

FOCUS

Investment Banking

Telecom Technology and Services Group

Carrier-Focused Telecom Technology Quarterly



Investment Banking and Advisory Services

FOCUS Investment Banking LLC is a leading investment bank with specialized telecom technology and services expertise, concentrating on providing highly tailored services to emerging middle market and larger organizations in this sector:

- Mergers & Acquisition Advisory
- Corporate Development Consulting
- Strategic Partnering & Alliances
- Capital Financing, Debt & Equity
- Corporate Valuations

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Carrier-Focused Telecom Technology Quarterly

By Richard Pierce, FOCUS Managing Director and Telecom Technology and Services Team Leader

FOCUS believes that the Carrier-Focused Telecom Technology sector is one of the most important in Telecom. As communications service providers struggle to keep up with ever increasing demand from their data hungry customers, they are turning to their technology partners to help them satisfy these needs in a cost-effective way. In addition to simply increasing the capacity of both wireline and wireless networks, companies in the Carrier-Focused Telecom Technology sector are also helping customers perform a variety of other critical functions including network planning and optimization, network monitoring, service assurance, network testing and service delivery and monetization. While some of the largest technology companies in the world are helping to meet many of these challenges, we believe there is significant innovation among middle market technology providers and ample opportunities for them to create meaningful value for their shareholders. FOCUS is proud of its commitment to the Carrier-Focused Telecom Technology sector and we are excited about the prospects for middle market companies in this space.

The FOCUS Telecom Technology and Services group consists of professionals with substantial expertise in both Telecom and investment banking. The FOCUS Telecom team is uniquely qualified to help middle market clients reach their strategic objectives because the group:

- Devotes significant senior level resources to executing transactions for lower middle market clients,
- Has a breadth of knowledge that covers most segments of the telecom industry,
- Has a proven transaction methodology for delivering results,
- Is equally comfortable with buy side and sell side M&A,
- Leverages an experienced team of research professionals,
- Has a national presence with coverage of both East and West coasts.

Sub Sector Definitions

Large Cap: Large, diversified companies with products across a variety of sub sectors

OSS/BSS Software: Software systems that manage and bill the customer base and monitor and maintain telecom networks

IP Networking: Carrier Ethernet switching, routers and IP Multimedia Subsystem ("IMS") components

Wireline Access and Transport: DSL equipment, PON equipment and WDM-based transport

Cable and Video: Products such as headends and servers that support video delivery as well as broadband products for cable networks

Broadband Wireless: High capacity, fixed wireless equipment

Test and Measurement: Equipment used by both service providers and manufacturers to test and monitor networks and equipment

Summary Comments

Public Markets

For the third straight period the FOCUS Carrier-Focused Telecom Technology Index (CFTTI) had a negative return. In this case, the CFTTI was only slightly in the red with a three-month loss of 0.3%. This performance trailed the broader indices as the S&P 500 and NASDAQ both turned in strong gains this period of 7.3% and 8.8%, respectively. The CFTTI's 1.8% decline in the past year also compared unfavorably to strong year-over-year gains in both the S&P 500 and NASDAQ. Sector multiples closed out the period lower than they were at this same time last year. The sector revenue multiple dipped from 2.3x to 2.2x, while the sector EBITDA multiple fell more sharply from 14.4x to down to 11.9x

Large Cap

The Large Cap sub sector was the CFTTI's worst performing sub sector this period with a three-month loss of 3.0%. Cisco fell 3.2% over this time frame, while Nokia stock plummeted nearly 30%. On the plus side, Ericsson enjoyed a 15.3% gain and both Juniper and ZTE also had nice returns. For the full year the Large Cap sub sector declined 5.3%. This was due to a 5.3% loss at Cisco as well as double digit losses at both Nokia and Juniper. However, not all of the stocks in the sub sector were down over the past 12 months. In particular, ZTE delivered a strong year-over-year return of more than 50%. Sub sector multiples closed out the period at 2.2x revenue and 11.2x EBITDA. Both of these are lower than year-ago multiples of 2.4x revenue and 14.1x EBITDA.

OSS/BSS Software

It was a solid winter reporting period for the OSS/BSS Software sub sector as the sub sector posted a three-month gain of 5.4%. Gains were broad-based as eight of the ten companies in the index were in positive territory for the period. This included particularly strong gains at Evolving Systems (up 16.7%), NetScout (up 13.8%), Optiva (up 21.6%) and Tecnotree (up 113.4%). The sub sector also had a respectable year-over-year gain of 8.1%, with exactly half of the companies in the index posting a positive return. Despite the year-over-year gains, sub sector multiples remained relatively flat. The sub sector revenue multiple remained steady at 2.1x, while the sub sector EBITDA multiple actually declined slightly from 13.9x a year ago to 13.4x currently.

IP Networking

After a strong gain in our fall reporting period, the IP Networking sub sector took a step in the other direction with a three-month loss of 1.5%. The loss was due to a more than 40% decline at Ribbon Communications. The other two stocks in the index, Allot Communications and Audiocodes, were up 13.3% and 37.4%, respectively. The situation is similar for the full year period. Strong returns at Allot Communications and Audiocodes drove a 16.3% increase in the index, while Ribbon Communications was down 45.1% over the past year. The sub sector revenue multiple jumped from 1.2x a year ago to 1.5x currently. The sub sector EBITDA multiple ended the period at 37.1x. This compares to a "Not Meaningful" EBITDA multiple from a year ago.

