

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

Our Spring 2020 report marks a full year of reports where the Carrier-Focused Telecom Technology Index (CFTTI) delivered a negative return for the three-month period. In this case the sector was down 6.9% over the past three months. The broader indices are also down over this time frame, although not as steeply. The S&P 500 lost 6.0% over this same period, while the NASDAQ only dropped 1.1%. The situation for the full year is even more discouraging as the CFTTI is down 17.0% year-over-year while the S&P 500 and NASDAQ are up 6.1% and 13.7%, respectively. Sector multiples have also dropped significantly compared to this same time last year. The sector revenue multiple dropped from 2.5x to 2.1x, while the sector EBITDA multiple fell from 14.9x to 10.6x.

Large Cap

The Large Cap sub sector dropped 5.7% this period. Cisco, Ericsson and Juniper all suffered double digit losses. On the plus side, Nokia turned in a modest gain while ZTE was actually up significantly with a three-month gain of more than 60%. The Large Cap sub sector is also in negative territory for the full year with a loss of 18.9%. All of the companies in the index are trading lower than they were a year ago with the exception of ZTE, which rode this period's gains to a 60.6% year-over-year increase. Sub sector multiples closed out the period at 2.1x revenue and 10.1x EBITDA. Both of these are significantly lower than year-ago multiples of 2.5x revenue and 14.4x EBITDA.

OSS/BSS Software

The OSS/BSS software sub sector returned to the red this period as it dropped 8.3% in the past three months. On the plus side, half of the ten companies in the index actually turned in a positive return, including large gains at Tecnotree and Pareteum. However, these gains were not enough to counterbalance losses at some of the larger market cap names in the sub sector like Amdocs (down 8.0%), CSG Systems (down 22.6%) and Optiva (down 24.4%). The sub sector still remains easily in positive territory for the full year period with a 12-month gain of 12.2%. Sub sector multiple performance over the past year was mixed. The revenue multiple ticked up slightly from 1.9x a yearago to 2.0x currently, while the EBITDA multiple declined from 13.5x to 11.4x over the corresponding time period.

IP Networking

The IP Networking sub sector was the top performing sub sector in the CFTTI this period with a three-month gain of 4.6%. This was the result of strong gains at both Allot Communications and Ribbon Communications, counterbalanced somewhat by declines at Audiocodes. The sub sector is also up 15.0% year-over-year, which is good enough to make it the CFTTI's best performing sub sector over this time frame as well. Allot Communications and Audicodes were the companies that had strong 12-month gains of 47.0% and 69.0%, respectively, while Ribbon Communications was in negative territory. The sub sector revenue multiple increased meaningfully compared to last year, jumping from 1.2x to 1.5x. The EBITDA multiple dropped considerably from 81.5x a year ago to 15.4x currently, largely due to the fact that the EBITDA multiple for Ribbon Communications went from "Not Meaningful" to 15.0x over this time frame.

Wireline Access and Transport

Other than IP Networking, the Wireline Access and Transport sub sector was the only other sub sector in the CFTTI that delivered a positive return this reporting period. The sub sector was up 0.2%, largely driven by access vendor Calix and transport vendors CIENA and Infinera. Year-over-year performance is still poor with an 8.4% drop over the past 12 months with companies like ADTRAN, ADVA and CIENA sporting significant losses. Multiples ended the period at 1.3x revenue (down from 1.6x a year ago) and 17.3x EBITDA (down from 34.3x a year ago).

Cable and Video

The Cable and Video sub sector was among the harder hit sub sectors this past three months as the index plummeted nearly 15% this period. Harmonic shed roughly a quarter of its value, and Casa Systems also suffered a double-digit decline. The sub sector is also the CFTTI's worst performing sub sector for the full year period with a 12-month decline of 27.1%. Despite the steep decline in the index, multiples for the sub sector fared relatively well. The sub sector revenue multiple dipped slightly from 1.7x a year ago to 1.6x at the end of the current period, while the EBITDA multiple actually increased sharply from 13.8x to 29.2x. These dynamics point to a significant deterioration in EBITDA margins as the primary reason for the subsector's woes.

