Confidential

Unofficial Notes:

Connectivity Business Investment Conference 2019

June 26th and 27th, 2019
55 Hudson Yards, New York, NY

SUMMIT RIDGE GROUP

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Executive Summary

On June 26th and 27th, Connectivity Business held a two-day conference in NYC. The event was held in the shiny new Hudson Yards office of the law firm Milbank LLP (formerly known as Milbank Tweed Hadley & McCloy). True to form, Milbank supplied not only an excellent location, but also terrific food and drinks. In a nice break from law firm rivalry, other law firms, including Hogan Lovells, Reed Smith, and Sheppard Mullin were also event sponsors.

The content itself was an interesting "crossover" between satellite and wireless and a clear recognition of the increasing interdependence of the two formerly separate industries. Speakers fairly sober about the challenge in front of the industry, ranging from 5G and IoT business models to financing large constellations to the changing role of service providers.

We are looking forward to next year's event, Scheduled for June 23rd and 24th in the same location. Summit Ridge Group's summary each session is attached.

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June 26th and 27th, 2019

TABLE OF CONTENTS

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1. DAY ONE

1.1 Intro – Jonathan Rainbow

- Satellite companies increasingly moving to data

1.2 The Focus of Private Capital Investment

Moderator
Elizabeth Evans - Partner, **Reed Smith**
Panelists
Beth Michelson - Senior Managing Director, **Cartesian Capital Group**
Will Porteous - General Partner & Chief Operating Officer, **RRE Ventures**
Jason Tofsky - Managing Director, TMT, **Goldman Sachs & Co.**

- Will Porteous (RER Ventures)
  - Mostly focused on earth observation
  - But this has some implications for communications business
  - Lots of capabilities out there
    - Plenty of early stage VC money, but need to be further along to get $25M+ B or C round
  - RRE Ventures has classic VC structure – 30 companies in portfolio – 3 to 4 will drive most of performance, next ten are 2x return and remainder are under 1x
  - Have international customers, but have challenges with US govt regulations – navigating CFIUS[1] is a drag
  - More launch companies than market can support
    - Will be hard if offered money or business from a Chinese partner
    - US Govt want to align markets with US interests
      - Wilbur Ross signed a space collaboration agreement in Luxemburg
  - Lots of work on reserve assets and checking validity of data/picture in space to deal with potential security issues
  - LEO constellation assets are a lot like terrestrial data centers at an abstract level and open the door for lots of application-level development
  - This is a golden era of satellite venture capital – tell all portfolio companies the organize around the idea that the last financing is your last
    - Gaps in availability for larger raised (past $25 million)
      - Strategic have started to fill the gap in the past two years
  - Need to be deep in the sector to evaluate antenna terminals for NGSOs

- Beth Michelson (Cartesian Capital Group)
  - Technology agnostic
  - Have not done much in satellites –
    - Need big jumps that are too big for us or growth capital better for VCs
    - We are middle market single digit multiples

[1] CFIUS = Committee on Foreign Investment in the United States

  - Favorite space is towers
  - Also, Fiber in Brazil, data center in Mexico
  - Pre-revenue to pipes
  - Invested in fiber in 2017 in Brazil – fiber and content companies are coming to them – due to "insatiable demand" less competition, more trying to figure out the most economical solution
  - Open to financial insurance products to protect downside
  - Need to grow the companies – can't do big risk as one bankruptcy would blow-up the fund.
  - Permitting is a bigger challenge in developing markets are they are not as far along as in the US – takes longer to get permitting in place
  - Comfortable working China, but tower/telecom in China is a bit harder to get comfortable with
  - If technology risk were eliminated, would consider investing the LEO constellations, but would not be a leader – would let others have some success first
  - In some markets in Latin America, the idea of tower sharing is not acceptable, many still on 3G. But they will eventually get there as they have the same challenges as the US operators
  - There is a chase for yields – so lots of money looking for returns in the private market

- Jason Tofsky (Goldman Sachs & Co.)
  - Runs TMT business
  - See same trends – convergence, etc.
    - Convergence more in business plans than in reality
  - Goldman has invested in several satellite-oriented businesses
  - Many opportunities tend to be ancient VC-type opportunities
    - Have been thinking about how to funnel money into those businesses
  - Regulatory issues are usually solvable – just a matter of time
  - Increased concern with security – but consistent with what is happening in the communications landscape
  - Lots of capital chasing LEO constellations
    - Use cases are interesting – many of them
    - If you build a good constellation, you will be able to do lots of interesting things
  - Need to find the right investor at the right time
  - Carrier will look at LEOs for backhaul if it makes sense

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1.3 Investor Keynote

Steven Sonnenstein - Managing Director, **Digital Colony, Digital Bridge Holdings**

- On the edge of next industrial revolution
- 9 platform investments, $10B raised, 300+ accretive acquisitions, $616M of site cash flow
  - Towers (America and Europe)
  - Small cells and fiber
  - Data center and fiber
  - Enterprise data centers and hyperscale data centers
- Created (with Colony Capital) 1st dedicated digital infrastructure fund
  - Closed at $4.05B this month
- Digital assets power information and connectivity – world is moving in this direction
  - Must deliver 99.999% of reliability
- Macro demand is driving fund opportunities
  - Data centers have outstripped towers and fiber
  - Most content in the world was created in last 18 months
  - Average 8-year old has been exposed to as much data an 80-year old
- Need to increase tower density, etc. to handle 5G
- Growth is global but little revenue growth from $1.03B in 2018 to $1.14B in 2025
- Driverless cars store 12 terabits/day
- Can reduce energy usage by 90%
- 5G is expensive to deploy
  - Can have neutral host platform
  - Some mentality that these are strategic and should be in-house
- Use case – almost unmanned planes at Norwegian airline
- Likely to tip-toe into 5G network upgrades over time
  - Due to capital costs of doing this
- Need to pick markets well to avoid over building
  - Some overlevered telecom networks
  - Telco can't rely on outsourced networks with 6-8x leverage
  - A challenge if market goes from 4 to 3 MNOs – customer base falls by 25%
  - People are investing more in greenfield opportunities
- Spectrum is an asset class that may or may not be digital infrastructure
  - It may be over time as it can be traded easier
- Carriers will need to focus investments

