Wireless Power Transmission

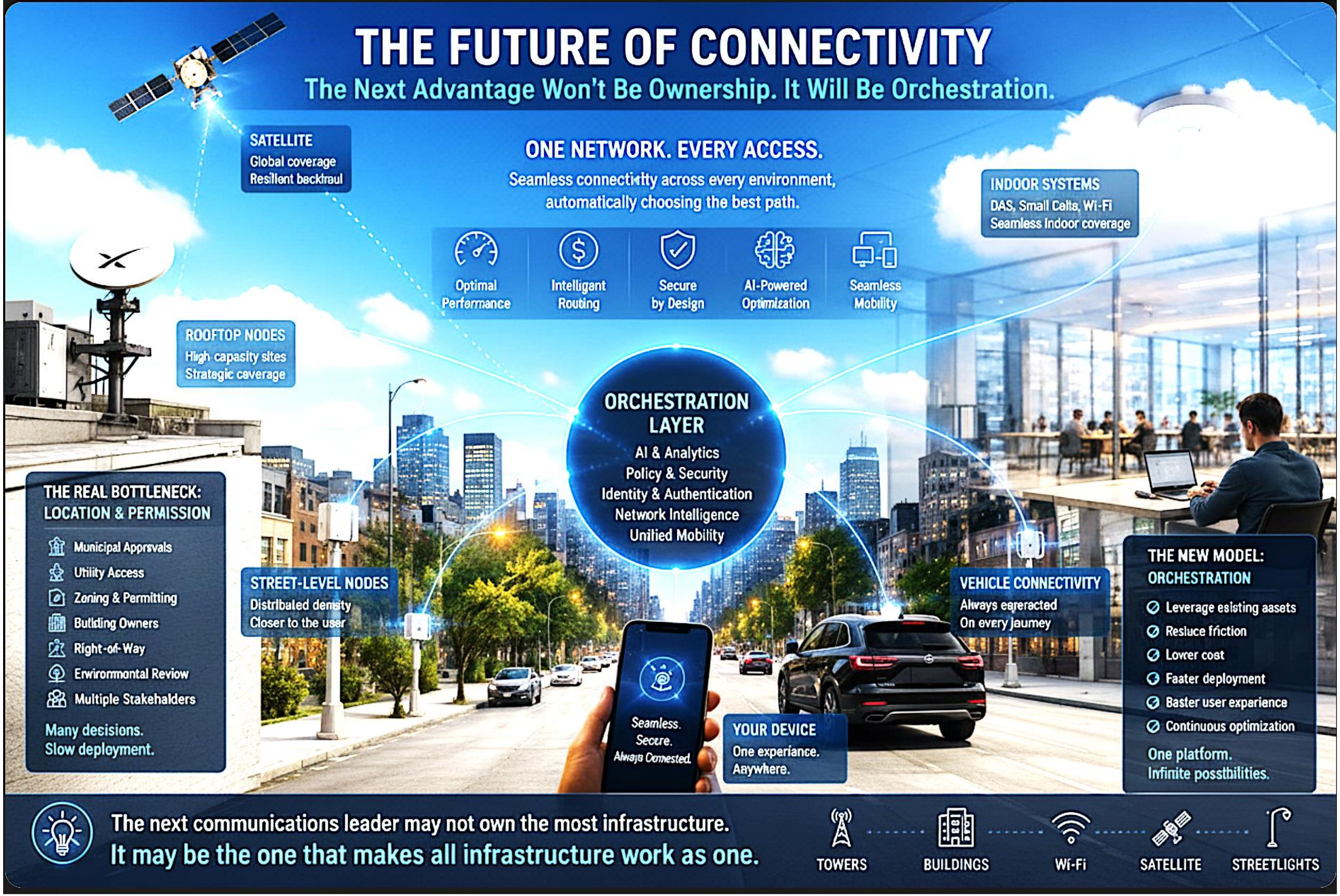
Karl J. Weaver
Newport Technologies

Newport Technologies
美國新港科技

Wireless Power Transmission

Wireless power uses magnetic fields or radio waves to send energy without wires. *Near-field* charging works over short ranges using magnetic loops, like charging a phone on a pad. *Far-field* power transmits energy over long distances via radio or laser beams, such as Wi-Fi or satellite signals.

Wireless power transfer eliminates the battery bottleneck in smart city infrastructure by continually powering millions of Internet of Things (IoT) sensors without human intervention. Grounding this presentation in the context of smart urban environments will show how near-field grids power moving vehicles and public spaces, while far-field arrays create a blanket of ambient radio frequency (RF) energy for low-power devices.



THE FUTURE OF CONNECTIVITY
The Next Advantage Won't Be Ownership. It Will Be Orchestration.
SATELLITE
Global coverage
Resilient backtraul
ONE NETWORK. EVERY ACCESS.
Seamless connectivity across every environment,
automatically choosing the best path.
INDOOR SYSTEMS
DAS, Small Cells, Wi-Fi
Seamless Indoor coverage
Optimal Performance
Intelligant Routing
Secure by Design
AI-Powered Optimization
Seamless Mobility
ROOFTOP NODES
High capasity sites
Strategic coverage
ORCHESTRATION LAYER
AI & Analytics
Policy & Security
Identity & Authentication
Network Intelligence
Unified Mobility
THE REAL BOTTLENECK:
LOCATION & PERMISSION
Municipal Apprsvals
Utility Access
Zoning & Permitting
Building Owners
Right-of-Way
Environmental Review
Multiple Stakehalders
Many decisions.
Slow deployment.
STREET-LEVEL NODES
Distribated density
Closer to the user
VEHICLE CONNECTIVITY
Always easrected
On every journey
THE NEW MODEL:
ORCHESTRATION
Leverage existing assets
Resluce friction
Lower cost
Faater deployment
Baster user experiance
Continuous optimization
One platform.
Infinite possibilities.
Seamless.
Secure.
Always Connested.
YOUR DEVICE
One experiance.
Aaywhere.
The next communications leader may not own the most infrastructure.
It may be the one that makes all infrastructure work as one.
TOWERS
BUILDINGS
Wi-Fi
SATELLITE
STREETLIGHTS

How Wireless Power Connects to Buildings Embedded

Wireless power and buildings are closely connected because future smart building designs integrate power transmitters directly into walls and ceilings. This setup eliminates physical cords for interior devices like smart lights, sensors, thermostats, and IoT equipment.

