



LEOs – Serious Competitor or Space Junk?

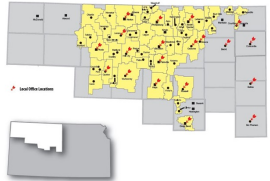
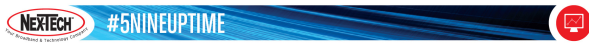
Presented By:



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Nex-Tech, LLC

- Parent company: Rural Telephone Cooperative, incorporated in 1951
- 39 exchanges
- 10,020 square mile coverage area
- 15,872 access lines
- 30,000+ broadband customers
- 9,282 video customers
- 300+ employees

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High-Tech!




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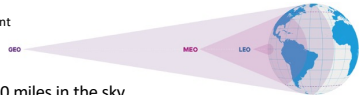

The Game Changer... (for a second)




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What are the Different Types of Satellites?



- GEO - 35,000 km or 22,000 miles in the sky
 - Satellite completes an orbit in 24 hours
 - Great coverage but slow speeds and data caps at a high price
 - High latency 550-600ms
 - One satellite could serve a continent
- LEO – 400-1,000 km or 250-620 miles in the sky
 - Satellites orbit about every 2 hours – one goes across the horizon every 10-15 minutes
 - Lower latency (Starlink claims as low as 20ms, Telesat 30-50ms)
 - Need many satellites or a constellation for coverage

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What Companies are Involved?

- Starlink (Elon Musk) – 3,000 satellites currently - 42,000 satellites by 2027
- Project Kuiper (Jeff Bezos) – 3,236 satellites by 2029
- OneWeb (Richard Branson) – 428 satellites currently – 648 by ?
- ViaSat – 5 GEO satellites currently – 288 LEO satellites by 2026
- Telesat – 15 GEO satellites – 298 LEO satellites by 2023

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Constellation Differences

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Nex-Tech Tests Starlink

- Setup comes with a dish and router that needs to be mounted/wired
- Originally: \$499 up-front - \$99 monthly
- Now: \$599 up-front - \$110 monthly

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What'd We Learn?

- Overall, the service is fairly reliable
- Every once-in-awhile we'd see disconnects or pauses of video conferencing/ buffering of streaming service
- Slight degradation of service due to rain/snow
- Multiple tests yielded below results:
 - Average of 64ms of latency with 103 Mbps downloads and 28 Mbps uploads
 - Highest latency was 391ms during snowstorm
 - Highest download was 161 Mbps and the highest upload was 44 Mbps
- FWIW - Ookla showed tests in US with the following results for 2022
 - Average 43ms latency (up from 40ms in 2021)
 - Download of 90.5 Mbps (up from 65.7Mbps in 2021)
 - Upload of 9.3 Mbps (down from 16.3 Mbps in 2021)

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Challenges

- CATS!
- China
 - Military looking at a plan to destroy Starlink
 - Starlink near crashes w/space station
 - Internet censorship
- Launching Gen2 Satellites
 - 4-5x bigger than Gen1 - too big for current rockets
- 5G for 12GHz
- Global Outage
 - Human error?
 - Russia?

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Other Challenges - "Space Weather"

- On February 3, 2022, Starlink launched 49 satellites – 40 of those satellites crashed back to earth and burned up in the atmosphere.
- These satellites were affected by a geomagnetic storm caused by a "minor" solar storm
- A geomagnetic storm, also known as a magnetic storm, is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave and/or cloud of magnetic field that interacts with the Earth's magnetic field.

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OOH YOU ALMOST HAD IT


\$886 Million of RDOF Funding – DENIED

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Is it Feasible?


- Ground Network can be expensive
 - Ground Station to data center distance could be more than the altitude of the satellite
- Constellation requires thousands of satellites that have a limited life span
 - 5-10 years before needing replaced
- Shared bandwidth between subscribers
 - The more customers they have, the lower their speeds
 - Not a great solution for urban areas
- **At Starlink's current pace – they would need to do a launch every four to five days and a satellite replacement launch every five days for the next decade to reach 42,000 satellites**



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LEO Potential Uses



- Cellular Backhaul
- "Sky Cell sites"
 - Partnering with T-Mobile
 - Work with Gen2 satellites, starting with text in 2023, voice and data after
- Aviation
 - In-flight Wi-Fi – Starlink partnered with Hawaiian Airlines for 2023
 - Enables satellite communications for crew
- Marine
 - Starlink has partnered with Royal Caribbean
- Military
 - DARPA supposedly Launching LEOs - "Blackjack" - but have yet to get anything off the ground



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LEO Potential Uses

- Internet of Things
 - Musk could have the world's first true fully autonomous cars come to market
- Farms could potentially become run by LEOs
 - Rural service providers need to prepare for "last acre" networks





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Starlink's Martian Governing Law Clause

10. Governing Law.

For Services provided to, on, or in orbit around the planet Earth or the Moon, this Agreement and any disputes between us arising out of or related to this Agreement, including disputes regarding arbitrability ("Disputes") will be governed by and construed in accordance with the laws of the State of California in the United States. For Services provided on Mars, or in transit to Mars via Starship or other spacecraft, the parties recognize Mars as a free planet and that no Earth-based government has authority or sovereignty over Martian activities. Accordingly, Disputes will be settled through self-governing principles, established in good faith, at the time of Martian settlement.



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Thank You!

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