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1.4 The Outlook for Investments in Fleet Connectivity

<u>**Moderator**</u>
Craig Barner - Senior Financial Journalist, **Finance Information Group**
<u>**Panelists**</u>
Gabriele Cambriglia - Executive Director, Media & Communications, **J.P. Morgan**
Jon Cobin - Executive Vice President, Corporate Development & Chief Strategy Officer, **Gogo**
Arunas Slekys - Vice President, **Hughes Network Systems, EchoStar**

- Arunas Slekys (Hughes)
  - Hughes has some auto services, but small data rates
  - Connectivity rates now potentially higher and potential hybrid cellular services
    - Now a niche that needs to be developed
  - Lots of hype but less reality for self-driving cars
    - Don't see removing drivers completely in our lifetime
  - All of the infrastructure predictions will happen
    - Question is when and what is the low-hanging fruit
  - GEO world is driving 70-80% of the satellite industry revenue
    - LEOs/MEOs maybe 10-14%
    - GEO will drive satellite connectivity [Armand's comment: not so sure]
  - Operations in lots of places (Brazil, China, etc.)
    - Broadening the base because the demand is huge
  - Can now justify satellite backhaul in some areas
    - Also partnership with Facebook
  - Underestimated enterprise opportunity (managed services for enterprise)
    - Satellite may only be a small part of the solution
  - Smart grid is a large IoT opportunity
    - Satellite, 2G, 3G, 4G & 5G – no one technology
  - Partnered with others to offer in-flight connectivity
    - 8,000 planes today, but maybe 4-5x that over next several years
    - Biggest complaint is the limited capacity – but it is getting better
      - Especially with Ka-band high-capacity beam forming
      - Ku-band has wider beams
        - Want to seamlessly provide coverage between the bands to planes
  - Technology and service are different – service takes a lot investment
    - Satellite is now sometimes more favorable than terrestrial
      - Ex-urban, satellite cost is lower than terrestrial
      - Now at about $100 mb [sec/month]
    - Total capacity is now 3-4 terabits, but 5-8 years could be 10x that amount
  - Initial OneWeb gateways are in place and working – possibly 10,000 handoffs/second
    - Still in test mode
    - Flat panel antennas will alleviate the need for electro-mechanical antennas for planes that cost $100k+
      - Will eventually get to single digit thousands
      - Will impact the consumer terminal development

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- Jon Corbin (Gogo)
    - Lots of benefits of bringing IoT to transportation
    - Need a lot of things to come together to be able to rely on autonomous vehicles
        - Lots of infrastructure
    - Use an open ecosystem as opposed to ViaSat's closed system
        - Allows us to leverage innovation to serve customers better
        - Need to be able to layer capacity where needed – this takes an open system where we can rely on multiple satellites
            - Intelsat29e opened a lot of eyes about the benefits of an open ecosystem
        - Our investments are now more success-based
        - Need to work with satellite partners to tell story better
    - Cover 98.5% to 99% of aviation time – just missing the poles
        - Excited about GEO and where it is headed
            - New software defined satellites will improve polar coverage a bit
            - But will really need HEO and other technologies to solve that
    - Our JV's will work
        - Have been working with Yahsat for 8-10 years with backend support
            - We know their markets and how we can complement them
        - Yahsat does not have managed services and we bring a lot of knowhow in the consumer market
        - We are vertically integrated and now joining someone with local market knowledge
            - ExploreNet paid $290 million for 10% of next satellite for Canada
    - Satellite industry was fragmented in the past, but is less so now so the margins can be applied to service delivery
        - Integration/consolidation is happening in a positive way that will open opportunities for smaller payers with application services and other areas

- Gabriele Cambriglia (J.P. Morgan)
    - Lots of white space is open and may be used for 5G
    - Lots of investments will crowd in the dense urban areas
        - May create opportunities in other areas where there are fewer people
    - We are late in economic cycle, so there may be less capital available over the next 5-10 years
    - Does not matter where connectivity comes from
        - Needs to be reliable and delivered on a network agnostic basis
    - Key for public investors is that everyone recognizes the growth opportunity but how do you make a return on it?
    - ECA (Export Credit Agency) financing – lots of initiatives in the space and large amounts of capital are needed
        - Will all 5-6 LEO constellations get launched? No but likely 1-2 will get launched
        - Not clear that the first will have a market advantage
        - Good news that ExIm Bank is back on line
    - Consolidation is helping the sector

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- Going to be horizontal integration
- Will be more vertical integration in some areas, including in-flight connectivity
- Will see operators trying to get closer to the consumer

1.5 Strategy Keynote / Interview

Moderator
Steve Kaufman - Partner, **Hogan Lovells**
Panelist
Haynes Griffin - Chairman & Chief Executive Officer, **SmartSky Networks**

