Executive Summary

SatFireWatch

(Fire Prediction Software and Services)

Universeh – Satellite Communications, Regulation and Business

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1. Business Summary Vision, Mission & Goals

SatFireWatch is a promising start-up in the area of technology and space communications with the vision of providing a product and services aiming to protect and save lives from wildfire. Our mission is to offer prediction of wildfire through a cutting-edge software that relies on data collected by our own LEO satellite constellation. With our wildfire detection app, we make fire detection easily accessible to individuals. Our ultimate goal is to stop wildfire propagation and save lives.

2. Market Opportunity & "Call to Action"

As climate change exacerbates wildfires, the demand for rapid response solutions is growing, particularly from governments, environmental agencies, and disaster management organizations in high-risk countries. Our CubeSat constellation is conceived to meet this increasing need for the advanced wildfire monitoring. With a potential for global coverage, our technology could serve any country with forest areas, positioning us at the forefront of this crucial environmental challenge. This project represents a timely fusion of innovation, market potential, and dedication to sustainability.

3. Product/Service, Pricing, Margins

- For Personal Users: 30 logins to the SatFireWatch detection app for free + advertisement, then, a one-time payment of 9.99€, with a 3.00€ margin.
- For Companies and Industries:
- Wildfire prediction software license plan at 499.99€/month, with a 350.00€ margin (SatFireWatch detection app is included).
- Raw satellite data purchase at 149.99€, with a 100.00 euros margin:
  This option does not include access to the detection app, the prediction software license, or the consulting and integration services.
- Consulting and integration services:
  Advanced predictive capabilities are delivered through our consulting and integration services, priced at 699.99 euros, with a margin of 500.00 euros. These services help professionals to effectively utilize the software predictions, ensuring seamless integration into the professionals' existing workflows.
- Premium Package: Licence + consulting and integration services, for 999.99€.

4. Anticipated Client Capture Plan

Potential clients for our wildfire detection service include government agencies, private companies, insurance companies, environmental organizations, agricultural stakeholders, research institutions. Early prediction of fire in wildfire-prone regions protects ecosystems, natural habitats, infrastructure, private property, estate, crops and livestock. In addition, our data can be used for studies on fire behaviour, ecology and climate change.

5. Operations

Phases	1 : Design and Development	2: Prototype Testing and Validation	3: Production and Pre-Launch Preparations	4: Back-up time margin	5 : Launch and Deployment	6: Operational Management and Data Handling
Duration	**7 months**	**6 months**	**5 months**	**3 months**	**6 months**	**working period**

Description	Satellite Design,Software Development	Assembly of Prototypes, Ground Testing	Pre-Launch Testing, Launch Coordination	For underestimated problems	Launch – Deployment Initial Calibration	Regular Operations - Data Processing and Analysis

Milestones: Design Finalization: **7/24 -** Launch Date: **10/25 –** Full Operational Capability: **3/26.**

6. Operations

Our engineers will build our Leo constellation of satellites and ensure its launch, while a dedicated tech team will develop the software and the app. The product placement on the market and its visibility to the targeted public will be handled by the marketing and commercial department.

7. Risks

Three kinds of risks must be taken into consideration. First, technical risks, our CubeSat project faces challenges such as launch failures, communication issues, and harsh space conditions, countered by partnering with reliable launch providers, implementing redundancy, and robust design. Second, operational risks that include managing constellation coordination and data handling, mitigated by regular telemetry checks and efficient data networks. Third, regulatory risks involve compliance with national and international export control laws for dual-use goods and defense products that could potentially affect our rocket and/or our satellite, especially at the manufacturing stage (possible reliance on brokering), and at launching state. We will seek advice to mitigate these issues. Further, compliance obligations in terms of insurance and financial audits are crucial for our space operations license. French Space Operations Act lays down specific administrative conditions for authorisation and registration of space objects. For this reason we will set up an internal compliance program.