Wireline Access and Transport

The Wireline Access and Transport sub sector was another sub sector that declined in our winter reporting period with a drop of 0.4% in the past three months. Two of the larger companies in the index, ADTRAN and CIENA, both suffered reasonably steep losses. However, this was largely counterbalanced by strong gains at ADVA, Calix and Infinera. For the full year, the sub sector remained strongly in the black with a 12 month gain of 12.3%. Only three of the nine stocks in the index delivered a positive year-over-year return, but a 16.4% gain at CIENA coupled with a 48.0% gain at Infinera pushed the index into positive territory. Sub sector multiple performance was mixed. The sub sector revenue multiple increased from 1.3x to 1.4x over the past year, while the sub sector EBITDA multiple had a slight decline from 25.6x to 23.0x over the same time period.

Cable and Video

The Cable and Video sub sector was relatively flat this period with a slight increase of 0.8%. Harmonic and SeaChange were both up sharply, gaining 25.3% and 50.9%, respectively. Conversely, Casa Systems shed more than 35% of its value while NetGem was down slightly more than 10%. The Cable and Video sub sector remains sharply down for the full year period with a loss of 35.6%. Once again Casa Systems was the biggest drag on the index as it dropped 76.3% over the past year. The sub sector revenue multiple closed out the period at 1.9x, down from 2.1x a year ago. The sub sector EBITDA multiple

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moved in the opposite direction, increasing from 13.8x to 33.9x over the past 12 months.

Broadband Wireless

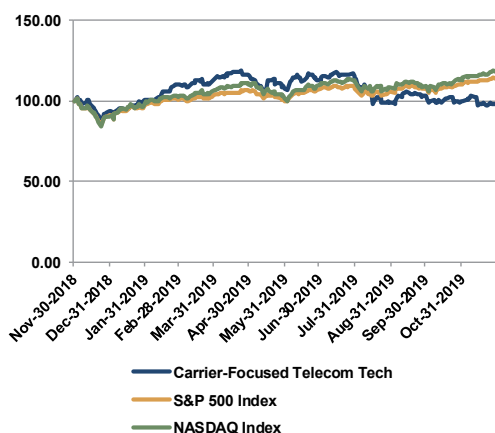
After a couple of lackluster reporting periods, the Broadband Wireless sub sector roared back with a three month gain of 72.7%. This gain was entirely due to a 78.4% increase at Ubiquiti Networks. In fact, every other company in the index had a negative return over the past three months. The situation is equally strong for the full year, with an 81.0% year-over-year gain at Ubiquiti Networks driving the sub sector to a 12 month increase of just over 70%. Sub sector multiples also jumped up sharply compared to this time last year and ended the period at 6.8x revenue and 28.7x EBITDA. These compare to year-ago multiples of 4.8x revenue and 20.6x EBITDA.

Test and Measurement

With a three-month gain of 8.7%, the Test and Measurement sub sector had a solid performance for the second straight reporting period. In fact, the gain was good enough to make it the second best performing sub sector in the CFTTI this period. All of the stocks in the index delivered positive returns, with EXFO and Spirent leading the way with gains of more than 20%. The picture also looks rosy for the full year, with the sub sector's 38.3% gain making it the second best performing CFTTI sub sector over this time period as well. Sub sector multiples closed out the period at 2.6x revenue (up from 2.2x a year ago) and 15.6x EBITDA (down from 16.9x a year ago).

Carrier-Focused Telecom Technology: Public Market Summary

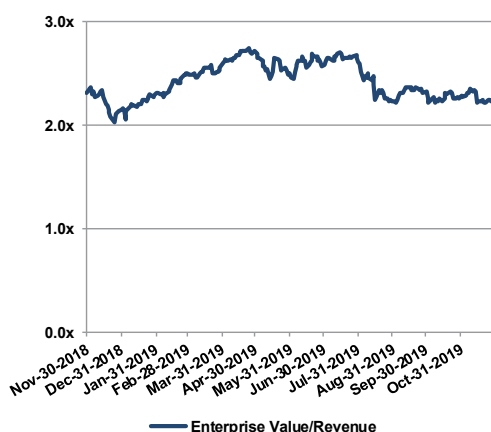
Twelve Month Index Returns



Sector and Sub Sector Returns

	12 Month	3 Month
Carrier-Focused Telecom Tech	-1.8%	-0.3%
Large Cap	-5.3%	-3.0%
OSS/BSS	8.1%	5.4%
IP Networking	16.3%	-1.5%
Wireline Access and Transport	12.3%	-0.4%
Cable and Video	-35.6%	0.8%
Broadband Wireless	72.1%	72.7%
Test and Measurement	38.3%	8.7%
S&P 500	13.8%	7.3%
NASDAQ	18.2%	8.8%