Wireless Power Transfer - Powering the Smart City

Transmitters: Infrastructure features built-in power transmitters that blanket rooms or desks in safe electromagnetic or infrared energy fields.
No Cords or Batteries: Small electronics, security cameras, and automated window blinds receive continuous power without needing disposable batteries or wall plugs.
Easier Retrofitting: Smart automation systems expand faster because installers do not need to cut into drywall to run new electrical wires.
Benefits in Modern Architecture
Flexibility: Room layouts change freely without being restricted by floor outlets or heavy extension cords.
Safety: Exposed wiring hazards and tripping risks disappear completely from workspaces and living areas.
Efficiency: Automated climate control and lighting networks scale up rapidly as sustainable, low-voltage additions.

Wireless Power Transmission
Near-Field vs. Far-Field WPT: Core Difference

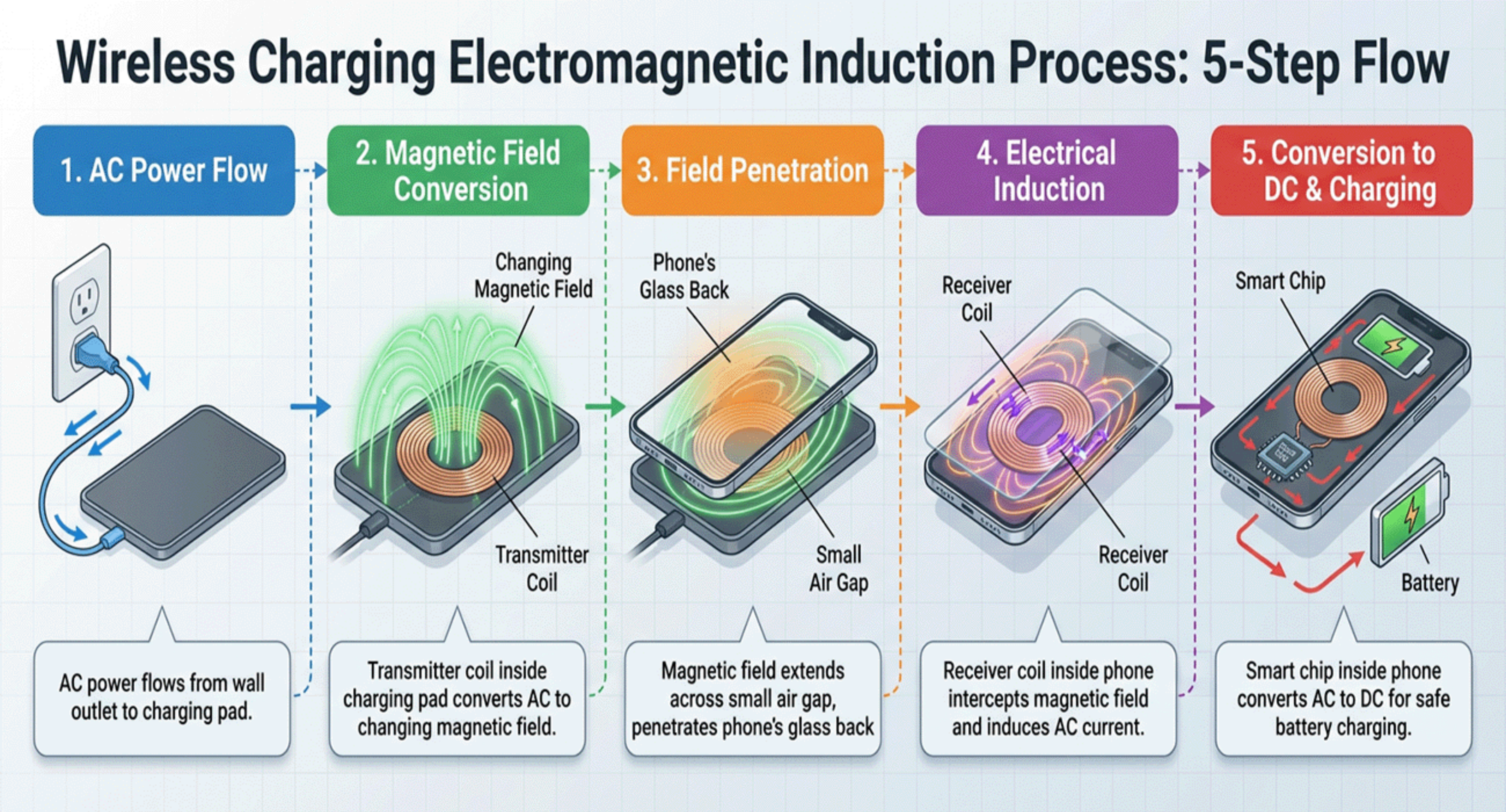
Technology Category	Real-World Deployment Examples	Primary Standards / Operators
Near-Field WPT	• **Smartphones & Accessories**: Apple MagSafe & Qi2 magnetic inductive charging pads. • **Electric Vehicles (EVs)**: WiTricity & BMW resonant pad charging system (SAE J2954). • **Consumer Appliances**: Sealed inductive bases for oral care devices. • **Medical Tech**: Transcutaneous energy transfer (TET) for implants and pacemakers.	**Wireless Power Consortium (WPC)**, **SAE International**
Far-Field WPT	• **Smart Home Over-the-Air**: Energous WattUp (RF) & Wi-Charge (Infrared laser) charging hubs. • **Industrial IoT**: Battery-free ambient RF energy harvesting for supply chain sensors. • **Defense & Aerospace**: Laser power beaming for continuous airborne tetherless UAV flight. • **Space-Based Solar (SBSP)**: Caltech MAPLE orbit-to-ground RF beam demonstrator & ESA SOLARIS.	**FCC Part 18/Part 15 (6 GHz)**, **ESA SOLARIS**, **Caltech Space Solar**

