Access Spectrum

Strategic Overview for UAS Industry

Upper 700 MHz A Block Spectrum
AGENDA

• Overview of 700 MHz A Block Spectrum
• Strategic Purchase
• Business Use Case
• Applications CII
• Applications UAVs
• 700 MHz A Block Equipment Manufacturers
• UAV Update
• Pricing Example
• Next Steps
• Q&A
Upper 700 MHz A Block

Favorable FCC Rules

- Unencumbered - clear licensed spectrum
- Superior propagation characteristics
- SCADA, Voice, Telemetry, Backhaul, Unmanned Aerial Systems
- Base station transmission: up to 1000 and 30 watts ERP
- Antenna height: up to 1000 feet (305 meters) HAAT
- Operate in TDD or FDD

2x1 MHz paired (2 MHz total) Block Licenses for Sale

- 52 Major Economic Areas
- Population coverage of 319 million (POPs)
- 757-758 MHz
- 787-788 MHz
No Build Out Requirement

- **Substantial Use of Service:** Service which is sound, favorable and substantially above a level of mediocre service
- **Safe Harbor:** signal covering 50% of population in the geographic area covered by the license prior to renewal

Ease of Renewal

- Current A Block licenses expire on June 13, 2019
- 10 year terms – renewal, in perpetuity, if compliant with FCC Part 27 Rules
- FCC Administrative Renewal Fee approximately $350
Invaluable Spectrum Asset

The 700 MHz A Block License Owners will Renew Any Remaining Licenses by June 2019!
Invaluable Spectrum Asset

Spectrum is An “**Indefinite-Lived Asset**“ And Strengthens the Balance Sheet

*Key Point within your Business Use Case to the C Suite*
700 MHz as a Strategic Investment

- **Spectrum Scarcity**
  - FCC does not see need to dedicate spectrum for CII
  - Licensed solutions becoming more of a priority
  - FCC Auctions dominated by Common Carriers
  - FCC has limited options to provide alternative spectrum based on demand

- **Similar Spectrum 3x the cost**
  - T-Mobile's Purchase of 700 MHz from Verizon was $1.85/MHz POP
  - AMTS 200 MHZ went for approximately $3.00/MHz POP
  - Utilities more inclined to lease as a line item expense than to purchase

- **Ability to Develop a New Core Business Service Offering**
  - Unique Service to Customers – New Revenue stream for Company
  - Bundled Solutions with Equipment Providers
  - Outsource FCC Interface (ASL can assist)
  - Support State Initiatives
  - Maximize Spectrum Asset for Internal Use
Spectrum as a Strategic Investment

Licensed 700 MHz Spectrum

Revenue Sources

- **Sell Licenses**: Appreciable asset that can be sold (all or portions) at any time
- **Lease & Retain Asset**: Spectrum Licenses – you set market price

Operational Enhancements

- Internal Operations
- New Service to Customers
- Unique New Business Opportunities
- Partnership Opportunities
- Separate and distinct UAV business practice

Good Will

- Spectrum for:
  - Utilities and Municipal Water
  - First Responders
  - Events
  - Emergency Radio Systems
  - IOT Development
700 MHz Spectrum Tactical Applications

Critical Infrastructure Industry

- SCADA
- Fixed Data and Site Sensing
- Secure Backhaul
- Mobile Data
- Narrow Band WiMax: GRIDMAN 802.16s
- Land Mobile Radio
- Digital Mobile Radio

- Teleprotection
- Well Head monitoring

- Unmanned Vehicle Systems /Drones:
  - Pipeline Inspection Drones
  - Other Asset Remote Site Inspections
  - Asset Mapping & Survey Mapping
700 MHz Spectrum Tactical Applications

Unmanned Aircraft Systems/Drone

- Land/Sea/Air—System Control
- Ranching
- News Media Coverage
- Oil Operations in Alaska and the Gulf
- Commercial delivery
- Line Inspections (Transmission Lines & Pipelines)
- Tower and Remote Site Inspections
- Topography & Foliage Growth Patterns
- Shale Operations
- Security
- Mining
- Agriculture
- Asset Mapping & Survey Mapping
- Broadcast and Film
700 MHz Equipment Manufacturers

**SCADA/DATA Solutions**
- GE Energy Connections
  - *Orbit* (Point to Multi-Point Data <50 kHz)
  - *Orbit* (Point to Multi-Point Data > 50 kHz)
- 4RF:
  - *Aprisa XE* (Point to Point Data)
  - *Aprisa SR Plus* (Point to Multi-Point Data)
- ABB:
  - *ArcheOS 7000 Series* (Point to Point Data 12.5 kHz -> 250 kHz)
  - *ArcheOS 7000 Series* (Point to Multi-Point Data 12.5 kHz -> 250 kHz)
- XETAWAVE: *Xeta7 Series*
- MiMOMax: *Tornado 700* (Point to Multi-Point Data 12.5 kHz -> 25 kHz)
- Full Spectrum: *FullMax* (FDD & TDD supporting 40 kHz to 1 MHz channel sizes)
- Cambium Networks: *cnReach 700 series for PtP and PtMP*

**Land Mobile Radio**
- Harris/Tait: *P25 Trunked Core Network 700 MHz* (Mobiles, Base Stations, etc.)
  - PowerTrunk Tetra System

**UAV (Drone) Command and Control**
- Rockwell Collins
- Harris
- Robot Aviation
- *Others coming on line within the next 6 months*
Unmanned Aerial Systems (UAS) /Drones

- **Drone** = Unmanned Aircraft Systems (UAS)
  - > 50 LBS: Large UAS
  - < 50 LBS: Small UAS