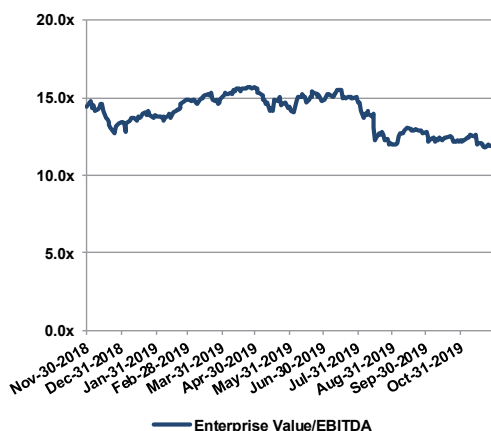
Revenue Multiple Trends



Sector and Sub Sector Revenue Multiples

	11/30/2019	11/30/2018
Carrier-Focused Telecom Tech	2.2x	2.3x
Large Cap	2.2x	2.4x
OSS/BSS	2.1x	2.1x
IP Networking	1.5x	1.2x
Wireline Access and Transport	1.4x	1.3x
Cable and Video	1.9x	2.1x
Broadband Wireless	6.8x	4.8x
Test and Measurement	2.6x	2.2x

EBITDA Multiple Trends



Sector and Sub Sector EBITDA Multiples

	11/30/2019	11/30/2018
Carrier-Focused Telecom Tech	11.9x	14.4x
Large Cap	11.2x	14.1x
OSS/BSS	13.4x	13.9x
IP Networking	37.1x	NM
Wireline Access and Transport	23.0x	25.6x
Cable and Video	33.9x	13.8x
Broadband Wireless	28.7x	20.6x
Test and Measurement	15.6x	16.9x

Source: Capital IQ

M&A Summary Comments

M&A

The level of M&A activity in the Carrier Focused Telecom Technology sector remained relatively light with ten transactions for the current three-month period. Announced transaction dollar volume picked up slightly with just more than \$500 million for the period, but this is still relatively low compared to historical standards. With just one month remaining in 2019 we count 40 total transactions for the sector year-to-date with a total announced transaction dollar volume of less than \$1 billion. This means that 2019 is almost certainly going to be the lowest in the last five in terms of both of these measures of deal activity.

OSS/BSS Software

As is typical, the OSS/BSS software sub sector was the most active with six transactions for the period. Two of these transactions involved telecom software consolidators as Constellation Software's Volaris unit acquired mquadr.net and ZephyrTel acquired Accuris. CIENA was also an active acquirer with its pickup of service assurance company Centina. We also saw Mind CTI make a relatively rare acquisition with its purchase of mobile messaging services provider GTX, while Comlinkdata acquired customer analytics company Tutela. Finally, it was interesting to note that Ericsson was a seller of OSS/BSS assets this period with the divestiture of its IoT charging, pricing and billing unit to Kansys.

IP Networking

There were no transactions in the IP Networking sub sector this period.

Wireline Access and Transport

The Wireline Access and Transport sub sector had a relatively active three-month period with three total transactions. This included the acquisition of optical transport vendor ECI by Ribbon Communications, which at more than \$450 million was far and away the period's largest transaction. The sub sector also had the period's second largest transaction as Huber+Suhner acquired FTTH and cable hardware company Bktel. Finally, in the sub sector's final transaction for the period, China Poly Group acquired China Huaxin Post and Telecom Technologies.

Cable and Video

There were no transactions in the Cable and Video sub sector this period.

Broadband Wireless

The lone transaction in the Broadband Wireless sub sector in this past three months was the acquisition of millimeter wave hardware vendor EMClarity by McKay Brothers.

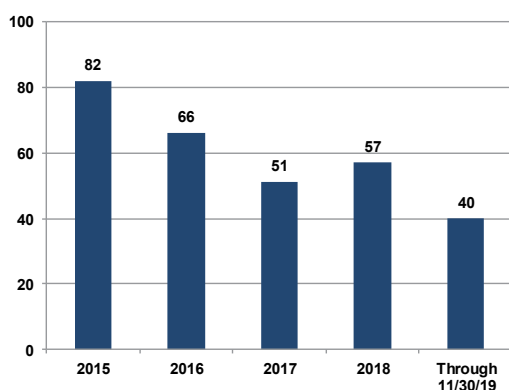
Test and Measurement

There were no transactions in the Test and Measurement sub sector this period.

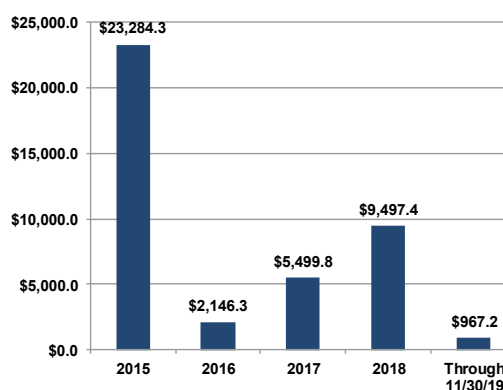
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Carrier-Focused Telecom Technology: M&A Summary

M&A Activity: Number of Transactions



M&A Activity (\$ Value of Transactions in Millions)



Transactions with Multiples

Both of the transactions with announced multiples this period were in the Wireline Access and Transport sub sector. First, the acquisition of ECI by Ribbon Communications was done at multiples of 1.2x revenue and 19.8x

EBITDA. The Huber+Suhner acquisition of Bktel was done at a similar revenue multiple of 1.1x. The EBITDA multiple for this transaction was not announced.

