakness: A lot of technical constraints are required for drones, including:

(1) Fly as low as possible to maximize signal strength while high enough where the wind is not very strong. The low altitude also results in low coverage, increasing

operational costs.

(2) Fly outside of regulated airspace for safety and quick deployment while be able to precisely control the location.

(3) Build the smallest structure possible with minimal energy to stay aloft while large enough to harvest energy from the sun. Operational efficiencies are still some time away.

(4) Build the cheapest structure to produce enough to span many areas while re-usable to make it more cost effective.

Strength: Based on these constraints, drones operating at 12.3 miles are ideal. At this altitude, a drone has a good resolution that covers a city-sized area of territory with a medium population density. This is also close to the lowest altitude for unregulated airspace, and a layer in the atmosphere that has very stable weather conditions and low wind speeds. Thus an aircraft can easily cruise and conserve power.

Solar-powered aircraft has long endurance. With the efficiency and endurance of high altitude drones, it's even possible that these aircrafts could remain aloft for months or years. This means drones have more endurance than balloons, while also being able to have their location precisely controlled.

Drones can be quickly deployed, leading to a potential use for post-disaster Internet. They can be launched quickly and then directed to fly over affected areas on short notice.

Drones are highly maintainable and have possibility for upgrade. Unlike satellites, drones won't burn up in the atmosphere when their mission is complete. Instead, they can be easily returned to Earth for maintenance and redeployment.

c. Satellites

Despite the clear strengths of balloon- and drone-based solutions, there are still places where it remains uneconomical to deploy balloons or drones. In remote areas with extremely low population density, satellites may prove a cheaper and more readily available alternative. SpaceX is preparing to create a fleet of satellites to blanket the globe in wireless broadband connectivity, as shown in Figure 5. The initial satellites in the network are expected to come online in 2018.

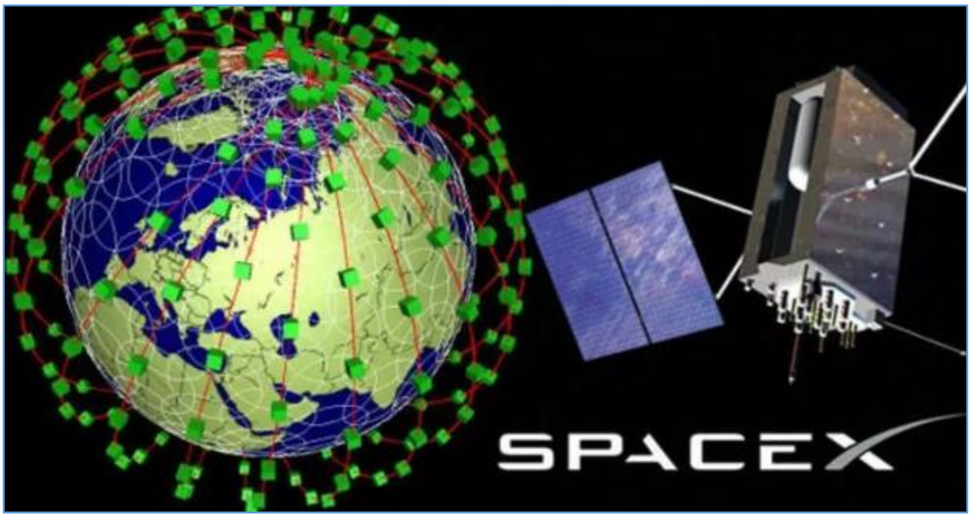

Figure 5. SpaceX's fleet of satellites.

Strength: As a truly global option. Satellites can cover the whole of planet Earth all the time. Companies such as SpaceX believe satellites can deliver fast, reliable image transimission to everyone. Satellite technology can help reach families who live in rural or hard-to-serve places where fiber optic cables and cell towers do not reach, and it even offers more competition where terrestrial Internet access is already available.

There are two types of satellites:

(1) Geosynchronous (GEO) satellites hold steady at 35,786 km above the sea level and stay pointed at one region indefinitely.

(2) Low Earth orbit (LEO) satellites provide a usable detection while using less power. This means these satellites can be smaller and therefore cheaper to launch. There's also comparatively less signal latency at this orbit, so it's easier to use real-time services.

Weakness: To ensure consistent coverage, providers of satellites need to put up many satellites. The capital costs of this system would be the highest of the options, due to launch and spacecraft construction costs. Contemporary satellites is mostly used by companies and organizations that require access in remote environments or in specific scenarios such as natural disasters.

Some critics of satellite broadband have warned of the risk of creating more debris in space that could prove harmful to other space operations. Collisions with debris as small as 10 cm can catastrophically damage satellites, and debris as small as 1 cm can disable spacecraft.