

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of	)	
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The Tomorrow Companies, Inc.	)	
	)	
Application for Authority to Launch and	)	File No.
Operate a Non-Geostationary Orbit	)	
Satellite System for Weather Monitoring	)	

**APPLICATION FOR APPROVAL OF ORBITAL DEPLOYMENT AND OPERATING
AUTHORITY FOR THE TOMORROW.IO WEATHER CONSTELLATION**

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TABLE OF CONTENTS

I. INTRODUCTION	4
A. TOMORROW.IO BACKGROUND	4
B. TOMORROW.IO’S WEATHER CONSTELLATION	6
1. SPACE SEGMENT	7
2. GROUND SEGMENT	7
II. THE PUBLIC INTEREST WILL BE SERVED BY AUTHORIZING TOMORROW.IO’S WEATHER CONSTELLATION	7
III. ADDITIONAL LEGAL INFORMATION	9
IV. REQUESTS FOR WAIVER OF FCC RULES	10
A. Provisional Request for Waiver of Section 25.112(a)(1)	10
B. Waiver for Processing Round Rules	11
V. CONCLUSION	11

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**APPLICATION FOR APPROVAL OF ORBITAL DEPLOYMENT AND OPERATING
AUTHORITY FOR THE TOMORROW.IO WEATHER CONSTELLATION**

The Tomorrow Companies, Inc. (“Tomorrow.io”) in accordance with the Federal Communication Commission’s Part 25 Rules, hereby requests authority to launch and operate a non-geostationary orbit (“NGSO”) Earth Exploration Satellite Service (“EESS”) system, the Tomorrow.io Weather Constellation, which will consist of satellites that receive commands via S-band uplinks, and transmit passive microwave sounder data and telemetry in X-band to provide state of the art, near real-time weather forecasting services.¹

Consistent with the information required by the Commission’s rules, Tomorrow.io has also provided a completed Form 312, accompanying Schedule S, and Technical Attachment, which includes an Orbital Debris Mitigation Assessment Report. Tomorrow.io specifically seeks

¹ Tomorrow.io notes that the term “sounder” is used within the weather sensing industry, but stresses that this is a passive sensor and does not transmit. In this application space, “sounding” refers to the measurement of vertical profiles of geophysical parameters – typically temperature and water vapor.

to include EESS bands 2025 - 2110 MHz (Earth-to-space) and 8025 - 8400 MHz (space-to-Earth) to connect its microwave sounder space stations with earth stations located around the world. Grant of this application will allow Tomorrow.io to deploy and operate its Weather Constellation, which is designed to provide a new paradigm in weather and climate prediction to individuals, governments and businesses worldwide.

I. INTRODUCTION

A. TOMORROW.IO BACKGROUND

Tomorrow.io, headquartered in Boston, Massachusetts, is a U.S.-based weather technology company on a mission to help countries, businesses, and individuals better manage their weather related challenges with the best information and insights – and to democratize access to global weather forecasting and thereby better enable climate adaptation. In 2017, two years after Tomorrow.io's founding in 2015, the company launched its Weather Intelligence Platform ("Platform"), which it designed to provide actionable weather insights to logistics, aviation, agriculture, construction, insurance, sports, and energy & utilities services around the world. Today, leading and trusted entities such as the U.S. Air Force, JetBlue, Ford, National Grid, and Uber rely on the Platform to understand the impact of weather in advance, and adapt their operations to avoid safety risks.

Since 2015, the company has raised over \$260M, and the founders, Shimon Elkabetz, Itai Zlotnik and Rei Goffer have grown their team to more than 180 employees, serving more than a thousand customers. Tomorrow.io's co-founder and Chief Executive Officer (CEO), Shimon Elkabetz, founded the company after serving in the Israeli Air Force for eleven years, and surviving multiple near-death weather-related experiences. After his tenure in the Israeli Air Force he attended Harvard Business School, where he received his MBA. The combination of

these two chapters has prepared Elkabetz to excel as a leader and ensure the Tomorrow.io Weather Constellation is a success.