- Background
  - Cellular operator in the 1980s; sold business to AT&T in 1999
  - Was on the board of CTIA
- Terrestrial might be better than satellite for parts of in-flight connectivity
  - Air-to-ground
    - Similar to cellular
    - Expect to burst on the scene this fall
  - Expect to go after customer satellite is not serving
    - Can bring a new level of connectivity
    - Early focus on business jets
    - 80% of business jets are too small to accommodate satellite
- What do economics look like?
  - Very capital efficient – can build a handful of our networks for the cost of a single satellite
  - Only have to cover the whole country with a few hundred sites
    - Can be EBITDA positive with small market share
- Demand side
  - Great believer in other services but think of ourselves as providing high-speed bi-directional affordable internet connection to aircraft
    - Demand is high and getting higher and is unmet
    - Bringing solution to an industry that knows the importance of the benefits of internet connectivity
    - Enable applications and services that aren't available today
  - IoT is mostly the return path from the aircraft to the ground; most satellite connectivity focuses on the forward path
  - Other applications are not available today due to the lack of a platform they can operate on
- Lot of conversation today is about connecting passengers in the plane
  - Even in business jets, many executives won't use a plane if there is no WiFi, so it's very important
  - Other use of services may be more important
    - Cockpit and airframe connectivity
    - Rolling-out applications for flightpath optimization (just like Waze does in your car)

        - Might be able to save 10% of time (and thus reduce fuel consumption)
- Latency
    - Future proofing network for 5G, which is undefined compared to defined 4G/4G LTE
    - Will offer very fast connectivity
    - Let customers use “Fortnight” – uses lots of data and can’t tolerate latency
    - Using unlicensed wi-fi spectrum – 60 MHz block

- Distribution?
    - Have an agreement with distributors that have over 100 installation sites
    - Satellite is complementary as opposed to competitive as satellite cannot serve the smaller 70-80% of the business markets
        - Most smaller regional jets don’t have connectivity – so that market is open
- Other
    - On corporate jets, it could include video conferencing in flight

2 DAY TWO

2.1 Understanding Positive and Negative Sentiment in the Equity and Debt Capital Markets

<u>**Moderator**</u>
Dara Panahy - Partner, **Milbank**
<u>**Panelists**</u>
R. Clayton Funk - Managing Director, Towers Group, **MVP Capital**
Chris Moon - Managing Director, Head of Telecom & Media Finance, **ING**
Rudi Stuetzle - Senior Vice President, Infrastructure Debt, **MR Infrastructure**

- Dara Panahy (Milbank)
    - 40% of world's population has no broadband access
    - Need to monitor deals and update over time to minimize risk
    - Inmarsat being taken private is an example of covenant light financing

- R. Clayton Funk (MVP Capital)
    - Limited infrastructure and real estate investments for funds to look at, so now looking harder at communications infrastructure
        - May be running away from traditional infrastructure due to lack of opportunity as opposed to running to data infrastructure
    - Interest rate have been down for a long time
    - AMT and Crown have been trying to convince REITs and are getting successful especially as retail downturn, etc. has made alternative less appealing
    - Cost of capital for digital realty is lower than other real estate asset classes
        - Race to lower capital – big guys get larger and small ones will get squeezed
        - Some increase in speculative builds
    - Wireless connectivity is a must for most people – less immune to macroeconomic factors
        - Bull market will eventually end but connectivity industry is less susceptible to downturn
    - Ideas to replace towers come-up occasionally but so far have not displaced towers
    - 5G has yet to be deployed and not clear how it will be monetized
        - Uber and Lyft did not exist before 4G
        - Lots of speculation about what 5G will do and carriers need to figure out how to make money from 5G
            - One can argue they were not able to monetize 4G
    - Everything is fiber connected – that is what 5G is about

- Rudi Stuetzle (MR Infrastructure)
    - Not getting paid for risk in traditional infrastructure investments – need to look elsewhere
    - With data, etc. you also take regulatory risk, etc.
        - May get same rating but when you drill down there is more risk so you end up taking more risk for less return

- Fewer deals as there is some confusion if deal is an infrastructure or a real estate deal
  - Rating models are different but most deals are hybrids
  - Need to isolate the components
- We are all expecting a downturn but we are in it for the long-term (20-30 years)
  - We can't change the market and as an investor our mandate is to deploy money
    - Don't want to be on wrong foot if market turns south – make sure that project can withstand shock
- Look at history and structural mechanisms
  - Need to analyze the risk – who are the counterparts
  - Risk is allocated to party who can best manage it
- Few major scale small cell projects
  - Not opposed to technology risk but projects need a certain scale
    - Might be able to pool some projects (has been done in residential solar)
      - But this can be complicated

- Chris Moon (ING)
  - Imbalance of liquidity contributes to problem
    - Massive liquidity in market – it's unbelievable
  - Until Fed stops providing liquidity the current environment will continue
    - Leads to extreme competition for limited number of assets
  - Need to balance impact of Fed policy with private markets
    - Lots of private capital/liquidity available
    - Data growth is uncorrelated with market cycle
  - Lots of structures don't amortize and looking for refinancing at end of 7-year or end of project
    - Need to refinance and look at what that might be
      - Can try to limit customer concentration
      - Need to really look at renewal terms might be so one decision won't collapse thesis
      - Don't want correlated customers
      - Look differently at projects financed by hyperscalers[2] versus projects financed by enterprises
    - Try to not to overweight
  - Have looked at number of DAS (digital antenna system) and small cell and limited deployment small cell projects
    - Most are small scale and hard to engage a bank or large capital provider
      - Mostly funded by high net worth/angel level or corporate level at companies such as AMT and Crown
  - Covenant light structures only available to 10-15% of companies
    - Getting lighter now
    - Problems with definitions of EBITDA getting looser, etc.

[2] Roughly, companies now being called "hyperscalers" are companies like Google, Facebook, and Amazon that are making efforts to dominate the public cloud and cloud services industries as well to expand their business into numerous related verticals.