8. Finance: Benefits vs Costs

SatFireWatch s.a.r.l will be established in France and will provide real-time connectivity through its LEO constellation of satellites to an application capable of detecting wildfire for individuals. But most importantly, it will provide a prediction software for professionals to prevent wildfire. In the initial phase, our focus will be on covering European dry forests, encompassing 96,000 km², through the launch of 30 satellites from France within the first year. Subsequently, our goal is to expand coverage globally.

Our cost estimation encompasses the manufacturing of CubeSats, launch operations, deployment of ground stations, and software development, amounting to a total investment of €9.3 million over three years.

For obtaining returns from this investment, we offer a detection app for individuals through a one-time payment after the end of the trial period, licences of our prediction software, sell of raw data, and consulting and integration services. In the first year, we anticipate earning €1.7 million.

9. Summary of Business Plan Hypotheses

LEO satellites enable timely prediction of wildfires while high-resolution imaging enhances accuracy. Constant monitoring on a global scale increases effectiveness and enhances service reach including remote and inaccessible areas. This contributes to environmental protection, significantly lowers the risk of excessive fire damage, saves animals, their natural habitats, and any potential human life loss.
Due to climate change, there are more risks of wildfires across the globe, thus, there is a viable market for our business model. The technology that can successfully contribute to lowering the risk of wildfires can create trust and security for potential clients.

Annexes

Annex 1: SWOT Analysis

Strengths	Weaknesses
• **Innovative Technology** The software utilizes advanced algorithms and data analytics for accurate wildfire prediction. • **Early Warning System** Provides early detection, allowing for timely intervention and mitigation efforts. • **Scalability** The software is scalable, capable of covering large geographic areas and accommodating increased data volume. • **Customization** Flexibility to tailor the software to specific environmental conditions and geographical regions. • **Data Integration** Ability to integrate with various data sources, such as weather patterns, satellite imagery, and topography.	• **Dependence on Data Accuracy** Accuracy is heavily reliant on the quality and reliability of input data sources. • **Initial Investment** Developing and implementing the software may require a significant initial investment in research and development. • **Market Education** The need for educating potential customers about the importance of wildfire prediction software. • **Regulatory Challenges** Adherence to and compliance with various regulations and standards in different regions. • **Infrastructure Requirements** Clients may need to invest in compatible infrastructure for effective software utilization.
Opportunities	**Threats**
• **Growing Awareness of Wildfire Risks** Increasing awareness of the devastating impacts of wildfires creates a market for proactive solutions. • **Collaboration with Authorities** Opportunities for collaboration with government agencies and emergency services for widespread adoption. • **Continuous Improvement** Ongoing advancements in technology provide opportunities for continuous improvement and feature enhancements.	• **Competition** Potential competition from other companies offering similar wildfire prediction solutions. • **Data Security Concerns** Growing concerns about data security and privacy may impact customer trust. • **Climate Change Uncertainties** The unpredictable nature of climate change can affect the accuracy of predictive models. • **Budget Constraints** Economic downturns or budget constraints may lead to reduced spending on wildfire prevention technologies. • **Regulatory Challenges** Changes in environmental regulations or policies may impact the market landscape.

Annex 2: Market Analysis and Decision

The objective is to deploy a constellation of small satellites into Low Earth Orbit (LEO) with a budget of €10 million.

Key factors to consider include:

1) The number of small satellites that can be launched within the €10 million budget.
2) The coverage footprint on Earth that this constellation will provide, which is determined by the number of satellites deployed.

Selection of Small Satellite Type for the Project:

Various types of small satellites are available [1]:

- Minisatellites: 100-180 kilograms
- Microsatellites: 10-100 kilograms
- Nanosatellites: 1-10 kilograms
- Picosatellites: 0.01-1 kilograms
- Femtosatellites: 0.001-0.01 kilograms

Given that the cost of these satellites increases with size [2] and considering our requirement for a payload capable of capturing high-resolution images of Earth and transmitting them back to our control station, Nanosatellites, or more specifically, CubeSats, emerge as the optimal choice.