In addition to the founding team, the Tomorrow.io Advisory Team possesses a deep understanding of weather and space, consisting of individuals including:

- Rear Adm. Tim Gallaudet, PhD., the former NOAA Deputy Administrator and Former Commander of the U.S. Navy Meteorology & Oceanography Command,
- Professor Kerri Cahoy, Ph.D, the Director of MIT STAR Lab, and Co-Director of MIT Small Satellite Center,
- Steve Smith, Former NASA Astronaut, and Director of the International Space Station US National Laboratory,
- Lt. Gen. Ray Palumbo, Former U.S. Army 3-star General and Former Director for Defense Intelligence at The Pentagon, and
- Dr. Marshall Shepherd, Director, UGA Atmospheric Sciences.

In 2021, Tomorrow.io received a contract award from the Defense Innovation Unit and the U.S. Air Force² to demonstrate the integration of commercial data into Air Force weather models using passive microwave sounder data from its Weather Constellation. This award follows an earlier \$19.3 million Air Force contract³ which is helping fund Tomorrow.io's weather radar-equipped spacecraft, Tomorrow-R1 and Tomorrow-R2.

Tomorrow.io's approach to weather is different. With its proprietary data and models, and the partnership with MIT Lincoln Labs and Blue Canyon Technologies, it has designed passive microwave sounder small satellites, eighteen of which will be launched to form the Tomorrow.io

² DIU Selects startups for U.S. Military weather modeling project;
<https://spacenews.com/diu-selects-startups-for-u-s-military-weather-modeling-project/>

³ Tomorrow.io wins Air Force funding for weather satellite constellation
<https://spacenews.com/tomorrow-io-wins-air-force-contract/>

Weather Constellation. Grant of this NGSO FCC application will enable Tomorrow.io to provide near-real time forecasting and monitoring services pertaining to key weather features such as temperature and moisture, at unprecedented revisit rates, resolution, and coverage that is reliable, encrypted, and spectrally efficient.

Given the funding track record, the accomplished management and advisory team, U.S. Government interest and support, along with the experience of the Tomorrow.io technical team, Tomorrow.io is well-positioned to carry out this project and introduce state-of-the-art weather services and tools, all while maintaining a sustainably safe space environment, without contributing to orbital debris or the risk of harmful interference.

B. TOMORROW.IO'S WEATHER CONSTELLATION

Tomorrow.io's Weather Constellation as proposed would consist of eighteen LEO satellites, equipped with microwave sounder payloads, supported by a global network of earth stations utilizing S-band between 2025 - 2110 MHz (Earth-to-space) for uplink commands and X-band between 8025 - 8400 MHz for telemetry and microwave sounder payload downlink. While Tomorrow.io's Weather Constellation will be the first global constellation of microwave sounders offering weather monitoring services, Tomorrow.io is aware that other networks utilize these bands for telemetry, telecommand and payload data transmission. It is committed to designing its constellation to ensure that it can coexist with other operators, and will seek to coordinate and collaborate with incumbents to the greatest degree possible. Critical aspects of the space and ground segments are outlined below and in the accompanying Technical Narrative and Schedule S.

1. SPACE SEGMENT

The space segment of Tomorrow.io's Weather Constellation will consist of eighteen spacecraft distributed in circular orbits at 550 km at either 45 degree or sun-synchronous inclinations, each with an estimated operational lifetime of five years. These satellites will be sent up in pairs across nine launch vehicles, and will be manufactured and operated in partnership with Blue Canyon Technologies. While the spacecraft are not equipped with on-board propulsion, they will carry the latest attitude determination control system (ADCS) technology and avionics equipment, such that precise knowledge of each location can be maintained.

2. GROUND SEGMENT

Tomorrow.io will procure ground station network ("GSN") services through one or more third party vendors for its S-band command uplinks and X-band telemetry and passive microwave sounder payload data. These earth stations ("ES") will be located at seventeen sites, two of which are in the U.S.. Tomorrow.io will work with the vendor to submit separate applications to the Commission for individual licenses for any U.S.-based ES according to Section 25.115 of the Commission's Rules.