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Broadband Wireless

The Broadband Wireless sub sector continued its roller coaster ride from our last several reports with a steep drop in the index this period. The sub sector was down 30.6%, most of which was due to a 31.2% loss at sub sector bellwether Ubiquiti Networks. Performance looks somewhat better over the full year period, but is still in negative territory with a year-over-year loss of 8.4%. The sub sector revenue multiple fell from 6.1x to 4.8x over the course of the past year, while the sub sector EBITDA multiple dropped from 24.5x to 20.1x over the corresponding time period.

Test and Measurement

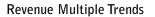
Giving up the gains from our Winter report, the Test and Measurement sub sector dropped 10.8% this spring. All of the four stocks in the index were in negative territory for the period, and three of the four suffered double-digit declines. The poor performance this period dragged the sub sector into negative territory for the full year with a loss of 0.5%. Sub sector multiples ended the period at 2.3x revenue and 13.1x EBITDA. Both of these multiples are lower than year-ago multiples of 2.6x revenue and 18.2x EBITDA.

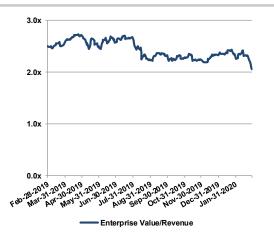


Carrier-Focused Telecom Technology: Public Market Summary

150.00 100.00 50.00 APT - 101-2019 - 2019 AU9312019 octal 2019 Dec31-219 0.00 Waral 2019 JUNIARDAS Sepad Ala 680-B-2019 1811312020 Jul-31-2019 Nov.302019 Carrier-Focused Telecom Tech S&P 500 Index NASDAQ Index

Twelve Month Index Returns





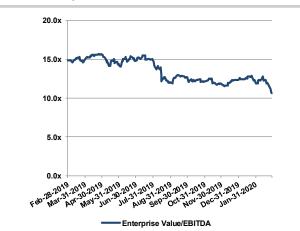
Sector and Sub Sector Returns

	12 Month	3 Month
Carrier-Focused Telecom Tech	-17.0%	-6.9%
Large Cap	-18.9%	-5.7%
OSS/BSS	12.2%	-8.3%
IP Networking	15.0%	4.6%
Wireline Access and Transport	-8.4%	0.2%
Cable and Video	-27.1%	-14.8%
Broadband Wireless	-8.4%	-30.6%
Test and Measurement	-0.5%	-10.8%
S&P 500	6.1%	-6.0%
NASDAQ	13.7%	-1.1%

Sector and Sub Sector Revenue Multiples

	2/29/2020	2/28/2019
Carrier-Focused Telecom Tech	2.1x	2.5x
Large Cap	2.1x	2.5x
OSS/BSS	2.0x	1.9x
IP Networking	1.5x	1.2x
Wireline Access and Transport	1.3x	1.6x
Cable and Video	1.6x	1.7x
Broadband Wireless	4.8x	6.1x
Test and Measurement	2.3x	2.6x

EBITDA Multiple Trends



Sector and Sub Sector EBITDA Multiples

	2/29/2020	2/28/2019
Carrier-Focused Telecom Tech	10.6x	14.9x
Large Cap	10.1x	14.4x
OSS/BSS	11.4x	13.5x
IP Networking	15.4x	81.5x
Wireline Access and Transport	17.3x	34.3x
Cable and Video	29.2x	13.8x
Broadband Wireless	20.1x	24.5x
Test and Measurement	13.1x	18.2x

M&A Summary Comments

M&A

Over the past three months we counted nine deals in the Carrier-Focused Telecom Technology sector with a total announced transaction dollar volume of \$71.3 million. We also closed the books on calendar year 2019, which unfortunately had the lowest level of M&A activity in the sector in recent memory. The sector had only 40 transactions for the entire year, down significantly from the 55-60 transactions we see in a typical year. Dollar volume was also extremely light, with slightly less than \$1 billion in total announced transaction dollar value for the year. 2020 is off to a better start with nine transactions through the first two months of the year for a total announced transaction dollar volume of \$71.3 million.

OSS/BSS Software

The OSS/BSS software sub sector was relatively active this period with a total of six transactions. This included the period's largest transaction, the Digital Turbine Media acquisition of Mobile Posse for \$66.0 million. Constellation Software was once again an active acquirer this period as it picked up billing vendor Lifecycle Software. Komodo Systems inked its initial acquisition with the purchase of network management and analytics company Conxx, while Adaptiv Networks acquired quality of service company LiveQoS. Finally, we noted a blockchain-related acquisition this period as IQSTEL acquired itsBchain.