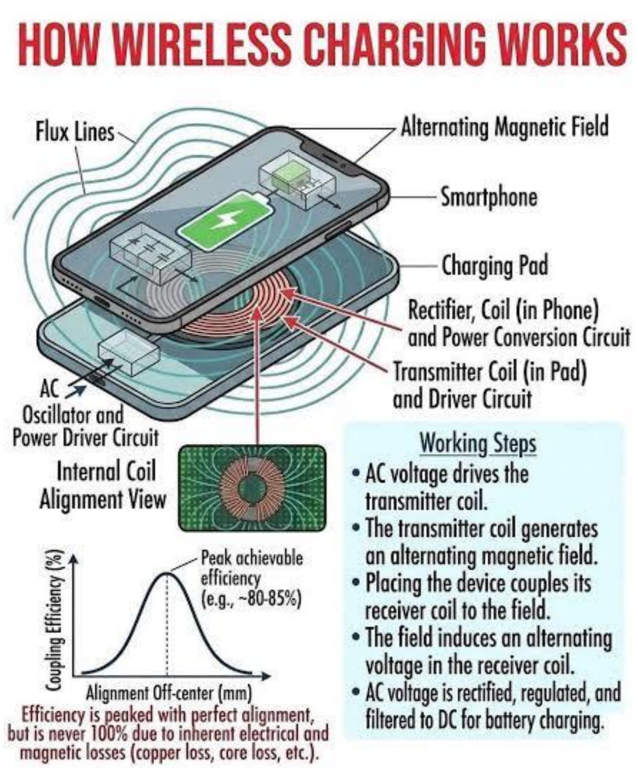
Technical Specifications & Benchmarks

Performance Metric	Inductive Coupling (Qi / Qi2)	Magnetic Resonance	Radio Frequency (RF)	Microwave / Laser (Space Solar)
Operational Distance	Contacts to < 1 cm	1 cm – 1 meter	1 meter – 10 meters	1 km – 36,000 km(Orbit)
Power Output Range	5W – 25W	100W – 22kW	< 1W – 10W	100kW – 1GW +
Transfer Efficiency	70% – 85%	75% – 92%	10% – 40%	15% – 45%
Primary Frequency	110 – 205 kHz	6.78 MHz/85 kHz	915 MHz/2.4 GHz /5.8 GHz	2.45 GHz/5.8 GHz /IR
Target Sector	Smartphones, Wearables	EVs, Industrial Automation	IoT Sensors, Smart Home	Defense, Space-Based Solar (SBSP)

Near Field Wireless Power Transmission –
How Wireless Charging on a Smart Device Works

How it works: It uses a magnetic field to transmit power from a pad to your smart device wirelessly through two copper coils: one inside the charging base and one inside your smart device. When power flows through the base coil, it creates an invisible magnetic field that generates a current in the phone's coil to charge the battery. ***This is Near Field Wireless Power Transmission***