All operations will be performed virtually via Blue Canyon Technology's cloud-based system. Tomorrow.io will not own or operate a physical satellite or network operations center.

II. THE PUBLIC INTEREST WILL BE SERVED BY AUTHORIZING TOMORROW.IO'S WEATHER CONSTELLATION

Today, more than seventy-five years after the first weather radar was deployed, it is estimated that 85% of the globe does not have access to reliable weather forecasting, more than five billion people live outside radar coverage, even as more than 70% of businesses are

impacted in some way by weather. One of CEO's major concerns is weather impact and volatility, yet today's weather forecasting systems are simply not optimized to help people, governments, or businesses make fundamental operational decisions. Our nation's weather data is too complicated to understand at face value, and isn't accurate enough to become actionable.⁴

To exacerbate the issue, our oceans have virtually no weather radar coverage, despite the fact that most weather systems originate there. The deployment of ground based weather radars in the U.S. alone is projected to cost \$3.1B.⁵ As this scales geographically, the installation of a global network of ground-based weather radars, without accounting for oceans and seas, is projected to scale to hundreds of billions of dollars. Shockingly, NASA's Global Precipitation Measurement (GPM)⁶ Core Observatory satellite serves as the only operational satellite equipped with precipitation radar, and has an average revisit time of three days. Past, current and planned NASA, JAXA and ESA missions (e.g. CloudSat, GPM, RainCube, and EarthCARE) either do not provide high-frequency data refresh or are not scalable for global forecasting needs.

Of all weather monitoring instruments that are currently operational and feeding into global forecast models, passive microwave sounders operating on-orbit have the largest impact on global weather forecasting.⁷ Currently, such satellites are used in conjunction with the GPM Core Observatory in precipitation monitoring⁸, but large gaps exist in global coverage, and data latency is high (typically over two hours), reducing the viability of this system for use in

⁴ GEO Task US-09-01a: Critical Earth Observation Priorities - Final Report, https://sbageotask.larc.nasa.gov/Final_SBA_Report_US0901a_v2.pdf

⁵ U.S. Doppler Radar Stations Need \$16.7 Million in Maintenance, <https://www.govtech.com/public-safety/us-doppler-radar-stations-need-167-million-in-maintenance.html>

⁶ NASA Global Precipitation Measurement Mission Passes Major Review; https://www.nasa.gov/centers/goddard/news/gpm_review.html

⁷ Data assimilation diagnostics: Assessing the observations impact in the forecast, https://confluence.ecmwf.int/download/attachments/131371575/FSOI_DALecture_CLupu_2019.pdf?version=1&modificationDate=1552647714213&api=v2

⁸ The GPM Constellation, <https://gpm.nasa.gov/missions/GPM/constellation>

enabling actionable weather-based decisions to be made globally in operational settings.

Tomorrow.io is developing its constellation to close these gaps in coverage and data latency, and its sounder satellites will work in conjunction with future precipitation radar satellites that it is developing. This constellation of diverse multi-sensor weather satellites is the only way to enable the operational decision making needs described above.

Tomorrow.io's Weather Constellation of Low Earth Orbit (LEO) satellites will mark the initial deployment of the world's first commercial, multi-sensor weather satellite constellation, offering global, high-quality, near-real time precipitation data and tropospheric thermodynamics – key pieces of data required to furnish major improvements in hurricane forecasting, flood alerts, and natural disaster management around the world. Tomorrow.io, in partnership with MIT Lincoln Labs, has developed an operational version of the proven microwave sounder technology that is currently flying on NASA's "TROPICS" mission. This new instrument architecture incorporated into a low-cost satellite platform will enable missions that revolutionize climate science and weather forecasting, which is not only in our nation's public interest, but in the public interest of the world.⁹

III. ADDITIONAL LEGAL INFORMATION

A. ITU Filings and Cost Recovery (Section 25.111)

Tomorrow.io accepts responsibility to pay any ITU cost recovery fees associated with this application. Invoices for such fees may be sent to the contact noted in the FCC Form 312.