M&A Announced Transactions (9/1/19 – 11/30/19)

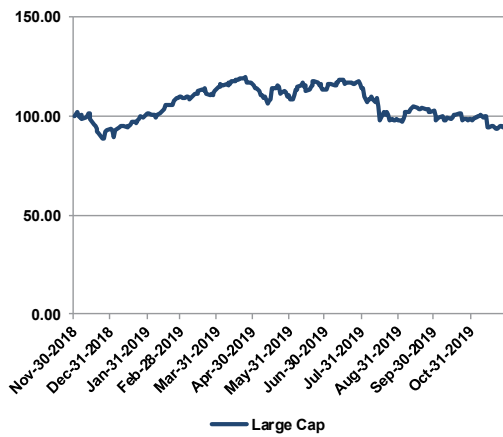
Acquiror	Target	Sector	Date Announced	Purchase Price	Description
Ribbon Communications	ECI Telecom	Wireline Access and Transport	11/14/19	\$455.6	Networking and data transport products for service providers, utilities, governments and defense and security customers.
ZephyrTel	Accuris	OSS/BSS Software	10/28/19	NA	Provides network functions virtualization and cloud-based Wi-Fi roaming hub SaaS to wireless and data center operators.
Kansys	Ericsson (Enterprise Billing Assets)	OSS/BSS Software	10/22/19	NA	Charging, pricing, billing, settlement and customer care that enables businesses to monetize products and IoT services.
McKay Brothers	EMClarity	Broadband Wireless	10/7/19	NA	Develops and manufactures millimeter wave radio links for global telco, enterprise and defense applications.
CIENA	Centina	OSS/BSS Software	10/3/19	NA	Service assurance and network performance management software to resolve network issues quickly and optimize network performance.
China Poly Group	China Huaxin Post and Telecom Technologies	Wireline Access and Transport	10/1/19	NA	Solutions include mobile core network, broadband and wireless access, optical access and transmission and IP network.
Huber+Suhner	Bktel	Wireline Access and Transport	10/1/19	\$50.2	Active and passive components for fiber-to-the-home and hybrid fiber coax broadband networks.
Constellation Software	mquadr.at	OSS/BSS Software	10/1/19	NA	Network management software to control internet service and IoT devices via modems, home networks and smartphones.
MIND CTI	GTX	OSS/BSS Software	9/26/19	\$0.3	SMS-focused mobile messaging services via SMS, Rich Communication Services and instant messaging applications.
Comlinkdata	Tutela	OSS/BSS Software	9/5/19	NA	Customer analytics SaaS for mobile telecom providers that enables real-time insights for improved network capacity and planning.

M&A Announced Transactions with Revenue Multiples (12/1/18 – 11/30/19)

Acquiror	Target	Sector	Date Announced	Purchase Price	Revenue Multiple	EBITDA Multiple	Description
Ribbon Communications	ECI Telecom	Wireline Access and Transport	11/14/19	\$455.6	1.2 x	19.8 x	Networking and data transport products for service providers, utilities, governments and defense and security customers.
Huber+Suhner	Bktel	Wireline Access and Transport	10/1/19	\$50.2	1.1 x	NA	Active and passive components for fiber-to-the-home and hybrid fiber coax broadband networks.
IMI Mobile	3Cinteractive	OSS/BSS Software	7/24/19	\$53.2	2.2 x	NA	Mobile application deployment SaaS for businesses and wireless telecom service providers.
Astronics	Freedom Communication Technologies	Test and Measurement	7/1/19	\$22.0	2.0 x	NA	Communication test equipment for land-based mobile radio and long-term evolution high-speed wireless communications networks.
Hansen Technologies	Sigma Systems	OSS/BSS Software	5/1/19	\$118.0	2.1 x	8.4 x	Software for cable and telecom service providers for service fulfillment and management, device provisioning and service mediation.
Enghouse Systems	Espial Group	Cable and Video	3/25/19	\$17.2	0.9 x	NM	Provides IPTV and set-top box middleware, video-on-demand management and delivery software and TV Web browser software.
SeaChange International	Xstream	Cable and Video	2/11/19	\$5.5	0.9 x	NA	Provides over-the-top content and authenticated streaming online video management and distribution SaaS.
Boku	Danal	OSS/BSS Software	12/6/18	\$61.3	12.0 x	NM	Mobile identity and access management, authentication, carrier billing and payments apps for mobile telecom service providers.
Inside Secure	Verimatrix	Cable and Video	12/5/18	\$158.0	2.0 x	10.9 x	Provides IPTV content encryption and digital rights management SaaS for cable and IPTV service providers.

Sub Sector Analysis: Large Cap

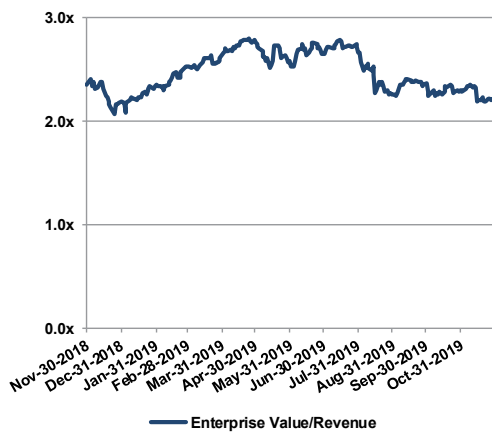
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
Large Cap Index	-5.3%	-3.0%
Cisco	-5.3%	-3.2%
Ericsson	7.7%	15.3%
Juniper	-12.7%	8.2%
Nokia	-35.6%	-28.5%
ZTE	52.9%	8.5%