IP Networking

In the IP Networking sub sector, Enghouse Systems acquired media processing and network infrastructure management company Dialogic. This is the second acquisition that Enghouse Systems has made of a company with a meaningful hardware component to its revenue stream, indicating a willingness to branch out beyond its traditional software focus.

Wireline Access and Transport

Technetix acquired the broadband business of ECAD. This business is a manufacturer of broadband equipment and is based in Germany.

Cable and Video

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

Broadband Wireless

For the second straight reporting period there was only a single transaction in the Broadband Wireless sub sector. This was the acquisition of Virtual Network Communications by COMSovereign.

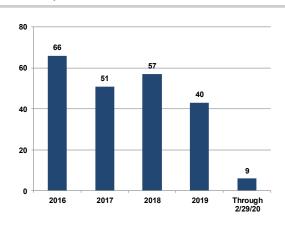
Test and Measurement

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

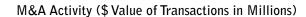
Transactions with Multiples

The first transaction with an announced multiple this reporting period was Digital Turbine Media's acquisition of Mobile Posse. This transaction was done at a multiple of 1.1x revenue and 5.2x EBITDA. In addition, Billing Services Group sold its wireless business to Single Digits for a multiple of 1.8x revenue and 10.9x EBITDA.

Carrier-Focused Telecom Technology: M&A Summary



M&A Activity: Number of Transactions





M&A Announced Transactions (12/1/19 – 2/29/20)

Acquiror	Target	Sector	Date Announced	Purchase Price	Description
COMSovereign	Virtual Network Communications	Broadband Wireless	2/27/20	NA	Fixed and mobile broadband communications solutions for wireless networks.
Technetix	ECAD (Broadband Business)	Wireline Access and Transport	2/26/20	NA	Manufacturer of broadband equipment.
IQSTEL	itsBchain	OSS/BSS Software	2/24/20	NA	Blockchain-based software for mobile number portability, carrier wholesale VoIP and SMS and data payment solutions.
Digital Turbine Media	Mobile Posse	OSS/BSS Software	2/10/20	\$66.0	Mobile content discovery solutions for wireless carriers that enable manufacturers to capitalize on the mobile advertising economy.
Komodo Systems	Conxx	OSS/BSS Software	2/6/20	NA	Network management and analytics platform that provides a multi-dimensional model of the network.
Single Digits	Billing Services Group (Wireless Business)	OSS/BSS Software	1/31/20	\$5.3	Roaming hub service that acts as a managed service for enabling interconnection between Wi-Fi networks.
Adaptiv Networks	LiveQoS	OSS/BSS Software	1/7/20	NA	Provides quality of service solutions for OEMs to optimize their overall network quality.
Constellation Software	Lifecycle Software	OSS/BSS Software	1/6/20	NA	Provider of billing, customer management and business intelligence software to mobile network operators, MVNOs and MVNEs.
Enghouse Systems	Dialogic	IP Networking	1/2/20	NA	Media processing and network infrastructure management SaaS and hardware for mobile operators and system integrators.

M&A Announced Transactions with Revenue Multiples (3/1/19 - 2/29/20)

Acquiror	Target	Sector	Date Announced	Purchase Price	Revenue Multiple	EBITDA Multiple	Description
Digital Turbine Media	Mobile Posse	OSS/BSS Software	2/10/20	\$66.0	1.1 x	5.2 x	Mobile content discovery solutions for wireless carriers that enable manufacturers to capitalize on the mobile advertising economy.
Single Digits	Billing Services Group (Wireless Business)	OSS/BSS Software	1/31/20	\$5.3	1.8 x	10.9 x	Roaming hub service that acts as a managed service for enabling interconnection between Wi-Fi networks.
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.
IMImobile	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.