- Going concern provision is a hard line for us (only forward-looking element of the document) as is MFN
- It's terrifying and getting worse

2.2 CFO Keynote / Interview

Moderator
Jason Rainbow - Group Editor-in-Chief, **Finance Information Group**
Keynote Speaker
Mark Wong - Chief Financial Officer, **Kacific Broadband Satellites**

- Want to connect the unconnected and unserved
- Cover Asia Pacific as this is where the need is the greatest and geography makes it harder for terrestrial providers
  - Indonesia has 260 million people and over 900 inhabited islands
    - 1 Tbps of demand in 2020
- Kacific1 coverage
  - Indonesia, lots of Pacific islands, and New Zealand (lots of unconnected islands)
  - No coverage of Australia
- Assume "One Internet" where people have the same requirements [AM: comment – not sure about this]
- Example: provide connections to health clinic
  - Having internet access has changed the way they operate
- Example: can use for emergency medivac
- Kacific1: Boeing 702 MP satellite
  - Expect Q4 launch and operational before yearend [AM comment: seems quick]
  - SpaceX launch
  - CondoSat solution
    - Have ½ of satellite; other half is SKY Perfect JSAT Group ("JSAT") – the two operate independently
    - JSAT helps with some of the technical and regulatory issues
  - Marsh provides insurance advice for financing etc.
- $600 million in take or pay customer contract with telcos (5-15 years)
  - Allows Kacific to operate with lean team and not have to deal with retail side of business
- Went with GEO
  - Wanted lowest cost possible and GEO was the only one that met need
- Did not expect to get trunking business but got some interest and customers
- Fiber is not affordable in the area
  - $10 to $200/month in revenue per square mile
  - Fiber cost $25,000/mile to connect – does not make sense
- $164 million of debt and equity raised
  - Raising series B round underway
- Gap between VC funds looking for high growth and returns of multiples and more mature funds
  - Kacific is in between

        - Wanted to raise $10 million in Series B [xx to be confirmed xx] but decided to raise $10 million more
- Not able to get XM Bank funding – opened too late
    - Looking at refinancing process as well
- Kacific is an infrastructure asset in the making
    - More equity funding than most infrastructure projects
- Series A was high net worth people and those with connections to the satellite industry
    - Had less success with traditional investment firms – hard story
    - Investment basis is not backlog but long-term demand in the region
    - Now getting more interest from institutional investors
- A lot of backlog is from ISPs which are under pricing pressure
    - Has not impacted Kacific as their price is lower than next solution
- Some ISPs, especially the larger ones, need proof of concept before ISPs can start marketing
- Interim service using Ku-band as a reseller to seed clients
    - Higher price and not making margin on it
- Not using beamforming satellites – targeting specific areas
    - May use beamforming on next satellite
- Competitive advantage vs. others
    - Having the right solution for specific audience without coverage
    - Don't try to be everything for everyone (mobility, maritime, etc.)
    - Customers want basic connectivity for Skype call to next village or for internet research
    - Select markets with more resiliency
- From financing perspective the attention to satellite is great
- Interest in helping last mile mobile operators for trunking
    - Not part of business model but have been approached for large telcos
        - Probably not as sustainable as VSAT as fiber deployment will continue

2.3 Navigating regulatory and antitrust issues

<u>Moderator</u>
William Jefferson Black - Managing Director, **Finance Information Group**
<u>Panelists</u>
Sasha Field - Deputy General Counsel, **Omnispace**
Ben Gris - Partner, **Shearman & Sterling**

- Sasha Field (Omnispace**)**
    - In-house at Omnispace
    - Huge increase in FCPA (Foreign Corrupt Practice Act) review
        - Formerly a "check the box" issue
    - "Know Your Customer" obligations are now requiring more serious effort
    - FCC was historically deeply involved in merger discussions and conferred with DoJ
        - Opinion was not always public
        - FCC may have a stronger voice to the extent spectrum becomes more important

- Lots of attention for cross-border licensing
- Can structure deals with price adjustments for tariff risk
- If there are “tit for tat” tariffs, how can you value and structure around this risk
- Not only problems with China but also Russia and others
    - Russian investors are interested in space
    - Hard to project where CFIUS will go
- People are looking to limit risk in non-traditional/creative ways
    - Put synergistic investments in different funds
- U.S. and European companies have different and conflicting rules for Iran
    - In EU can only stop doing business for economic reasons
    - In U.S., not allowed to do business
- Financial and strategic capital may look at the risks differently

- Ben Gris (Shearman & Sterling)
    - Lots of anti-trust experience from working at the FTC
    - Enforcers are getting more aggressive and forward-looking nature is in flux
    - Anti-trust is a major component of inequality and populist arguments among politicians
        - Historically a very academic area
        - Anti-trust folks are being asked to do much more than in the past
    - Historically people think about anti-trust as issue involving horizontal mergers
        - Enforcement agencies have gotten good at this
    - Now antitrust enforcement still getting their arms around “killer apps,” i.e., acquisitions of nascent companies that could be major competition in the future
        - WhatsApp and Facebook – some argue it should have been challenged
    - Sale of small companies to larger players are type of deals that enforcers are looking to pay more attention to
    - Long-term move to change assumptions to make acquiring company “prove” the merger would be “pro-competitive”
    - When drafting transaction documents, parties need to consider what confidential information is included
        - How do the documents describe the deal parties, especially in terms of competition?
        - Want to tell your story – how will new competition be added
        - Enforcers will hone-in on the same documents
    - Appellate court in AT&T/Time Warner seemed to embrace behavioral remedies
        - Previously, behavioral remedies OK for vertical mergers not accepted for horizontal mergers
        - DoJ: behavioral remedies not accepted in either type of deal (horizontal or vertical)
        - DoJ may need to lose more cases before DoJ changes its approach toward accepting behavioral remedies
    - Merger review is getting more politicized
        - FCC is a more politicized organization – announced Sprint/T-Mobile first to put marker down
        - State AG’s are also getting involved
    - Resurgence of industrial policy playing a role due to populism and nationalism