Benefits of Choosing CubeSats:

CubeSats, standardized by California Polytechnic State University and Stanford University, offer several advantages:

- **Cost-Effectiveness**: Their standardized design leads to reduced project costs.
- **Development Efficiency**: Standardization means less time is needed for development and testing.
- **Resource Availability**: There is an abundance of documentation, articles, and materials available for CubeSat development, facilitating in-house satellite construction.
- **Expertise Access**: Due to their popularity, assistance can be sought from researchers, professors, and laboratories.
- **Mission Versatility**: CubeSats can support a variety of missions, including our specific task of capturing high-resolution Earth images and transmitting them to the control station [3].

How to Launch Our CubeSat Constellation:

There are two main methods to launch our CubeSat constellation:

1. **Specific Small Satellite Launches (Small Satellites as Primary Payload**): This approach, where the CubeSat is the primary payload, can be quite expensive, potentially costing several million dollars [4].
2. **Rideshare Programs (Small Satellites on a Larger Satellite's Launch):** This more cost-effective method involves sharing a launch with a larger primary payload.

We will further explore the costs associated with these methods in the following section.

Cost Considerations:

As we have decided to work with CubeSats, their standardized format enables in-house development, construction, and operation. This can significantly reduce costs, potentially amounting to only a few thousand dollars for development.

However, the major expense is the launch. Launching a CubeSat into space, especially through rideshare programs [5], can be more costly.

Rideshare programs in the space industry allow multiple payloads to share a single launch, offering cost savings and increased launch frequency. This method is widely used by commercial companies, space agencies, and universities. It provides a lower financial barrier for smaller organizations and startups to access space. However, rideshare programs have some limitations, like possible delays and payload compatibility requirements. The cost of launching a CubeSat through a rideshare program depends on the CubeSat's size, target orbit, and launch vehicle, with additional costs for ground services.

Rideshare Launch Cost Comparison Table:

Launch Provider	Cost for CubeSat/SmallSat Launch	Additional Notes
SpaceX	$275,000 for 50 kg to SSO	**Additional costs** for insurance, separation springs, and fuel
Rocket Lab	$7-7.5 million per launch	**Dedicated launch** to LEO or SSO. But it proposes also **Rideshare** program
NanoRacks	$90,000 per 1U from ISS	$270,000 for 3U, $540,000 for 6U; includes CubeSat Safety and Verification

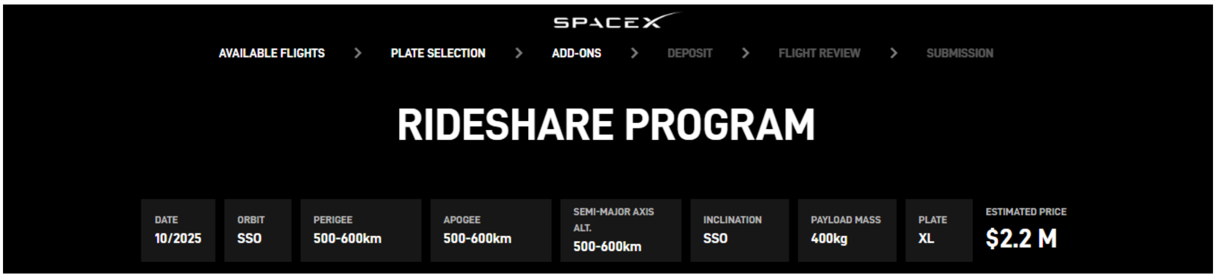
NASA CSLI	Varies	Offers opportunities for educational institutions, nonprofit organizations, etc., with technical support and collaboration opportunities

Note that the figures are for a specific fiscal year (FY2022) and may change over time. Additionally, the cost and availability of these services can vary based on specific mission requirements and other factors.

Order of magnitude:

For example, we can have:

- With **€2.2M** for space X: we can lunch **400Kg** of CubeSat [6]



- With **€1M** Nanoracks: (€1M/$90,000) = 11 1U CubeSat

Decision: we prefer to go on with spaceX

Number of CubeSat we can have

The size of 1U CubeSat is estimated at **3 Kg**

We have **400Kg** available so, the number of satellites we can have is

- **73 1U CubeSat**
- **10 6U CubeSat**

Each 6U CubeSat can have the control on 7 1U CubeSat.