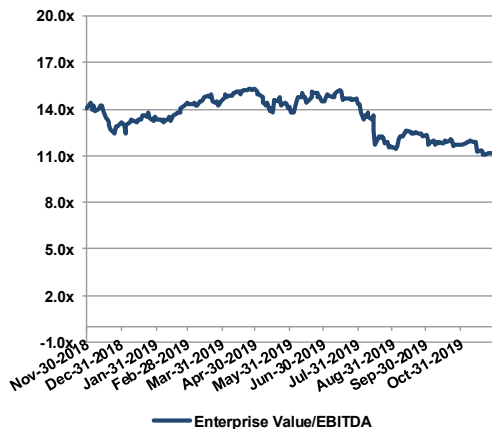
Revenue Multiple Trends



Company Revenue Multiples

	11/30/2019	11/30/2018
Large Cap Index	2.2x	2.4x
Cisco	3.5x	3.9x
Ericsson	1.3x	1.2x
Juniper	1.8x	1.8x
Nokia	0.8x	1.1x
ZTE	1.5x	1.0x

EBITDA Multiple Trends



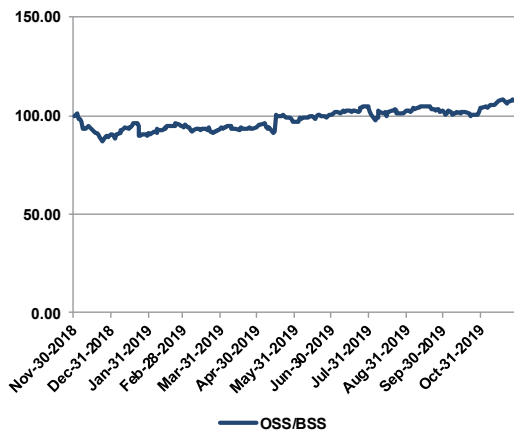
Company EBITDA Multiples

	11/30/2019	11/30/2018
Large Cap Index	11.2x	14.1x
Cisco	11.3x	13.1x
Ericsson	10.8x	48.0x
Juniper	11.3x	10.3x
Nokia	7.1x	10.3x
ZTE	23.2x	29.1x

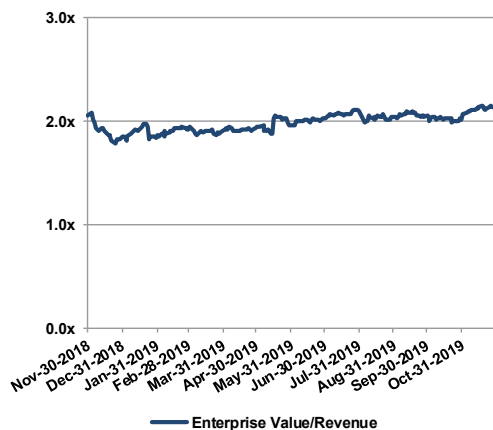
Source: Capital IQ

Sub Sector Analysis: OSS/BSS Software

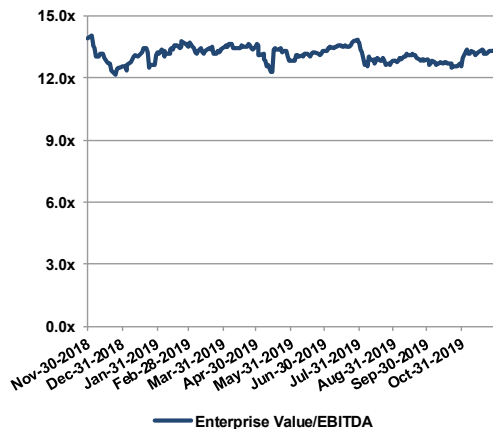
Twelve Month Index Returns



Revenue Multiple Trends



EBITDA Multiple Trends



Source: Capital IQ

Company Returns

	12 Month	3 Month
OSS/BSS Index	8.1%	5.4%
Amdocs	6.8%	7.0%
CSG Systems	63.1%	6.1%
Evolving Systems	-39.7%	16.7%
NetScout	-5.9%	13.8%
Optiva	13.2%	21.6%
Pareteum	-76.6%	-79.6%
Radcom	15.9%	8.0%
Subex	-9.3%	8.2%
Synchronoss	-26.8%	-43.0%
Tecnotree	190.2%	113.4%

Company Revenue Multiples

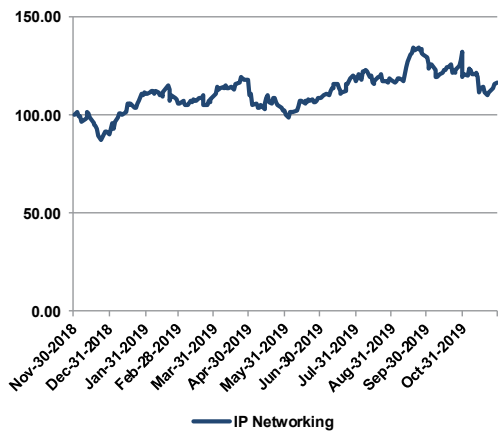
	11/30/2019	11/30/2018
OSS/BSS Index	2.1x	2.1x
Amdocs	2.2x	2.2x
CSG Systems	2.1x	1.6x
Evolving Systems	0.4x	0.5x
NetScout Systems	2.4x	2.4x
Optiva	2.4x	1.5x
Pareteum	1.0x	7.4x
Radcom	2.8x	1.3x
Subex	0.8x	0.9x
Synchronoss	1.5x	1.3x
Tecnotree	1.2x	0.5x