Sub Sector Analysis: Large Cap

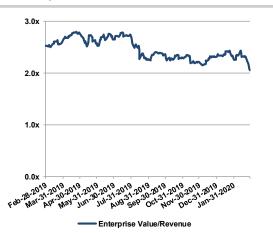
Twelve Month Index Returns

150.00 100.00 50.00

Company Returns

	12 Month	3 Month
Large Cap Index	-18.9%	-5.7%
Cisco	-22.9%	-11.9%
Ericsson	-11.4%	-11.1%
Juniper	-21.6%	-15.3%
Nokia	-37.4%	7.1%
ZTE	60.6%	63.8%

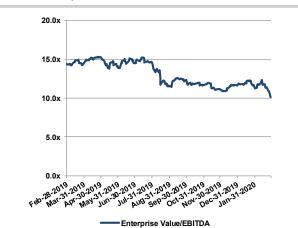
Revenue Multiple Trends



Company Revenue Multiples

	2/29/2020	2/28/2019
Large Cap Index	2.1x	2.5x
Cisco	3.1x	4.2x
Ericsson	1.1x	1.2x
Juniper	1.6x	1.7x
Nokia	0.8x	1.2x
ZTE	2.5x	1.5x

EBITDA Multiple Trends



Company EBITDA Multiples

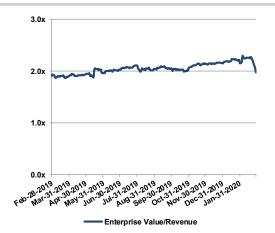
	2/29/2020	2/28/2019
Large Cap Index	10.1x	14.4x
Cisco	9.8x	13.9x
Ericsson	15.2x	17.7x
Juniper	9.7x	10.2x
Nokia	7.3x	9.9x
ZTE	40.0x	52.2x

Source: Capital IQ

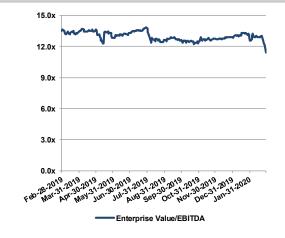
Sub Sector Analysis: OSS/BSS Software

Twelve Month Index Returns 150.00 100.00 50.00 AU9312019 JUN-32-2019 -2416413 1.219 APradalla Way 31.2019 Hou.302019 Janatapap F80-78-2019 0.00 Warst 2019 Jul-31-2019 Sepad Ang 0et-31.2919 OSS/BSS

Revenue Multiple Trends



EBITDA Multiple Trends



Source: Capital IQ

Company Returns

	12 Month	3 Month
OSS/BSS Index	12.2%	-8.3%
Amdocs	14.7%	-8.0%
CSG Systems	6.5%	-22.6%
Evolving Systems	-38.4%	-9.0%
NetScout	-6.1%	2.0%
Optiva	-13.4%	-24.4%
Pareteum	-86.1%	28.4%
Radcom	11.8%	-16.3%
Subex	7.8%	2.3%
Synchronoss	-38.9%	8.4%
Tecnotree	245.3%	38.6%

Company Revenue Multiples

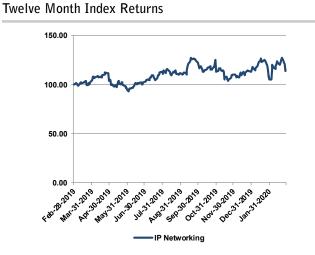
	2/29/2020	2/28/2019
OSS/BSS Index	2.0x	1.9x
Amdocs	2.0x	1.8x
CSG Systems	1.7x	1.7x
Evolving Systems	0.4x	0.5x
NetScout Systems	2.3x	2.5x
Optiva	1.9x	1.8x
Pareteum	1.2x	11.6x
Radcom	1.6x	1.2x
Subex	0.8x	0.7x
Synchronoss	1.5x	1.6x
Tecnotree	1.5x	0.6x

Company EBITDA Multiples

	2/29/2020	2/28/2019
OSS/BSS Index	11.4x	13.5x
Amdocs	10.7x	9.9x
CSG Systems	10.3x	10.9x
Evolving Systems	265.7x	5.3x
NetScout Systems	13.5x	22.1x
Optiva	12.5x	NM
Pareteum	36.4x	NM
Radcom	NM	NM
Subex	3.7x	6.6x
Synchronoss	NM	NM
Tecnotree	4.5x	3.8x

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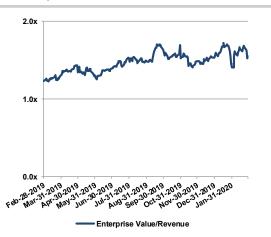
Sub Sector Analysis: IP Networking