Conclusion:

We have allocated a budget of €3 million for the launch of our CubeSat constellation. Although the estimated cost according to SpaceX's simulation is €2.2 million, we prefer to reserve the full €3 million to cover any additional fees that may arise. Our constellation will consist of 73 1U CubeSats and 10 6U CubeSats. We plan to launch by October 2025 into a Sun-Synchronous Orbit (SSO) at an altitude ranging from 500 to 600 kilometres (apogee and perigee).

Communication Path Overview:

Let's outline the communication network for our CubeSat constellation:

The constellation will consist of multiple CubeSats, each tasked with covering a specific area on Earth. These CubeSats are designed to capture high-resolution images of the Earth's surface and transmit them back to our Control Station (or ground station) on Earth. The transmission frequency could range from every 1h30 to 2h30 (the objective is to have the earth image in our control station id frequency of 1h30 to 2h30), allowing for rapid response and data update.

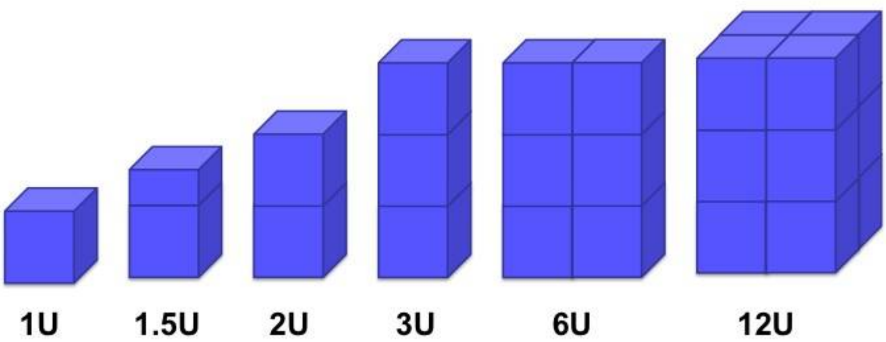
We are planning to have multiple SSO orbit (600 to 700lm) and in each orbit 1 to 2 CubeSats. 1 6U CubeSat will take the control of 7 1U CubeSat (1U CubeSat will play the role of cameras, that will send pictures to 6U CubeSats, and the 6U CubeSat will then sent them to the earth control station).

Once the images are received on Earth, they will undergo processing and analysis. The primary goal is to extract valuable information about various environmental conditions, such as wildfire detection or other significant Earth surface changes. After processing, this information is then relayed to our terrestrial network infrastructure and stored in our database. This database could be proprietary or hosted on external servers.

To make this data accessible, we will develop a web application that retrieves information from our database server. Users of this application will be able to access up-to-date information about specific earth conditions, such as the presence of wildfires, directly through the app. This system ensures that the data captured by our CubeSat constellation is not only processed for accuracy but also made readily available for practical use.

Annex :

CubeSat types :



Source: [1]

Sources:

[1] NASA: https://www.nasa.gov/what-are-smallsats-and-cubesats/

[2] TS2: https://ts2.shop/en/posts/what-are-the-main-differences-between-small-satellites-microsatellites-and-nanosatellites

[3] Canadien space agency: https://www.asc-csa.gc.ca/eng/satellites/cubesat/what-is-a-cubesat.asp

[4] nanoavionics: https://nanoavionics.com/blog/how-much-do-cubesats-and-smallsats-cost/#:~:text=Filling%20a%20spot%20on%20a,Radio%20transmission%20licenses%20are%20needed

[5] satcatalog: https://www.satcatalog.com/insights/cubesat-launch-costs/

[6] spaceX : https://rideshare.spacex.com/book/flight/75157fec-0e42-4686-bedc-f191a3ff8aa0

Annex 3: Benefits Vs. Costs

I] Business Plan Overview: Expanding Satellite Constellation in Europe and Beyond

In our ambitious venture, we plan to establish a satellite constellation business in Europe, with a strategic focus on developing and launching approximately 30 satellites over a year.