Company EBITDA Multiples

	11/30/2019	11/30/2018
OSS/BSS Index	13.4x	13.9x
Amdocs	11.6x	12.0x
CSG Systems	12.6x	9.8x
Evolving Systems	291.2x	4.6x
NetScout Systems	16.0x	16.3x
Optiva	16.0x	NM
Pareteum	30.2x	NM
Radcom	NM	12.8x
Subex	3.9x	6.6x
Synchronoss	NM	NM
Tecnotree	3.4x	2.8x

Sub Sector Analysis: IP Networking

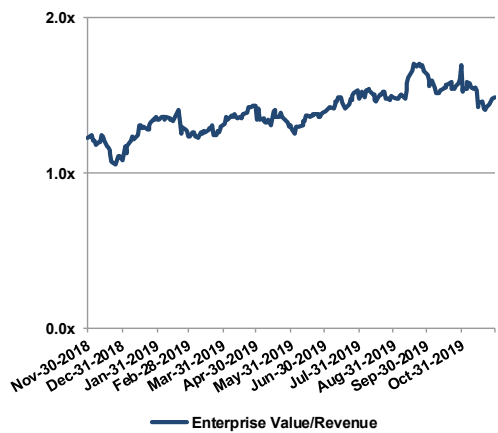
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
IP Networking Index	16.3%	-1.5%
Allot Communications	24.8%	13.3%
Audiocodes	122.4%	37.4%
Ribbon Communications	-45.1%	-43.3%

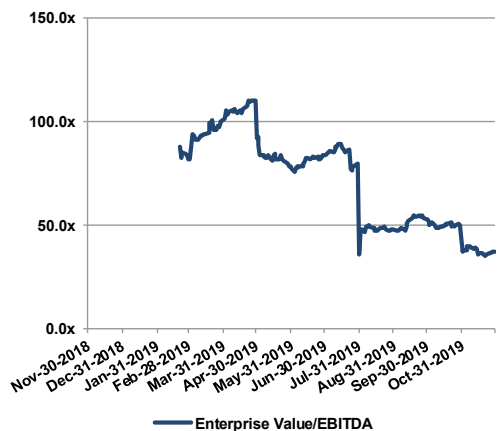
Revenue Multiple Trends



Company Revenue Multiples

	11/30/2019	11/30/2018
IP Networking Index	1.5x	1.2x
Allot Communications	2.0x	1.4x
Audiocodes	3.4x	1.5x
Ribbon Communications	0.7x	1.1x

EBITDA Multiple Trends



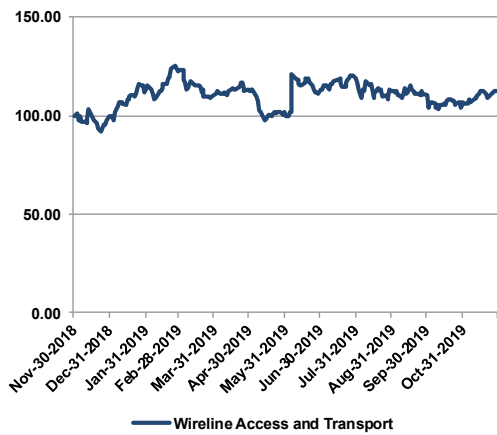
Company EBITDA Multiples

	11/30/2019	11/30/2018
IP Networking Index	37.1x	NM
Allot Communications	NM	NM
Audiocodes	27.9x	15.9x
Ribbon Communications	22.7x	NM

Source: Capital IQ

Sub Sector Analysis: Wireline Access and Transport

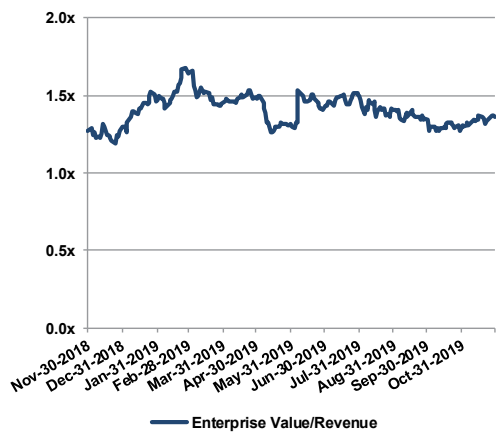
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
Wireline Access & Transport Index	12.3%	-0.4%
ADTRAN	-26.2%	-10.5%
ADVA	6.3%	39.9%
BATM	-11.3%	-4.0%
Calix	-19.7%	29.0%
CIENA	16.4%	-7.3%
Communications Systems	238.7%	72.0%
Dasan Zhone Solutions	-38.7%	-25.3%
Infinera	48.0%	19.7%
Net Insight	-13.6%	65.2%