Company Returns

	12 Month	3 Month
IP Networking Index	15.0%	4.6%
Allot Communications	47.0%	24.7%
Audiocodes	69.0%	-6.5%
Ribbon Communications	-37.3%	10.2%

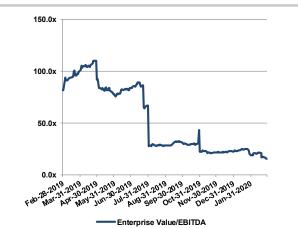
Revenue Multiple Trends



Company Revenue Multiples

	2/29/2020	2/28/2019
IP Networking Index	1.5x	1.2x
Allot Communications	2.7x	1.5x
Audiocodes	3.2x	1.8x
Ribbon Communications	0.7x	1.0x

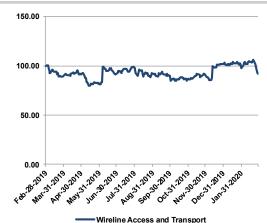
EBITDA Multiple Trends



Company EBITDA Multiples

	2/29/2020	2/28/2019
IP Networking Index	15.4x	81.5x
Allot Communications	NM	NM
Audiocodes	25.8x	17.3x
Ribbon Communications	15.0x	NM

Sub Sector Analysis: Wireline Access and Transport



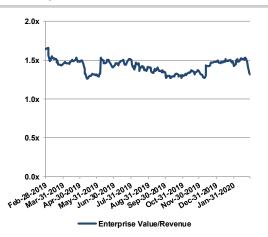
Twelve Month Index Returns

-8.4% 0.2% Wireline Access & Transport Index ADTRAN -46.4% -12.5% ADVA -31.5% -26.6% BATM -5.1% 9.2% Calix 9.8% 16.1% CIENA -9.9% 1.3% **Communications Systems** 121.8% -26.8% Dasan Zhone Solutions -44.8% -4.3% Infinera 6.6% 33.1% Net Insight -21.3% -32.4%

12 Month

3 Month

Revenue Multiple Trends

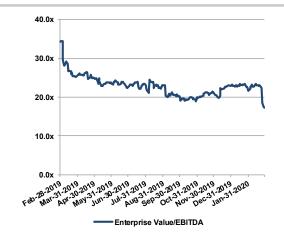


Company Revenue Multiples

Company Returns

	2/29/2020	2/28/2019
Wireline Access & Transport Index	1.3x	1.6x
ADTRAN	0.6x	1.2x
ADVA	0.6x	0.9x
BATM	2.1x	2.0x
Calix	1.2x	0.9x
CIENA	1.6x	2.0x
Communications Systems	0.5x	0.2x
DASAN Zhone Solutions	0.6x	0.9x
Infinera	1.2x	1.2x
Net Insight	1.5x	1.6x

EBITDA Multiple Trends



Source: Capital IQ

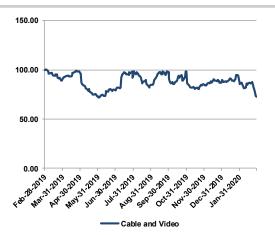
Company EBITDA Multiples

	2/29/2020	2/28/2019
Wireline Access & Transport Index	17.3x	34.3x
ADTRAN	NM	NM
ADVA	9.0x	12.4x
BATM	26.5x	104.2x
Calix	NM	NM
CIENA	10.6x	16.5x
Communications Systems	10.2x	NM
DASAN Zhone Solutions	38.2x	22.0x
Infinera	NM	NM
Net Insight	19.1x	NM



Sub Sector Analysis: Cable and Video

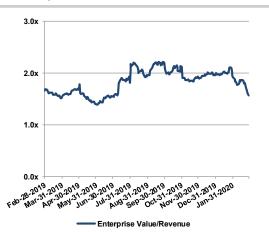
Twelve Month Index Returns



Company Returns

	12 Month	3 Month
Cable and Video Index	-27.1%	-14.8%
Amino	45.8%	18.2%
Casa Systems	-67.8%	-10.9%
Harmonic	11.2%	-25.7%
NetGem	-9.4%	22.5%
SeaChange	152.4%	4.6%

