

# AMAZON KUIPER – INFORMATION NOTE

The following document is an information note gathering all the information collected using various open sources on Kuiper Systems, the fully-owned subsidiary of Amazon.

More precisely, it tries to provide information on:

- Kuiper’s targeted users
- Kuiper’s business model
- Kuiper’s system architecture
- Kuiper’s key figures
- Kuiper’s other useful information

Please note that this information note is aimed at providing a good overall level of understanding of Kuiper. It however lacks a very high number of key in-depth information that are today not available publicly.

This note will therefore be updated once new information is available.

## IN A NUTSHELL

- In April 2019, Amazon, founded by Jeff Bezos, who also founded the launch company Blue Origin, announced the development of a 3 236 satellites’ constellation to deploy in low Earth orbit for low-latency, high-speed broadband, under the name Project Kuiper.
- Kuiper Systems is a fully-owned subsidiary of Amazon.
- Amazon will invest more than \$10 billion in Project Kuiper
- The system will rely on a very dense network of ground stations and gateways. Each satellite will have access to two gateways at any given time of its operations.

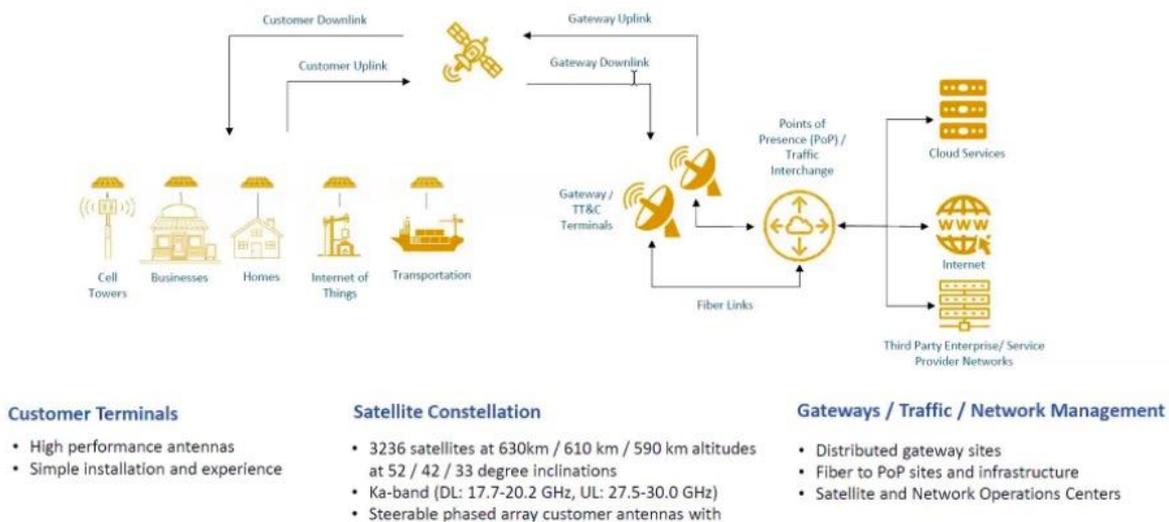
## TARGETED USERS

- Amazon’s focus with the Kuiper System is to connect “tens of millions of unserved and underserved consumers and businesses in the United States and around the globe”. it will especially target:
  - Transportation systems including aircraft, boats and land vehicles as well — making the constellation a competitor with other proposed low Earth orbit systems like those of Telesat and LeoSat that do not have consumer broadband as a focus.
  - Project Kuiper will serve individual households, as well as schools, hospitals, businesses and other organizations operating in places without reliable broadband.
- In addition to beaming internet directly to ground stations, Kuiper will also expand 4G and 5G coverage areas by enabling low latency backhaul services for cellular network operators

## BUSINESS MODEL

- Amazon will invest more than \$10 billion in Project Kuiper
- Consumer demand may be what Amazon considers its largest market: Consumer demand for broadband services “far exceeds the potential capacity available by all [non-geosynchronous satellite] systems proposed to date, including Amazon’s Kuiper System.”