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        - Big argument for Sprint/T-Mobile is positive impact on U.S. being 1st on 5G
    - Almost an opposite trend in the U.S. regarding synergies and orders
        - The synergies that mergers create come at the expense of orders (and thus at expense of workers)
            - Historically this was considered "good" – doing more with less
            - Now populism is causing this to be seen as anti-competitive
            - State AG's now asking if Sprint/T-Mobile will push down salaries in certain regions
    - Trump used CFIUS to block Qualcomm's acquisition of Broadcom
        - Then China blocked Broadcom's acquisition of NXP
    - State AG's will become more active over time
        - States came together for Sprint/T-Mobile
            - Pooled resources to afford it and brought in top talent to make it happed
        - More comfort for enforcers other than the U.S. federal agencies to say they have a stake and show up to voice their opinion

- Dara Panahy (Milbank) – Audience Comment
    - Some investors don't want to submit themselves to the uncertainty of approval risk

2.4 CEO Keynote / Interview

Moderator
Jason Rainbow - Group Editor-in-Chief, **Finance Information Group**
Keynote Speaker
PJ Beylier - Chief Executive Officer, **SpeedCast**

- U.S. now largest market by far in terms of customers, employees, suppliers
    - 1600 employees, 900 in the US
    - Trade on Australian Securities Exchange ("ASX")
- Operate in remote areas where terrestrial network is limited or not existing – diversified business
    - Lots of cruise business
    - Maritime
    - Government (mostly the U.S.)
    - EEM (Enterprise and Emerging Market)
        - Telcom, voice, mining, construction, media
- People in 40 countries – customers in over 140 countries
    - No customer more than 10% of revenue
- Don't own satellites – largest buyer of satellite capacity globally
    - Integrate and provide network for customers
- 2018 was challenging – three divisions growing, but energy down 14%
    - Hard as energy has higher margins traditionally
        - This is where services are most critical

- If services stop for a day, it costs millions of dollars and customers pay a premium for very high service level agreements and support
    - Oil prices are going up so that should help
        - 65% market share of deep-water rigs and service subs
        - Expect 5% increase y/y but can't talk about a recovery yet
    - Rollout of Nobile drilling fleet
    - Large project in Mozambique – largest LNG facility in the world
    - Growing relationship with Schlumberger
    - Offshore – many customers talking about improvements in 2020
- SpeedCast and RigNet are two players with capabilities to do well
    - Market has consolidated
- Expect other sectors to consolidate as well
- Have done 16 acquisitions but have said "no" to thousands
    - See all deals but are selective
    - Not actively pursuing acquisitions
        - Happy with scale and advantages it brings
- Focused with integrating acquisitions and deleveraging and driving organic growth
        - Not closed to new acquisitions if there is a compelling opportunity
- Leverage guidance is 3.0 to 3.2x EBITDA – important to meet that
    - Want to get to 2.5x
- In a situation of overcapacity as supply is in excess
    - Getting price of capacity down which has increased EBITDA margins from low 10s to low 20s (also scale has helped)
- May be in a position where satellite might be faster than terrestrial
    - Singapore to London 300ms
    - Maybe ½ the time for satellite with LEO
- Large capex projects by large operators so aren't going down the value chain much
    - If they want to go down the value chain, they need to do it through acquisition
    - Sector needs to be consolidated so they can buy large payer to minimize collateral damage when signaling competition with customers
        - SpeedCast would likely be on the top of the list of acquisition targets
    - Satellite operators going down the value chain does not cause sleepless nights
- Satellite operators should consolidate
    - Maybe consolidation with NGSO's
    - Could be forced by financial challenges
    - Total bandwidth will be 3 to 3.5 Tbps
        - One NGSO constellation is several times the existing capacity
    - Governments have hindered operator's consolidation
- 1,500 to 2,000 commercial ships for edge computing
    - doing IoT with 20,000 devices – terms are mixed
    - Have an AWS partnership to provide remote connectivity
        - Been using some of their development tools
        - Now taking to the next level and 1st satellite company
- Tend to buy back to back to minimize bandwidth risk
    - But at scale now that we can't just buy long-term

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  - 50% of contracts are longer (12-24 months) down from 3 years; 50% on spot market
  - 50% is bulk deals
- Talking to all constellations
  - Want to know what they can bring to our customers
  - Mission is to find best solution, not to fill a constellation
  - Anchor contracts can be valuable as it facilitates financing – but not in a rush to commit to anyone
    - Talking to Amazon, SpaceX, Telesat, LeoSat, OneWeb
- A few years between now and LEO/MEO constellations
  - OneWeb and M-Power are likely to be 1st
  - May be some tightness in the interim In isolated areas, but pricing will continue to decline
    - Will sign short-term contracts until LEOs arrive and then reevaluate
- Not buying capacity due to declining price, but because clients need it
  - Want to be a 98% to 99% utilization
- Competitors are smaller scale and less diverse
  - Taken 20-years to build SpeedCast and it's a very hard business
  - It's not the same as some of the terrestrial VARS as SpeedCast does a lot more including data analytics and other things plus satellite dynamics are different than terrestrial
    - With LEOs it may get closer to terrestrial
    - Use SpeedCast for remote access and AT&T for access to their office – SpeedCast does the hard stuff
    - Have gone from a managed connectivity provider to a managed network company and headed to being a managed information provider to get to the next level