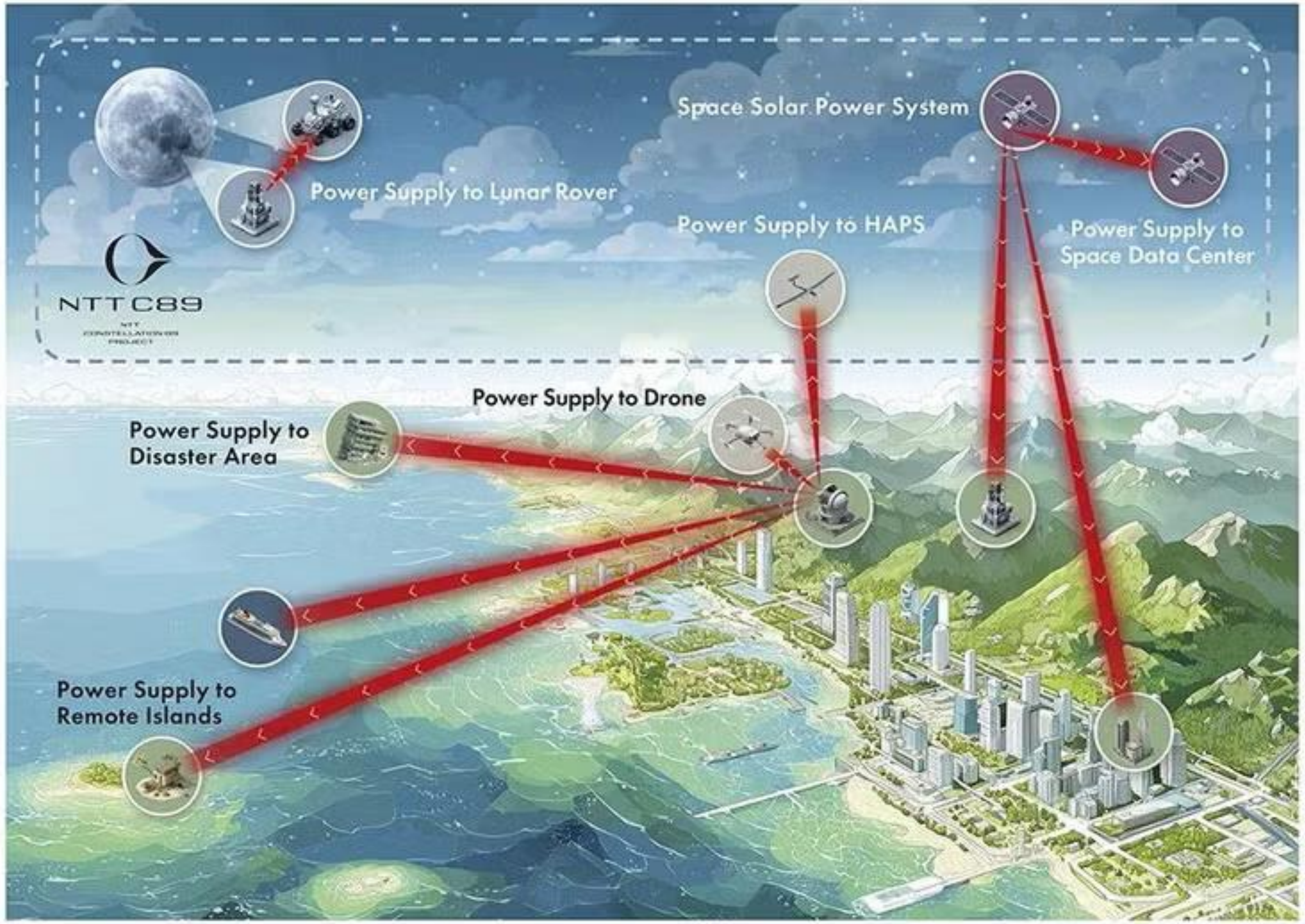


Far-Field Wireless Power Transmission – Directed Beam Networks

Concept: Utilizing active, line-of-sight tracking beams to pinpoint power delivery.

- **How it Works**: Smart base stations locate specific IoT sensors and blast target microwave or laser streams.
- **City Scale Application**: Powering high-altitude traffic cameras and drone fleets directly from streetlamps.
- **The Visual**: Network map showing central broadcast nodes communicating data and power down to individual devices.

Uses radiative electromagnetic beams (microwaves or RF waves)



Key usages of NTN Satellite for wireless connectivity

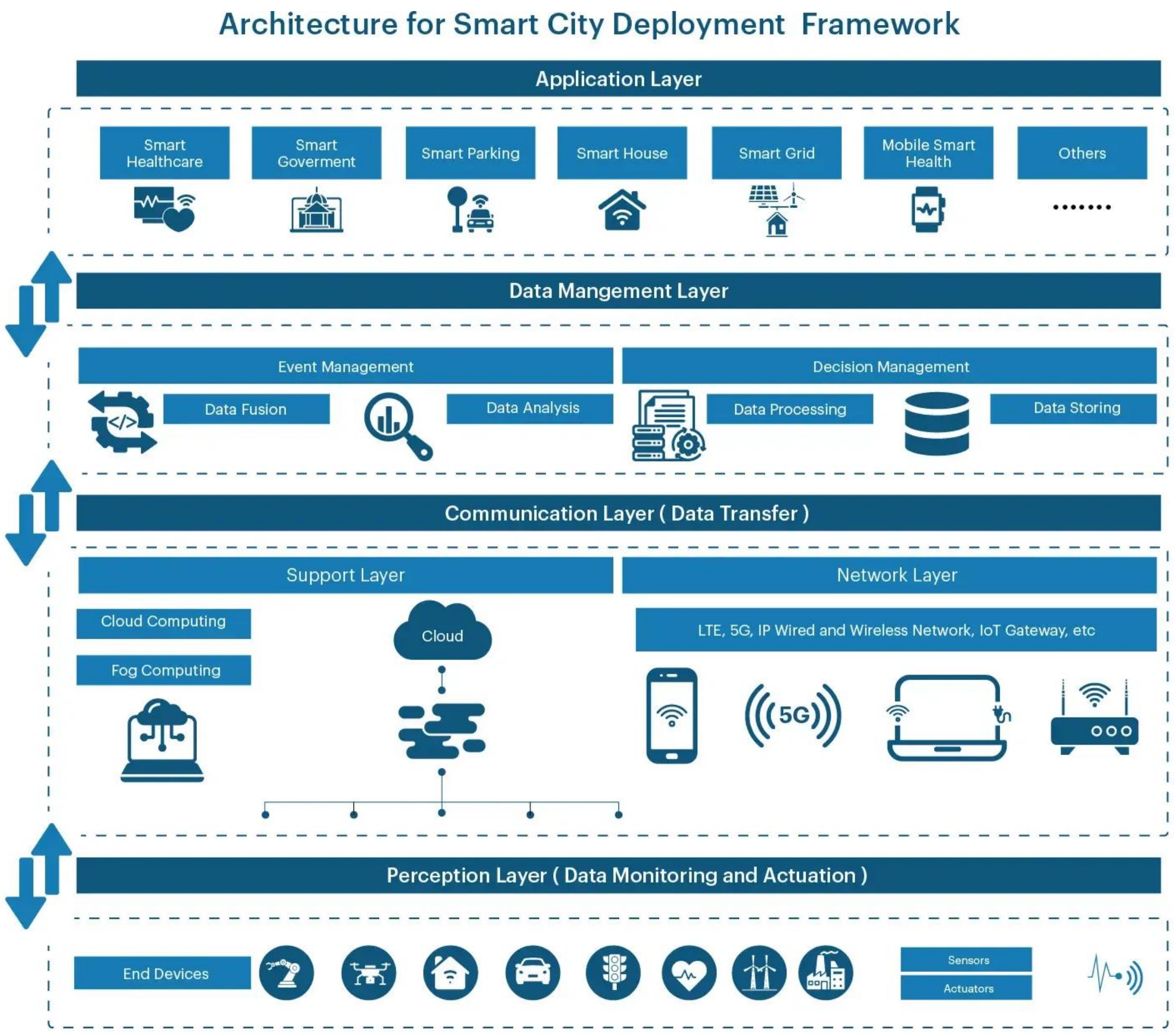
Use cases:

1) Fixed access via wireless at home, work, or a few regularly visited places
2) Nomadic use at places where we spend minutes or hours without moving much, such as airports, shops, friends' houses, restaurants, stations, etc. We might connect to WiFi, or just leave our phones on cellular.
3) Normal "moving about" mobility while walking or in a vehicle, especially in busy areas or along major routes
4) Remote or deep-rural connectivity, in places with little infrastructure.