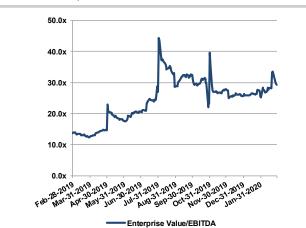
Revenue Multiple Trends



Company Revenue Multiples

	2/29/2020	2/28/2019
Cable and Video Index	1.6x	1.7x
Amino	1.6x	0.7x
Casa Systems	1.6x	2.9x
Harmonic	1.5x	1.4x
NetGem	0.8x	0.6x
SeaChange	2.0x	0.5x

EBITDA Multiple Trends

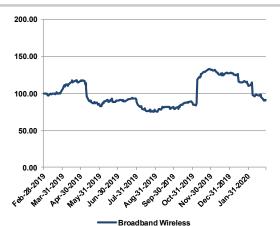


Company EBITDA Multiples

	2/29/2020	2/28/2019
Cable and Video Index	29.2x	13.8x
Amino	16.4x	6.7x
Casa Systems	62.3x	9.7x
Harmonic	16.7x	27.3x
NetGem	18.7x	8.1x
SeaChange	NM	NM

Source: Capital IQ

Sub Sector Analysis: Broadband Wireless

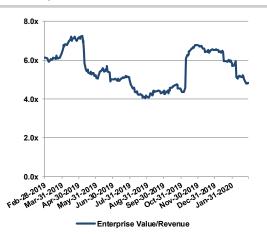


Twelve Month Index Returns

Company Returns

	12 Month	3 Month
Broadband Wireless Index	-8.4%	-30.6%
Aviat Networks	-12.4%	-13.8%
Cambium Networks	NA	-13.8%
Ceragon Networks	-55.8%	-13.8%
Redline Communications	-20.4%	5.6%
Ubiquiti Networks	-6.0%	-31.2%

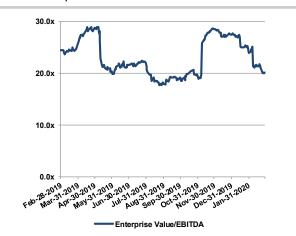
Revenue Multiple Trends



Company Revenue Multiples

	2/29/2020	2/28/2019
Broadband Wireless Index	4.8x	6.1x
Aviat Networks	0.2x	0.2x
Cambium Networks	0.8x	NA
Ceragon Networks	0.4x	0.8x
Redline Communications	0.4x	0.5x
Ubiquiti Networks	7.8x	9.2x

EBITDA Multiple Trends

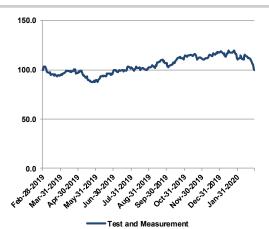


Company EBITDA Multiples

	2/29/2020	2/28/2019
Broadband Wireless Index	20.1x	24.5x
Aviat Networks	7.3x	6.1x
Cambium Networks	29.9x	NA
Ceragon Networks	6.2x	7.9x
Redline Communications	NM	NM
Ubiquiti Networks	21.1x	26.3x



Sub Sector Analysis: Test and Measurement

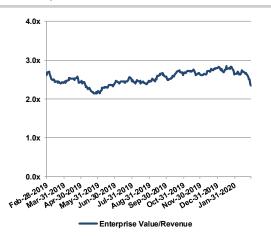


Twelve Month Index Returns

Company Returns

	12 Month	3 Month
Test and Measurement Index	-0.5%	-10.8%
Anritsu	-17.2%	-13.8%
EXF0	-3.7%	-20.9%
Spirent	34.6%	-1.7%
Viavi	0.5%	-12.2%

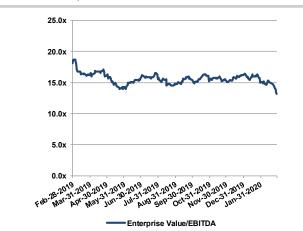
Revenue Multiple Trends



Company Revenue Multiples

	2/29/2020	2/28/2019
Test and Measurement Index	2.3x	2.6x
Anritsu	2.0x	2.9x
EXF0	0.7x	0.7x
Spirent	3.0x	2.3x
Viavi	2.7x	2.9x

EBITDA Multiple Trends



Company EBITDA Multiples

	2/29/2020	2/28/2019
Test and Measurement Index	13.1x	18.2x
Anritsu	11.0x	18.6x
EXF0	8.1x	14.9x
Spirent	14.4x	12.3x
Viavi	14.8x	19.3x

FOCUS Telecom Technology and Services Team



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