2.5 The Outlook for Wireless Broadband Services and 5G Connectivity

Moderator
Brian Weimer - Partner, Head of Communications Practice, **Sheppard Mullin**
Panelists
Todd Crick - Co-Founder, **Astra Capital Management**
Brian Holz - Chief Architect, **Akash Systems**
Zac Smith - Chief Executive Officer, **Packet**
Scott Wilcoxen - Executive Director, Media & Communications, **J.P. Morgan**

- Brian Weimer (Sheppard Mullin)
  - Basic facts
    - 186,232 miles/sec = speed of light
    - 20 mbps 4G speed
    - 20 gbps 5G speed
      - 400 8k movies simultaneously
    - 200 milliseconds – human reaction
    - 1 millisecond – 5G latency
    - 200 meters – millimeter wave deployment between towers

        - Will need to be a lot closer
  - What are the applications of 5G?
  - Commission does not have respect for satellite as wireless pays billions of dollars

- Todd Crick (Astra Capital Management)
  - Baseband unit and antenna (to massive MIMO) need to be replaced
  - Need standalone or non-standalone units
    - Likely to have 5G and then default to 4G if 5G is not available
  - 6G is being developed and standard likely to be frozen in 3 years
  - 4G has MIMO; 5G have Massive MIMO
  - Millimeter wave spectrum is very wide and can have enormous increase in
    - Speed
    - Capacity; and
    - Number of devices connected to the same tower
  - Densification has begun – 20 sites/square mile
    - 100,000 square miles of urban area in the US
    - Need about 2 million cells (unless they share)
  - There is some "we'll build it and they will come"
    - Some use cases with tangible evidence
    - Mobile video has surpassed fixed video with 4G
    - Virtual reality and augmented reality are possibilities
      - Could use it to walk you through fixing a car or all kinds of things and even analyze work to see if it has been done well
  - Carriers will get real capacity increases with 5G
    - Also driven from competition to have the best network
  - Rule of thumb for backhaul – 1st fiber, then microwave, then satellite
    - Satellite may be able to capture some of the backhaul market from microwave
    - If not, satellite will still increase as more towers are going to be build
  - Sprint/T-Mobile merger won't be meaningful for 5G future
    - May be easier to provide 5G if they are merged
  - If T-Mobile/Sprint is approved then expect 4th carrier to emerge

- Scott Wilcoxen (J.P. Morgan)
  - Other things needed included densification and virtualization of core network components
  - Carriers themselves are paying for this so far
  - People like satellite due to long-term contracts and stable cash flow
    - Don't need to pick winners and losers
    - Traffic is increasing so valuations are increasing
  - Sprint/T-Mobile have complementary portfolios so it will facilitate their 5G transition
  - No data to support if 3 or 4 carriers is better
  - T-Mobile's success has undermined the idea that a market with 4 carriers doesn't work

- Brian Holz (Akash Systems)
    - There has to be a need for lower latency
        - 96% of today's traffic is steaming video
        - Not clear people will pay more for lower latency
    - The ability to monetize higher data rates is getting lower
        - Returns likely in infrastructure and applications that specifically need 5G
            - Average consumer won't need this
        - Opportunities in content
    - With higher capacity of 5G you need to be able to move data around thus increasing infrastructure demand
    - Can move some applications to the tower to minimize traffic and the back and forth
        - Same is happen with satellite with beamforming and dynamically reallocating capacity
        - Satellite is moving to distributed teleports in local countries
    - Need to put computing to the edge to reduce latency to 1ms
    - Convergence of technology with smaller spacecraft where cost per Mbps can get down to microwave range
        - Will allow them to capture and hold cell towers
    - C-band proposal is a good thing
        - Won't be used for satellite in broadband applications so attractive for satellite operators to monetize it
            - This is what you need to do with spectrum
            - Broadcast uses satellite but it will be dead in 5 years
    - Ka-band is widely used around the word on satellite
        - The question is whether it can be shared?
            - You can, but there is a cost on the terrestrial side to allow co-existence
                - May take 10-years to get everyone to the table
    - Can design a terrestrial antenna to share Ka-band with satellite but it is expensive – who pays for it?

- Zack Smith (Packet)
    - Do people really want to pay for 5G?
    - 3G to 4G was a big change by allowing video
        - Not sure a faster iPhone will increase revenue
    - Apple and Netflix made money off 4G
        - Carriers don't want to make that happen again
    - Best investment is likely in the infrastructure
    - Computing power is increasing but it's hard to invest in computing power
        - Data centers are the next logical area
        - Data center market has consolidated (60-70% to under 5 players)
        - Edge computing allow you to invest in area where not competing with hyperscale advantage
    - Round trip latency is important as pieces of webpage are loaded from different places
        - Packet loss is about 15-20% which increases latency

- 5G latency reduction is irrelevant if you can't get applications closer to the tower
- Consolidation to 3 carriers is good for certain enterprise uses as this market is underserved
  - Need to update lots of antiquated networks to wireless

- Dara Panahy (Milbank)
  - Ka-band battle is more significant for the satellite sector

2.6 Will spectrum investment and operational cost changes materially affect the industry?

Moderator
Douglas Yu - Senior Financial Journalist, **Finance Information Group**
Panelists
Brian Barnell - Managing Director, **Q Advisors**
Bob Quinn - Partner, **Wilkinson Barker Knauer**
Vivek Stalam - Associate, Equity Research, US Communication Services, **New Street Research**