The envisioned constellation aims to cover significant regions, including Europe, North Africa, and parts of Asia. Our initial strategy involves selling our satellite data and services to governments in Europe and North Africa to generate revenue. The subsequent phases include expanding our satellite constellation to cover the entire globe and offering our solution to nations across various continents.

II] Budget Overview

Important note:

The estimates made in the following paragraphs are not always very rigorous. Firstly, because a more in-depth study of the subject would be required, i.e. optimization of the number of satellites, optimization of the number of ground stations, size of ground antennas, estimation of the quality of images taken by the observation satellites, etc.

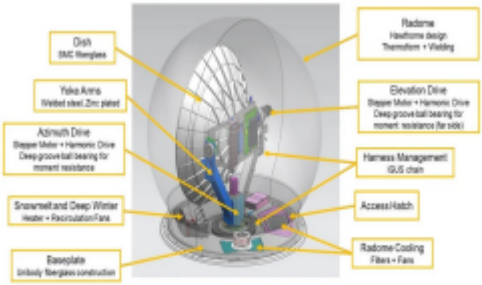
Note also that it is difficult to find information on component prices. That said, here's what has been done.

A] Total Cost over 5 Years: $16,25 Million

1. Build Cost (2 Years): $9.7 Million
    - 73 1U CubeSats: $50K-$80K each (Source: Wikipedia/RocketLab)
    - 10 6U CubeSats: $500K-$700K each (Source: RocketLab)
2. Launch Cost (October 2025): $3 Million
    - See Annex 2.
3. Ground Station costs: $300K

Explanation: A constellations connectivity is dependent on the spacecraft position in orbit relative to the fixed ground station location on the globe. For GEO spacecraft this is simple because they are continuously in view of a single ground station. For LEO constellations, the ground stations in view can change rapidly, and thus a large network of ground stations is required to keep LEO constellations active.

We find that 8 ground stations are realistic, according to this article (Source: https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=4326&context=smallsat).



This is typically the kind of antenna used for Starlink constellation: Sea Tel 4/5/6XXX VSAT for $40-60K depending on size.

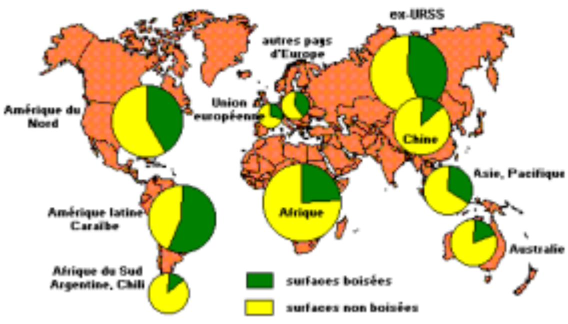
4. Software Development and Maintenance Costs: $3,25 Million
    - A 7-person team including AI, RF, Software, Cyber, Manager, Accountant, and Lawyer
    - Initial year development cost: $700K
    - Ongoing maintenance costs: $600K-$700K

B] Total Benefits over 1st year: $1,7 Million

1. Suggested price for 1km² with good resolution
    - Raw data → $1,50
    - Detection → $1,70
    - Prediction → $1,99

Source: [Applisat](https://www.applisat.fr/generalites-satellites/choisir-image-satellitaire)

2. Estimation of km² we can sell when covering EU



ONF - 1994 - d'après FAO

48,1 millions of hectares in EU [source] (European Parliament) i.e. 480 000 km²

Assuming we target only dry forest the 1st year i.e. 96 000 km²

Assuming we offer a 100cm resolution and our images contain 1000x1000 pixels, we would cover 1km² per image.

The speed propagation of a wildfire is between 1m/min and 25m/min. For surveillance, it is realistic to check every 30 seconds, i.e. we sell 2880 images per day.

Result → 2880*1,99 = $4,5K

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Slides and other resources from the Universeh Workshop.

ChatGPT was consulted.