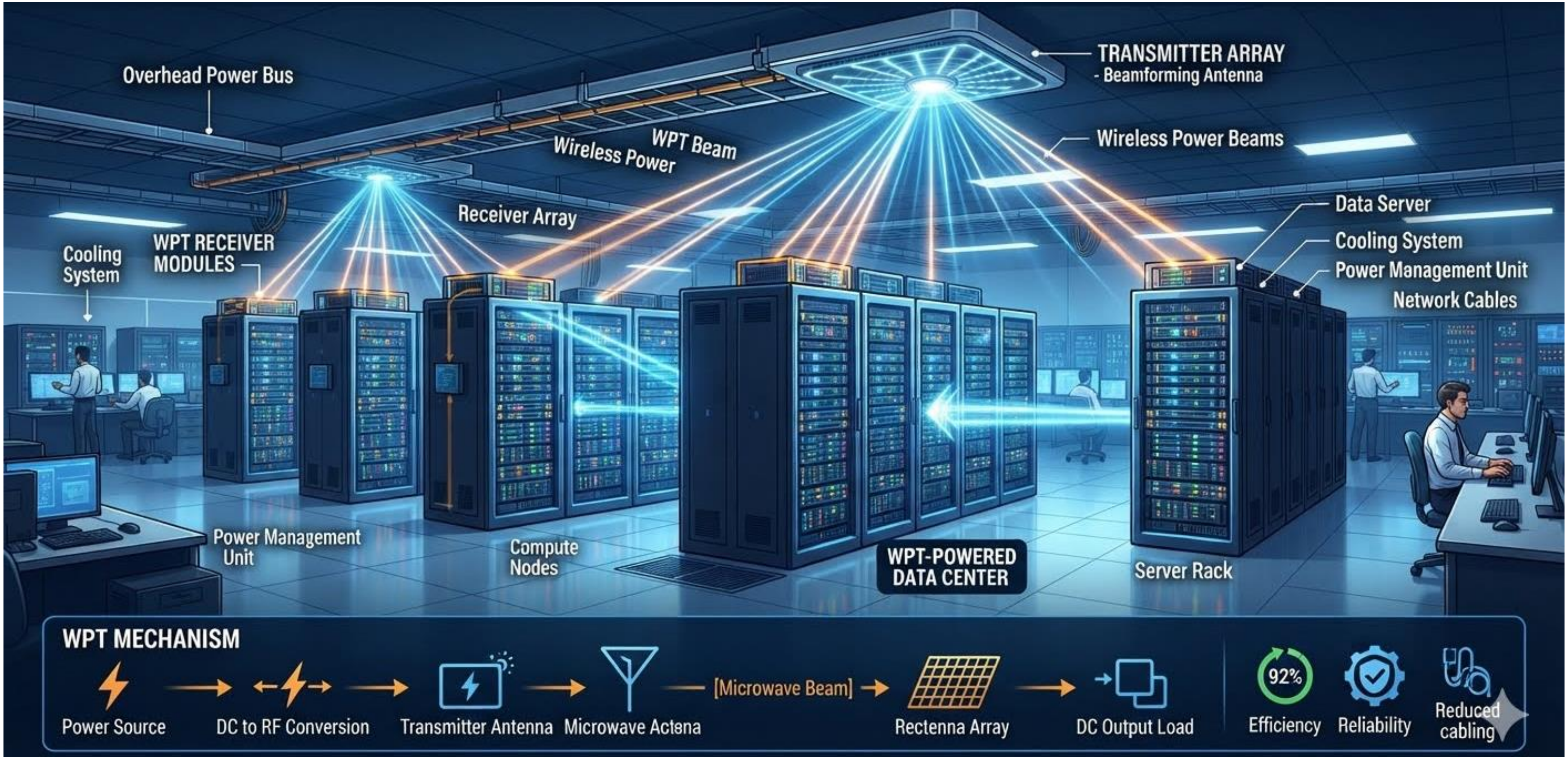
These are the 4 use cases of using NTN satellite wireless technology

The Architectural Blueprint of a Wireless Smart City

- **Layer 1**: Power generation via standard grids, solar collectors, and wind arrays.
- **Layer 2**: Distribution using near-field hubs for heavy vehicles and far-field routers for sensors.
- **Layer 3**: The Data Layer, where self-powered sensors report analytics back to central processing.
- **The Visual**: Full architectural flow chart tracking clean energy from conversion down to edge sensor activation.