- Vivek Stalam (New Street Research)
  - Spectrum formerly focused on coverage; now need higher frequencies with more capacity
  - mmWave auctions made sense, but unclear how much mmWave will be needed and how utility will be maximized considering lots of supply
  - Would have expected cable to participate more than they did but no surprises among operators
  - T-Mobile and AT&T might improve their positions in upcoming auctions
    - Not much scarcity of mmWave spectrum
    - Pricing might go down in future mmWave spectrum
  - AT&T does not need cash from DISH deal to participate in Auction 103
  - Charlie Ergin difficult to work with; rumored to be in a lot of deals
  - Dish is well-positioned to take over the Sprint assets
  - Cable is in the strategic opportunity set to be a wireless carrier
    - Big tech companies as well but have taken no major steps, which undercuts potential as competition
  - CBA auction structure is a bit unusual
  - CBRS will be more of a small cell application
  - Expect CBA will get something but it is a question about how much
    - FCC expected to come to a decision by the end of the year
  - For 5G, mmWave seems to be an expensive proposition, with press reports saying coverage is not enough to be meaningful
  - Everyone is looking at midband from 2.5 GHz to 6 GHz to provide broader 5G coverage
    - More regulatory uncertainty in US midband spectrum, including CBRS power limites

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- For Verizon to get to 30 million coverage for 5G will need to expand cell sites by 5x to 6x
  - Does not get cheaper with volume

- Bob Quinn (Wilkinson Barker Knauer)
  - Formerly wanted large footprint for coverage but now it's a capacity issue
    - Need spectrum at every level to have coverage and throughput
    - Midband very important
    - mmWave also impacted by rain fade
  - Lots of additional spectrum bands may open-up
  - Verizon cleaned-up 28 GHz as they bought quantity and got the best markets
  - Expect AT&T to be more aggressive on 39 GHz auction
  - Not enough spectrum to allow networks to grow traffic at current rates
    - Need to get traffic on fiber as fast as possible
    - AT&T made deployment of fiber commitment to 12.5 million but that is just the "NFL Cities"
      - Will be more expensive for the rest of the country
  - Cable companies not really interested in being the 4th wireless player
    - If cable companies were going to invest in wireless they would have been in the AWS auctions; they participated in 2006 auction but then flipped spectrum to Verizon
  - JVs are hard to make work
  - If cable companies look at the world and realize they need to have a nationwide footprint the mobile wireless it is less attractive opportunity
  - AT&T's public statements suggest they want to retire debt
    - Not sure what that means for satellite business – might sell if it fit into debt-reduction plan
    - Core competency with AT&T but TimerWarner does not have a lot of synergies
  - AT&T won't walk away from auctions as connectivity is their business
    - AT&T won't be shortsighted
  - Expect pricing in 37, 39, etc. auctions to be somewhat lower
  - Skeptical that AT&T would bring anything to the DoJ before 2020 ☺
  - Dish committed to be 5th wireless player but this has not happened
    - Have a strong spectrum position
    - If Dish can get infrastructure customers and some mid-band spectrum and buildout relief they are in a good spot to enter the marketplace
  - Cable companies had an opportunity to enter the market but did not take it
  - Don't think anyone believes Sprint will be a competitive 5G player
    - Only spend $1.5 B on capx and competing with companies spending $20B
    - Don't think people believe Sprint will ever be a 5G player
  - Dish may step in as a license preservation issue but will eventually need to sell it to someone
  - C-band spectrum will be sold
    - Carriers not used to single sealed bid – will see in comments next week
    - Congresswoman Matsui (D) discussion draft

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            - Calls for full blown auction with satellite operators getting less than 50% of revenue unless more than 300 MHz auctioned
                - Draft may be more message/signal/warning
        - Unjust enrichment -- what amount goes back to the U.S. government?
        - Can reduce interference issues if you aggregate earth stations to rural areas and then build fiber there
        - Lot of issues to work out – content companies not comfortable with satellite companies running the repack process with motivation to keep costs down
        - Won't see reaction of carriers until next week
        - CBA process has become more transparent
        - Remains to be seen if it will be an FCC auction or a private auction
        - Expect an FCC decision by end of year
    - Carriers won't limit themselves to licensed spectrum
        - Will do some aggregation into unlicensed spectrum as well
    - Tension between CBA and carriers about the amount of spectrum
        - Lots of pressure on CBA to get to a larger amount of spectrum
        - If three carriers and 300 MHz, each can get 100 MHz
    - Not many midband options other than C-band
    - Hardest part of infrastructure is digging-up streets and deploying fiber
        - Regulatory and right of way is the most expensive thing carriers do

- Brian Barnell (Q Advisors)
    - Cable companies might do deals and participate on the margins but not ready to take big step
    - Pricing for mmWave is really up to game theory people trying to make competitors pay more as opposed to being based on need
    - Don't see major new entrant in upcoming auction
    - AT&T trying to lower tower expenses
        - Possible to disintermediate tower and ram assets [xx check xx] by PE shops
        - Possible network sharing with FirstNet
    - Hard to be a 4th player unless it's handed to you by regulators on a silver platter
        - "If in doubt, don't build it out"
    - Not sure if tech companies want to be a national carrier
    - Any purchase of assets by DISH related to the S/TMUS deal would be to obtain build out release and subsequent spectrum sale
    - Carriers want the spectrum and will pay for it
        - They are likely to find a way to get it
    - Don't think European prices weigh into C-band calculus
    - Expensive is relative – not sure Sacramento is a good benchmark
        - Carriers will wait until the plan makes sense
    - Expect 5G use cases in next three years
        - Not sure if there will be returns unless there is more infrastructure sharing