B. Spectrum Access Eligibility (Section 25.159)

⁹ NASA Jet Propulsion Laboratory (JPL) RainCube; <https://www.jpl.nasa.gov/missions/radar-in-a-cubesat-raincube>

Tomorrow.io has not filed with the Commission any other applications for NGSO satellite systems in the S- or X-band frequencies involved in this application, nor any NGSO system that has been licensed, but not yet built in the subject bands. Accordingly, this application is compliant with the Commission's Rules limiting the number of pending applications and unbuilt systems.

C. System Deployment Milestones (25.164)

Tomorrow.io agrees to comply with the Commission's milestone rules for NGSO deployment.

D. Posting of Surety Bond (Section 25.165)

Tomorrow.io acknowledges that it will be required to post a performance surety bond pursuant to Section 25.165 of the Commission's Rules upon grant of this application.

E. Reporting Requirements (Sections 25.171 *et. seq.*)

Tomorrow.io will comply with all FCC reporting requirements that apply to it or may ultimately be adopted with respect to the specific services it plans to provide.

IV. REQUESTS FOR WAIVER OF FCC RULES

A. Provisional Request for Waiver of Section 25.112(a)(1)

In 25.112(a), the Commission states that applications will be deemed "unacceptable for filing and will be returned to the applicant" if, among other potential defects, they lack "completeness of answers to questions [or] informational showings." However, under Rule 25.112(b)(1), the Commission further states that if an application is determined to be defective in some manner that it may nonetheless be accepted and processed if accompanied by an appropriate waiver request. Therefore, Tomorrow.io seeks such a waiver to the extent necessary.

Tomorrow.io requests that if the Commission finds any discrepancies in this application that it provides Tomorrow.io with the opportunity to correct such ambiguities via supplement.

B. Waiver for Processing Round Rules

Tomorrow.io requests that this Application be processed on a first-come, first-served basis, as defined under Section 25.158 of the Commission’s Rules, and therefore requests a waiver of Sections 25.156 and 25.157, which define a processing round framework for “NGSO-like satellite systems”. In 2003, the Commission adopted the processing round regime for NGSO Fixed Satellite Service (FSS) applications with the aim of authorizing systems expeditiously, and to prevent a single system from limiting future applicants from operating in the requested frequency band.¹⁰ Since that time, the Commission has waived the modified processing round requirement and allowed for numerous NGSO systems to be processed on a first-come, first-served basis.¹¹ Tomorrow.io ensures that a grant of Tomorrow.io’s requested authorization for the operations of its NGSO EESS system will be capable of sharing with current and future NGSO systems in the same frequency bands, and will not preclude future use of S- or X-band spectrum.

V. CONCLUSION

For the reasons discussed above, grant of authority to launch and operate the Tomorrow Weather Satellite Constellation will serve the public interest. Tomorrow.io respectfully requests

¹⁰ See Amendment of the Commission’s Space Station Licensing Rules and Policies, 18 FCC Rcd. 10760, (2003)

¹¹ See, e.g., *Swarm Technologies, Inc., Memorandum Opinion, Order and Authorization*, 34 FCC Rcd 9469, ¶ 16 (2019) (“*Swarm*”); *Spire Global, Inc. SAT-LOA-20151123-00078* (granted Oct. 14, 2016) (“*Spire*”); *Planet Labs, Inc., SAT-LOA-20130626-00087* (granted Dec. 3, 2013) (“*Planet*”); *Skybox Imaging, Inc., SAT-LOA-20120322-00058* (granted Sep. 20, 2012) (“*Skybox*”); *Space Imaging, LLC, Declaratory Order and Order and Authorization*, 20 FCC Rcd 11694, 11968 (2005) (“*Space Imaging Order*”);

that the Commission grant such operating authority, including approval for orbital deployment and station licenses.

Respectfully Submitted,

The Tomorrow Companies, Inc.