## SYSTEM ARCHITECTURE



## SPACE SEGMENT

- To serve that full range of markets, Amazon said the Kuiper System will rely on a user-terminal mix comprised of flat, electronically steered, phased-array antennas and mechanically steered dish antennas. Kuiper System satellites will be equipped with Ka-band phased-array antennas to form reprogrammable spot beams that link with user terminals on the ground.
- Amazon's Kuiper System satellites will have a design life of seven years (i.e. less than half than that of a traditional geostationary communications satellite). It will be launched in five waves (time of launch and launch vehicle still unknown).
  - The first wave consists of 578 satellites that would provide internet service in two horizontal coverage bands, one between 39 degrees north and 56 degrees north (roughly from Philadelphia north to Moscow) another from 39 degrees south down to 56 degrees south (roughly from Hastings, New Zealand, to the top of Great Britain's South Sandwich Islands in the Atlantic Ocean).
  - The subsequent four waves would fill in coverage to the equator.
    - Amazon said it plans to launch production satellites to an altitude below the International Space Station and conduct system checks there before raising the satellites to their target orbit.
  - The FCC said Amazon has until July 30, 2026, to launch at least 50% of its satellites in order to maintain its authorization, and until July 30, 2029, to orbit the full constellation.
- Amazon said its "design goal" with the Kuiper System is to use an "unpressurized non-explosive propellant storage" for a chemically inert fuel.
  - The company said it is working with the U.S. Air Force's Combined Space Operations Center on safety aspects, including constellation design and maneuverer plans. Commercial space situational awareness companies are involved in those efforts too.
- Blue Origin is officially not guaranteed to launch Amazon's constellation and hope to compete for Kuiper launch contracts: "Blue Origin is founded and owned by Jeff Bezos, but we are not the same company, and there is no connection there."

## GROUND SEGMENT

- Kuiper is planned to work in concert with Amazon Web Services large network of 12 satellite ground station facilities (the "AWS Ground Station unit")
  - Six antenna-equipped facilities that will support satellite-to-ground communications are already built (Sweden, Bahrain, Australia, Ireland, and two in the USA)
  - Amazon plans to rent out the use of its ground to satellite network infrastructure to firms and public sector organisations that need access to satellite data
  - Amazon aims to address these challenges by providing customers with a more flexible and cost-effective way of accessing satellite data, based on the replication of its highly successful cloud computing model.
    - Amazon's 'satellite-as-a-service' will allow customers to download satellite data on a pay-per-use basis. The proximity of the new network of ground stations to Amazon's cloud data centres means that Amazon will be able to offer complementary services, including data processing, storage and analytics.
- Gateways
  - Gateway earth stations will be connected with high-speed fiber links to global Internet exchange points and point-of-presence sites to interchange traffic and reduce network hops and latency
  - The number of gateway earth stations "will be approximately equal to the number of active satellites serving US territory,"
  - There will be more Earth stations "in regions where higher rain fade is present" to account for signal loss, as well as along coasts "to support offshore customers."
  - Each Kuiper satellite will be able to access two gateway earth stations as part of Amazon's plan to minimize downtime. "Customers will always see a persistent connection" over a standard Ethernet interface in their homes and will be "unaware of the switching of satellites, gateways, or routes through the Kuiper System network,"

## ORBIT

- The Kuiper System calls for three "shells" of satellites all at the lower range of low Earth orbits — 590 kilometers, 610 kilometers and 630 kilometers. Due to their proximity to Earth, Amazon predicts dead satellites would naturally deorbit on average between five to seven years.
  - If a Kuiper System satellite fails, it would naturally deorbit within a maximum of 10 years.
  - Should a satellite lose contact with ground stations beyond a "pre-determined wait period," it would automatically decommission itself.
    - That decommissioning process involves orbit lowering, followed by depleting batteries, emptying fuel lines and tanks, and ensuring charging circuits are "permanently switched off or fused" to obviate the risk of a surprise recharge.

## OTHER USEFUL INFORMATION

- Amazon is setting up a research and development headquarters for Kuiper in Redmond, Washington, complete with laboratories, prototype manufacturing facilities, and office and design space.
- The company also plans to open a Redmond office for its Web Services division in 2021 with capacity for more than 600 employees.

## SUMMARY OF KEY FIGURES

- Capex: announced investment 10B\$
- Constellation
  - 3 236 satellites in LEO
  - Mass: unknown
  - Satellites cost: unknown
  - Lifetime: 7 years
- Deployment/launch
  - Launch operator: unknown, although Amazon also owns Blue Origin
  - First wave of 578 satellites for initial operations
  - Number of satellites/launch unknown
- Ground infrastructure
  - Unknown, but very dense: possibility to rely on Amazon Web Services Ground Station Unit
- User revenue
  - Unknown