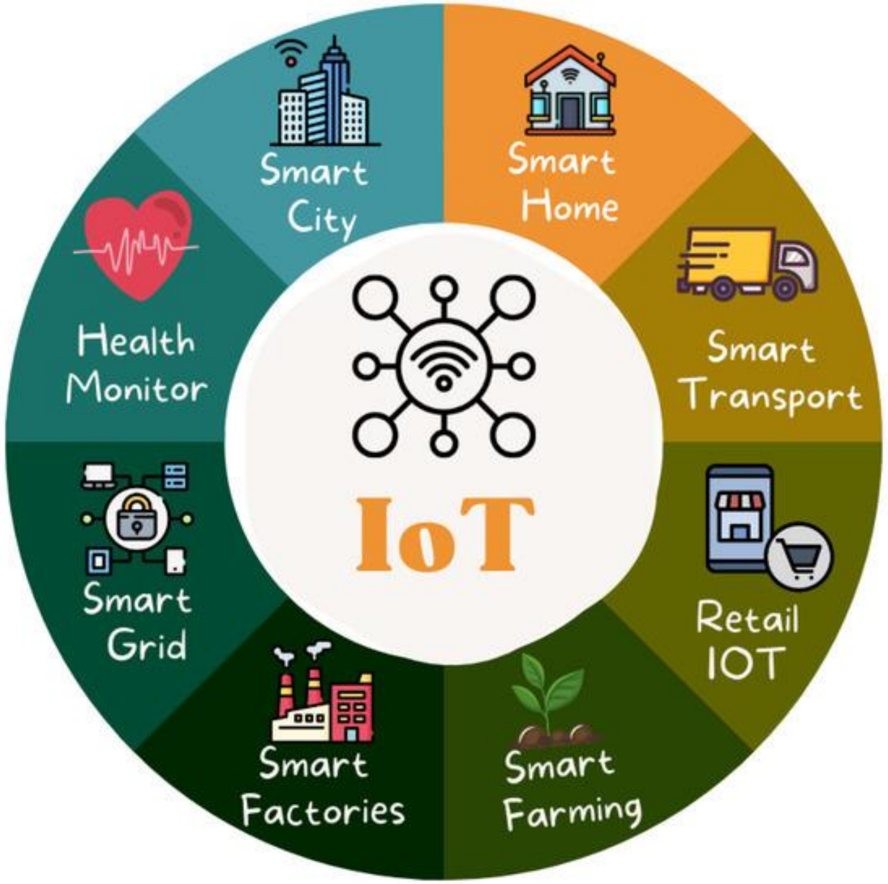


Wireless Power Transmission (WPT) in Data Centers – Efficient cable-free power



Wireless Power Transmission for the Next Decade

- **The Reality**: Battery-less IoT networks will drop ongoing municipal maintenance costs by huge margins.
- **Next Steps**: Standardizing urban charging frequencies to guarantee universal system interoperability.
- **Final Takeaway**: True smart cities require an invisible, cordless, automated energy grid.
- **The Visual**: Infographic visualizing an un-wired, interconnected urban digital workspace.



What Does "Femtocell" Actually Mean, and Why Does It Matter for Wireless Power Transmission?

- ✓ A femtocell is a miniature cellular base station originally designed for homes and small offices, providing coverage in a radius of roughly 30 meters (100 feet) or less — far smaller than the 1–8 kilometers (0.6–5 miles) a conventional macro cell tower covers. The hardware is inexpensive (typically under $10,000 per unit, compared to roughly $200,000 for a macro tower installation), but the coverage area is so small that achieving the density required for a nationwide mobile network would require an enormous number of units. SpaceX/Starlink wishes to deploy Femtocells on their user terminals with the launch of their Version 3 Satellites globally.
- ✓ SpaceX holds 65 MHz of exclusive-use, nationwide mid-band frequencies (40 MHz of AWS-4, 15 MHz of unpaired AWS-3, and 10 MHz of H-Block in the 1.9–2.2 GHz range), obtained through the FCC-approved acquisition of EchoStar's licenses for a combined $19.6 billion. SpaceX will begin deploying next-generation V3 satellites in 2027 and plans to start providing commercial service by the end of that year. The V3 satellites will operate on the full 65 MHz of EchoStar spectrum — a 13-fold increase from the 5 MHz currently borrowed from T-Mobile and other carrier partners.
- ✓ This will have a major impact on Data Centers if the trend is toward orbital data centers instead of Data Center terrestrially, as Elon Musk and others plan. If SpaceX/Starlink’s plans materialize with Femtocells, it creates a whole new industry for building coverage options for smart buildings and smart cities and Wireless Power Transmission.