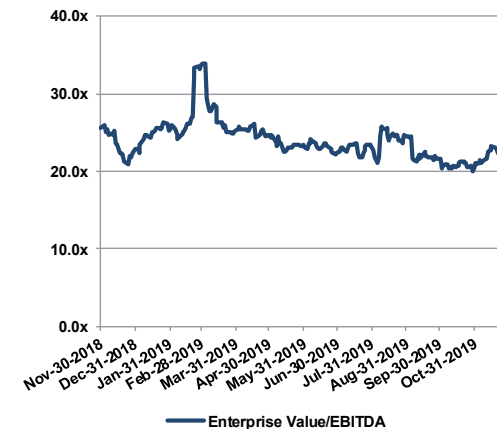
Revenue Multiple Trends



Company Revenue Multiples

	11/30/2019	11/30/2018
Wireline Access & Transport Index	1.4x	1.3x
ADTRAN	0.6x	1.0x
ADVA	0.9x	0.8x
BATM	2.0x	2.0x
Calix	1.0x	1.1x
CIENA	1.6x	1.5x
Communications Systems	0.8x	0.1x
DASAN Zhone Solutions	0.6x	0.9x
Infinera	1.2x	0.7x
Net Insight	2.2x	2.1x

EBITDA Multiple Trends



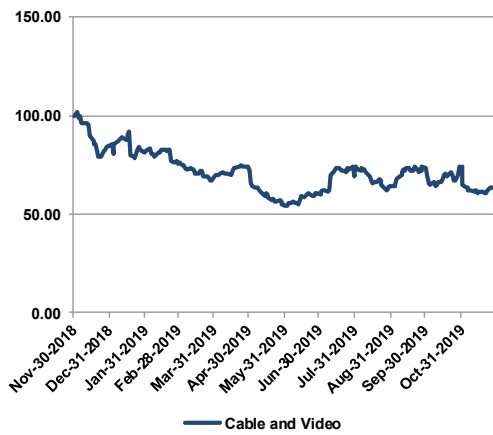
Company EBITDA Multiples

	11/30/2019	11/30/2018
Wireline Access & Transport Index	23.0x	25.6x
ADTRAN	NM	NM
ADVA	11.9x	11.2x
BATM	41.9x	100.7x
Calix	NM	NM
CIENA	11.5x	12.6x
Communications Systems	16.1x	NM
DASAN Zhone Solutions	38.4x	20.7x
Infinera	NM	NM
Net Insight	NM	NM

Source: Capital IQ

Sub Sector Analysis: Cable and Video

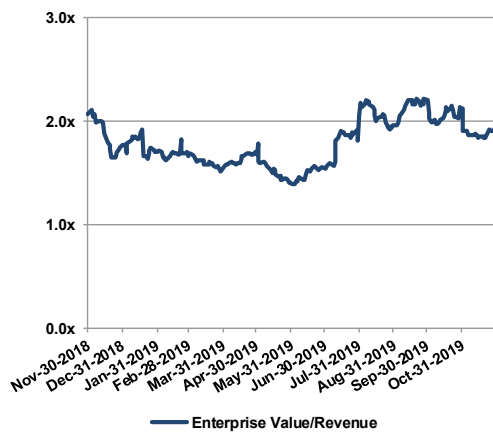
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
Cable and Video Index	-35.6%	0.8%
Amino	-8.9%	-4.2%
Casa Systems	-76.3%	-36.1%
Harmonic	47.0%	25.3%
NetGem	-18.0%	-10.1%
SeaChange	108.3%	50.9%

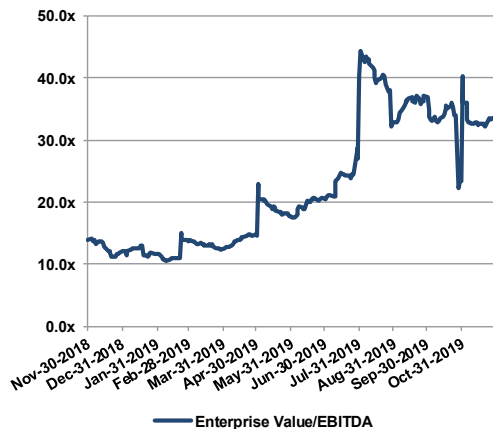
Revenue Multiple Trends



Company Revenue Multiples

	11/30/2019	11/30/2018
Cable and Video Index	1.9x	2.1x
Amino	1.0x	1.1x
Casa Systems	2.0x	3.7x
Harmonic	2.2x	1.4x
NetGem	0.6x	0.5x
SeaChange	1.9x	0.5x

EBITDA Multiple Trends



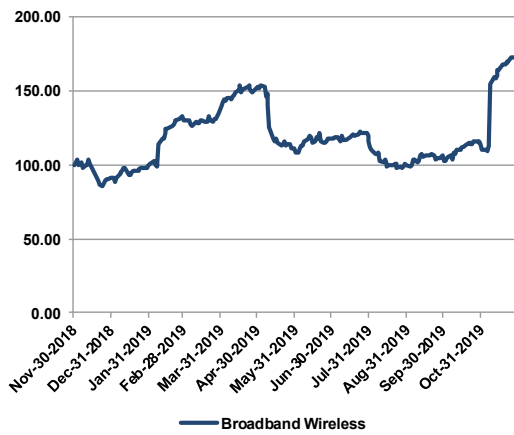
Company EBITDA Multiples

	11/30/2019	11/30/2018
Cable and Video Index	33.9x	13.8x
Amino	9.0x	11.1x
Casa Systems	35.8x	10.1x
Harmonic	24.2x	44.1x
NetGem	14.7x	5.1x
SeaChange	NM	NM