- **Drone also could refer to**
  - Land
  - Surface Ship
  - Subsurface Ship

- **Key Terms:**
  - Command and Control (C2)
  - Loss Link
  - Collision Avoidance
  - Line of Sight (LOS)
  - Beyond Visual Line of Sight (BVLOS)

Commercial Advantage → BVLOS
700 MHz Spectrum for UAS BVLOS

Safest and most secure control of UAV BVLOS

- Clean and unencumbered spectrum

Favorable FCC rules to promote commercial use

- Optimized with proper architecture and equipment
- 700 MHz A Block can fulfill all critical applications and requirements
- Along with Land Based Licenses - No 12 mile restriction

Plenty of bandwidth for flight controls and data applications

- No channel skipping and interference
- Uninterrupted signal between control station and aircraft/vehicle
- 12.5 kHz per aircraft link through exclusive spectrum
Terrestrial Beyond Visual Line of Sight (BVLOS)
What is New?

- We will have sold most of Northern Texas and transferred the licenses by December 31, 2017
- 2-3 more significant purchases will be completed by Q1 2018
- 250 kHz bandwidth equipment is now available through several manufacturers
- AVISTA signed for a Pilot Project
- July 2017, BNSF conducted an extensive test of 700 MHz A Block for rail operations
- We have completed two significant UAV Beyond Visual Line of Sights Tests at the FAA’s Northern Plains Test Site
- Q1 2018, NASA has enlisted the use of the 700 MHz A Block Spectrum (Command and Control) for Collision Avoidance Radar Test for Beyond Line of Site UAV Flights
What is New?

- Various manufacturers testing radios and infrastructure on 700 MHz A Block Spectrum
  - Harris
  - ELBIT Systems
  - Rockwell Collins
  - Robot Aviation (Largest UAV manufacture in Scandinavia and now has facilities in the USA)

- The following Agencies/Universities are planning test projects on 700 MHz A Block Spectrum (approved by the FAA and FCC)
  - Northern Plains Test Site
  - University of North Dakota (Engineering, Agriculture and Mining projects)
  - North Dakota State University (Projects TBD)
What is New?

Meetings with the FAA Flight Standards Service UAS Integration Office Officials & FCC Wireless Bureau

- Affirmed that Common Carrier Systems will not be approved for BVLOS
- Agree that Licensed Private Spectrum mitigates risk
- Current L Band Spread Spectrum is now known to interfere with Navy and Air Force Operational Navigation Band. This will further restrict current available unlicensed spectrum (L&C Bands)
- Concurred that the design of a ecosystem for C2 utilizing private 700 MHz and 12.5kHz C2 Channels with 12.65 kHz, GPS, C2 private spectrum link and tower positioning is technically sound and provides a safer sUAS environment
What is New?

- **White House Office of Science and Technology Summit:**
  - Confirmed that 700 MHz A Block Spectrum is looked to as a key resource for Commercial UAVs.
  - FAA: Panel discussion in which James Eck, Assistant Administrator of FAA NEXTGEN Committee is the final source for safety and standards of UAS which would include spectrum for command and control.
    - [https://www.whitehouse.gov/blog/2016/08/02/harnessing-potential-unmanned-aircraft-systems-technology](https://www.whitehouse.gov/blog/2016/08/02/harnessing-potential-unmanned-aircraft-systems-technology)

- **NASA Ames Research Center, meeting with FAA, FCC & key industries on Spectrum and Commercial UAS (8/26/16)**
  - Access Spectrum was invited by Dr. John Cavolowsky, NASA Director Airspace Operations and Safety Program Aeronautic Research Mission Directorate. 1 of only 50 attendees
  - Key to this meeting was affirmation that Common Carriers (Verizon, AT&T and other LTE common carrier systems) are unable to isolate their frequencies and systems and therefore are not operating the Command and Control of UAVs *Beyond Visual Line of Site* in accordance with the FAA's request for safe control of aircraft.
700 MHz Spectrum Investment

Population Covered (2016 Census) • 2 Channels • Spectrum Investment

Price: Currently below market value
Payment Terms: CAPEX, Payment by Installment
Flexibility on initial payment
Parcel sale by county, multi-county, state, and multi-state

$0.75

References from previous Buyers
Seamless integration on deals involving ASL and BPC
We will interface with FCC
FCC license transfer in 70-90 days
Merger and Acquisition Summary Available
700 MHz Spectrum Investment

- NorthWestern Energy
- Idaho Power
- Portland General Electric
- California High Speed Rail Authority
- Northrop Electric
- Salt River Project
- Navopache Electric
- Enterprise Products
- ONCOR
- Great River Energy
- First Energy
- First Energy

Locations:
- EA 72 Padukah KY-IL
- EA 80 Mobile AL
700 MHz Spectrum Investment

Population Covered (POP) × 2 Channels × $0.75 = Spectrum Investment

EA 72
"Padukah, KY-IL"
- 2014 population of 230,806 x 2 channels x $0.75/MHz = $346,209

EA 80
"Mobile, AL"
- 2014 population of 740,461 x 2 channels x $0.75/MHz = $1,104,692
How to Coordinate 700 MHz Pilots

Use of 700 MHz A Block for Pilot Products at NO COST

Step 1
List counties to test 700 MHz equipment

Step 2
Confirm with ASL that geography needed is available

Step 3
ASL will provide Temporary Spectrum Use Agreement for pilot

Step 4
After signature of TSUA, ASL will file with the FCC

Step 5
Begin testing 700 MHz equipment
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Thank you!