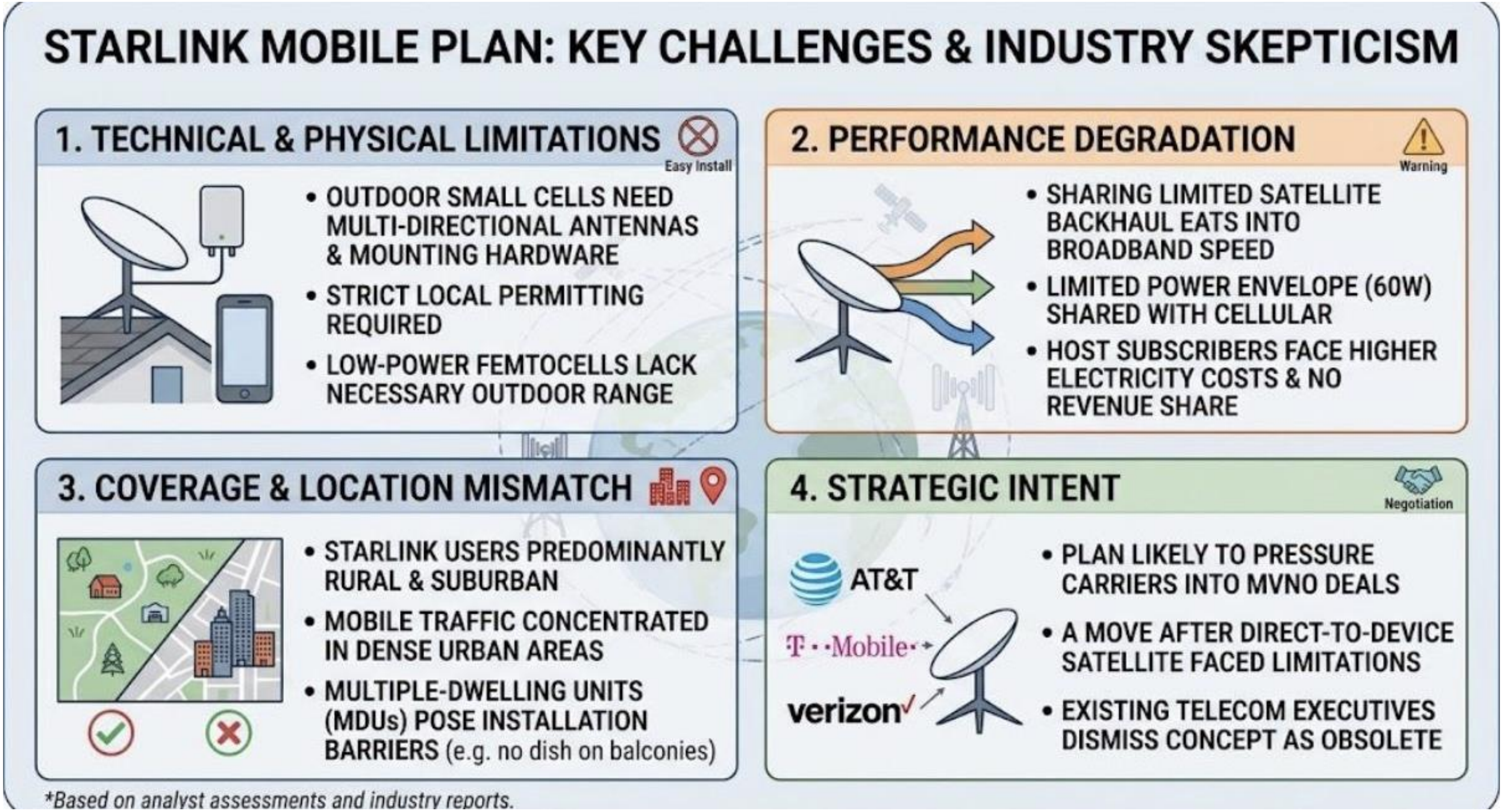
Pain points to Starlink adopting Small cells

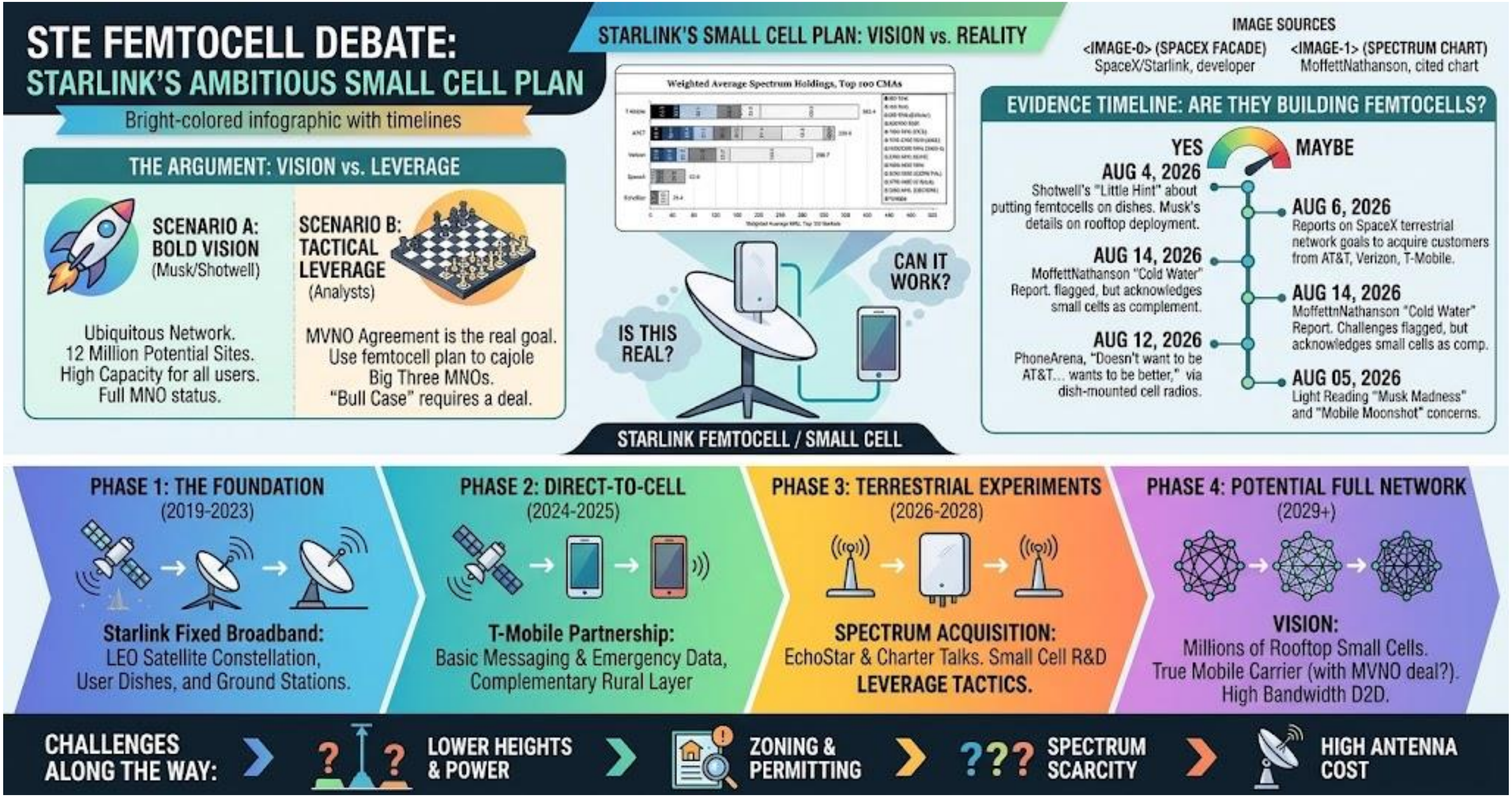
Technical & Physical Limitations: Outdoor small cells require multi-directional antennas and significant mounting hardware, triggering strict local permitting. Conversely, low-power indoor femtocells lack the range needed for effective outdoor mobile coverage.