Source: Capital IQ

Sub Sector Analysis: Broadband Wireless

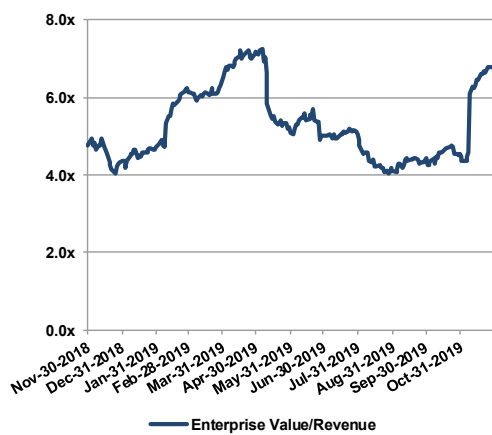
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
Broadband Wireless Index	72.1%	72.7%
Aviat Networks	-4.7%	-1.2%
Cambium Networks	NA	-19.4%
Ceragon Networks	-53.9%	-12.5%
Redline Communications	-16.4%	-13.1%
Ubiquiti Networks	81.0%	78.4%

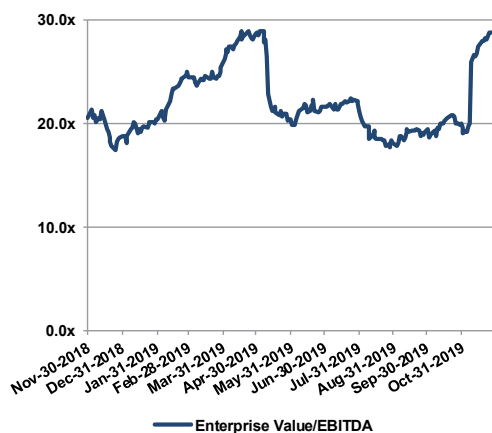
Revenue Multiple Trends



Company Revenue Multiples

	11/30/2019	11/30/2018
Broadband Wireless Index	6.8x	4.8x
Aviat Networks	0.2x	0.2x
Cambium Networks	0.9x	NA
Ceragon Networks	0.5x	0.8x
Redline Communications	0.4x	0.4x
Ubiquiti Networks	11.1x	7.2x

EBITDA Multiple Trends



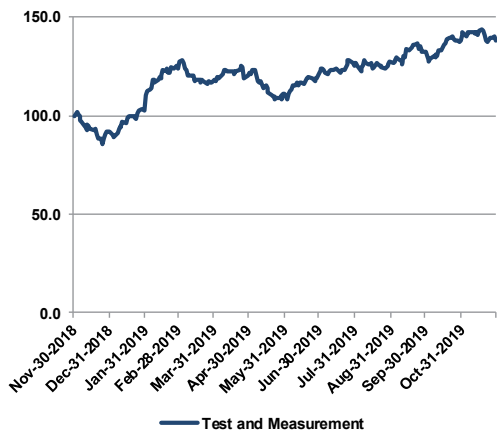
Company EBITDA Multiples

	11/30/2019	11/30/2018
Broadband Wireless Index	28.7x	20.6x
Aviat Networks	5.9x	7.2x
Cambium Networks	31.8x	NA
Ceragon Networks	6.2x	8.7x
Redline Communications	NM	29.7x
Ubiquiti Networks	30.2x	22.0x

Source: Capital IQ

Sub Sector Analysis: Test and Measurement

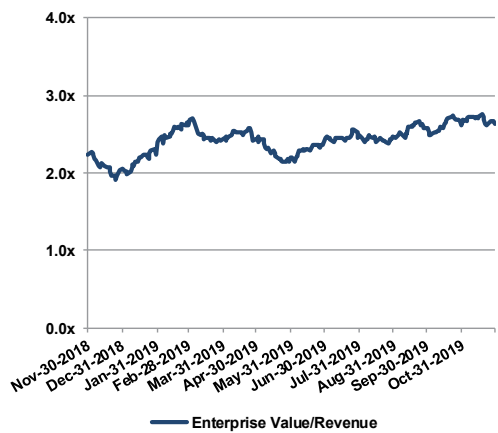
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
Test and Measurement Index	38.3%	8.7%
Anritsu	15.9%	1.5%
EXFO	42.5%	22.8%
Spirent	65.0%	21.3%
Viavi	48.1%	8.1%

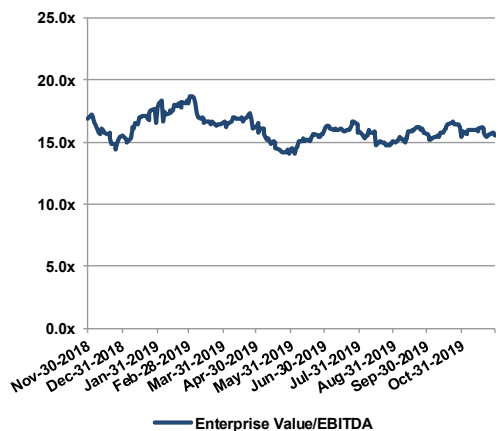
Revenue Multiple Trends



Company Revenue Multiples

	11/30/2019	11/30/2018
Test and Measurement Index	2.6x	2.2x
Anritsu	2.4x	2.6x
EXFO	0.8x	0.6x
Spirent	3.2x	2.0x
Viavi	3.1x	2.5x

EBITDA Multiple Trends



Company EBITDA Multiples

	11/30/2019	11/30/2018
Test and Measurement Index	15.6x	16.9x
Anritsu	13.3x	18.3x
EXFO	11.5x	17.7x
Spirent	17.4x	11.3x
Viavi	17.1x	19.2x

Source: Capital IQ

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