- Douglas Yu (Finance Information Group)

- Verizon has 11x the mmWave spectrum of T-Mobile (about 1200 MHz covering 60% of population)

2.7 Shifting M&A Dynamics and the Outlook for Consolidation

Moderator
Douglas Yu - Senior Financial Journalist, **Finance Information Group**
Panelists
Ryan Lepene - Co-President, **Peppertree Capital Management**
Vaibhav Lohiya - Managing Director, TMT Investment Banking, **Deutsche Bank**
Robert Paige - Senior Vice President, Mergers & Acquisitions, **Vertical Bridge**
Nic Volpi - Partner, **Permira**

- Douglas Yu (Finance Information Group)
  - Infrastructure for 5G might total $326 billion

- Ryan Lepene (Pepper Tree)
  - Consolidation is premised on increased data demand
  - Everyone wants to figure out how to drive revenue in the 5G world
  - Trying to get ahead of 5G trends – get content, drive eyeballs, etc.
  - Sites are constrained
    - Sprint/T-Mobile will need to upgrade towers
  - If companies need additional site on tower, that is what we are selling
  - Just want clarity on industry structure, then everyone can move forward
    - Currently too much uncertainty for people to more
  - Not all assets are created equal within fiber, towers, spectrum, etc.
    - Need to really understand them
    - For new people jumping in, they may regret when the music stops
  - Most towers have consolidated
    - If you are a big infrastructure fund it's hard to find enough assets to write a big check
  - 70% of what we do are towers in the U.S. and abroad
  - Have 28 portfolio companies
    - Added three in last few months
    - Need for more infrastructure – will continue to deploy capital to portfolio companies we have backed
      - May partner with a few more companies before the end of the years
  - Try to partner with carriers to help them keep costs down but also get decent returns for investors
    - Not all towers are equal, need to understand the specific towers and lease-up growth potential

- Vaibhav Lohiya (Deutsche Bank)
  - Availability of cheap financing drives consolidation as does competition and data demand

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- Competing with likes of Facebook etc.
- Reality is that some new infrastructure funds are willing to pay more
  - Need to consider their return expectations and time horizon
- IoT is broadly defined
  - Sometimes defined to include software
- Provides remote connectivity and redundancy layer in urban areas
- IoT business strategy is evolving and making progress
- Investors have traditionally over-siloed segments of the industry "wireless" vs "wireline" etc.

- Robert Page (Vertical Bridge)
  - Our firm is part of Digital Bridge Company
    - Largest private tower company in the U.S. with over 4,000 towers
  - 5G is driver of consolidation
    - No one knows what it is, but it is a technology shift and will be substantial
  - Facebook is largest telecom company in the world (per Vodaphone CEO)
  - Harder to get deals done for financial valuation reasons than regulatory reasons
  - 5G will be strong spending environment
  - From a tower perspective, merger of Sprint and T-Mobile is good
    - A viable fourth carriers would be fantastic!
  - People putting high valuations; many will not be able to execute and get the needed synergies
    - Execution risk goes up when you go outside of your experience area
  - We have a lot of capital and with CDPQ pension investor we take a very long-term approach – almost a perpetual approach
    - Market today is frothy
    - Deal we've done in the past year were small – we'll wait until prices come down
  - When your business strategy is based 100% on building towers or fiber, it is hard
    - Those companies will get hundreds of towers, not thousands and won't reach scale
  - To get a lease with AT&T and Verizon, they know the value of the asset and the leverage it
    - Tend to have leases that are favorable to carriers
  - Some small rural partners has Huawei equipment and need to figure out what they will need to do

- Nic Volpe (Permira)
  - Owned 3 FSS companies
    - Inmarsat, Intelsat and now ABS
  - Financing has helped M&A activity
    - Good environment to raise debt
      - Telecom is darling of leverage community
  - Synergies have helped M&A
    - People have mastered consolidation and rationalization in the sector

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  - This time for companies to come together to realize these synergies
- This is most benign regulatory environment unless CFIUS is involved
  - Now it the time to act – there will be a freeze at the second half of next year
  - Don't want to bet on current administration getting another four years
- Valuation environment is tough
  - Multiples are very high and boards was significant premiums to current prices to get a deal done
- People in my seat who have raised large funds can't stay on the sidelines but rather need to deploy funds
  - Can bridge the gap with synergies
- Most assets are being brokered to try to find outlier who will pay a higher price
- Sellers should use as wide a process as possible to find outlier who will pay the most
- Historically, many of the assets we paid the lowest for had the worst return
  - Assets that are cheaper (not market leaders, etc.) go down the most when the market turns
- Data center in South Africa has been a home run
  - Not a very big investment
- Need to take a global approach and find pockets where there is value
  - Better to put money in an existing platform you know than in a new one you don't know well where everything needs to go well
- Own a German software company with 2.5 billion devices globally connected to it
  - Now operating snow guns at ski resorts remotely
  - IoT has been used liberally, so hard to define
- Not many companies have made money on IoT
  - But it is important and need to have a strategy for it if you want to get a good price on sale
- More cooperation among competitors
  - C-band alliance, etc.
  - Likely to see more of this
- Funding is there for LEO systems
  - OneWeb has Softbank
  - SpaceX has funding
  - Real question if the constellations will survive
    - Maybe one or two will survive at the end of the day
  - Comes down to the end user and the cost to the user
      - Need to solve the ground antenna – not sure there is a solution today that is cost effective to make it as ubiquitous a solution as players would like it to be
- Security is a top 2-3 issue for CEOs and government has been on the watch on this issue
- U.S. government concerned about traffic going across Chinese satellite with AsiaSat

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