Performance Degradation: Sharing Starlink's limited satellite backhaul and power envelope (~60W) with third-party mobile traffic would degrade broadband performance for paying host subscribers. Additionally, hosted subscribers would absorb higher electricity costs without receiving shared revenue.

Coverage & Location Mismatch: Starlink's user base is predominantly rural and suburban, whereas mobile traffic is concentrated in dense urban areas where mainstream fiber and cellular networks dominate. Multi-dwelling units (MDUs) pose further installation barriers.

Strategic Intent: Analysts suggest the plan may not be a viable standalone network strategy, but rather a move to pressure major carriers into Mobile Virtual Network Operator (MVNO) agreements after direct-to-device satellite efforts faced limitations. Existing telecom executives have dismissed the concept as far-fetched and obsolete.


STARLINK MOBILE PLAN: KEY CHALLENGES & INDUSTRY SKEPTICISM
1. TECHNICAL & PHYSICAL LIMITATIONS
Easy Install
• OUTDOOR SMALL CELLS NEED MULTI-DIRECTIONAL ANTENNAS & MOUNTING HARDWARE
• STRICT LOCAL PERMITTING REQUIRED
• LOW-POWER FEMTOCELLS LACK NECESSARY OUTDOOR RANGE
2. PERFORMANCE DEGRADATION
Warning
• SHARING LIMITED SATELLITE BACKHAUL EATS INTO BROADBAND SPEED
• LIMITED POWER ENVELOPE (60W) SHARED WITH CELLULAR
• HOST SUBSCRIBERS FACE HIGHER ELECTRICITY COSTS & NO REVENUE SHARE
3. COVERAGE & LOCATION MISMATCH
• STARLINK USERS PREDOMINANTLY RURAL & SUBURBAN
• MOBILE TRAFFIC CONCENTRATED IN DENSE URBAN AREAS
• MULTIPLE-DWELLING UNITS (MDUs) POSE INSTALLATION BARRIERS (e.g. no dish on balconies)
4. STRATEGIC INTENT
Negotiation
AT&T
T · ·Mobile·
verizon
• PLAN LIKELY TO PRESSURE CARRIERS INTO MVNO DEALS
• A MOVE AFTER DIRECT-TO-DEVICE SATELLITE FACED LIMITATIONS
• EXISTING TELECOM EXECUTIVES DISMISS CONCEPT AS OBSOLETE
*Based on analyst assessments and industry reports.


STE FEMTOCELL DEBATE:
STARLINK'S AMBITIOUS SMALL CELL PLAN
Bright-colored infographic with timelines
THE ARGUMENT: VISION vs. LEVERAGE
SCENARIO A: BOLD VISION (Musk/Shotwell)
Ubiquitous Network. 12 Million Potential Sites. High Capacity for all users. Full MNO status.
SCENARIO B: TACTICAL LEVERAGE (Analysts)
MVNO Agreement is the real goal. Use femtocell plan to cajole Big Three MNOs. "Bull Case" requires a deal.
STARLINK'S SMALL CELL PLAN: VISION vs. REALITY
Weighted Average Spectrum Holdings, Top 100 CMAs
IS THIS REAL?
CAN IT WORK?
STARLINK FEMTOCELL / SMALL CELL
IMAGE SOURCES
<IMAGE-0> (SPACEX FACADE) SpaceX/Starlink, developer
<IMAGE-1> (SPECTRUM CHART) MoffettNathanson, cited chart
EVIDENCE TIMELINE: ARE THEY BUILDING FEMTOCELLS?
YES
MAYBE
AUG 4, 2026 Shotwell's "Little Hint" about putting femtocells on dishes. Musk's details on rooftop deployment.
AUG 6, 2026 Reports on SpaceX terrestrial network goals to acquire customers from AT&T, Verizon, T-Mobile.
AUG 14, 2026 MoffettNathanson "Cold Water" Report. flagged, but acknowledges small cells as complement.
AUG 14, 2026 MoffettnNathanson "Cold Water" Report. Challenges flagged, but acknowledges small cells as comp.
AUG 12, 2026 PhoneArena, "Doesn't want to be AT&T... wants to be better," via dish-mounted cell radios.
AUG 05, 2026 Light Reading "Musk Madness" and "Mobile Moonshot" concerns.
PHASE 1: THE FOUNDATION (2019-2023)
Starlink Fixed Broadband: LEO Satellite Constellation, User Dishes, and Ground Stations.
PHASE 2: DIRECT-TO-CELL (2024-2025)
T-Mobile Partnership: Basic Messaging & Emergency Data, Complementary Rural Layer
PHASE 3: TERRESTRIAL EXPERIMENTS (2026-2028)
SPECTRUM ACQUISITION: EchoStar & Charter Talks. Small Cell R&D
LEVERAGE TACTICS.
PHASE 4: POTENTIAL FULL NETWORK (2029+)
VISION: Millions of Rooftop Small Cells. True Mobile Carrier (with MVNO deal?). High Bandwidth D2D.
CHALLENGES ALONG THE WAY:
LOWER HEIGHTS & POWER
ZONING & PERMITTING
SPECTRUM SCARCITY
HIGH ANTENNA COST

THANK YOU!

Karl J. Weaver 魏卡爾
NewportTechnologies

https://www.Newport-technologies.com

Newport Technologies
美國新港科技

www.newport-technologies.com

Woodinville, Washington State