

OPTIMIZING THE SELECTION OF YOUR OPTICAL SPECTRUM ANALYZER

Francis Audet, Senior Product Manager

Several transmission schemes are being used throughout the industry today. From CWDM networks, with typically 20 nm spacing between channels, to DWDM applications (50 to 100 GHz spacing; 100 GHz translates to 0.78 nm) and ultra-DWDM systems that go as low as 12.5 GHz (0.099 nm) spacing, the requirements are far from uniform. With all these variations in current schemes and even more speculation over tomorrow's structures, how can you determine what type of OSA will best serve your needs?

As a rule of thumb, we suggest you choose an optical spectrum analyzer (OSA) that will capture the essence of your signal by providing relatively undistorted information. An OSA that is too powerful for your purposes may simply be overkill and, in today's market, easing budgetary pressures is just as important as obtaining meaningful results.

Let's say, for example, that you are in the market for a means of transportation. If you often travel long distances and have a family, a high-end SUV may be your solution, but if your budget is limited and you will only be using the vehicle for your daily commute to work, then perhaps a low-end compact may be more than enough. The compact is less powerful and offers less features, but your main need will still be met.

So if you only need the compact, what would incite you to purchase the luxury SUV? Either you simply have an unlimited budget, or you know that your situation will change in the near future. In this case, getting the SUV right away will allow you to fulfill both your current and future needs. However, if your budget will not allow the luxury model and you still would like to avoid purchasing a compact first and upgrading later, then the best solution may be to purchase a mid-range model that could adapt to your evolving needs, thus saving on the overall investment.

Choosing an OSA is very similar. The decision is based on your current and future requirements, as well as your workable budget. Some vendors offer modular units in platforms that can welcome several different OSA modules, from low- to high-end options. These units allow you to invest as your need grows, making the modular approach the equivalent of the affordable mid-range model that adapts to your evolving requirements.



EXFO's modular OSA

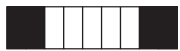


Determining Your Needs

In order to make an informed decision, it is essential to understand the overall workings of the OSA and make a few comparisons of results obtained in different situations.

What is an OSA?

Simply stated, an OSA is basically a wavelength-dependent power meter. A filter, or slit, lets through a certain amount of light onto a detector, which takes the measurement. The OSA then displays the measured power compared to the central wavelength of the filter and, moving the filter across the entire wavelength band of interest, a graph is generated, showing power vs. wavelength. Narrower slits will have higher resolution, as broad slits average the information from a broader range, which inhibits the view of closely spaced items. In addition, a slit is not a very good binary filter, as it allows leakage on each side of it, letting parasite light hit the detector and thus falsifying the results. Consider the example below:

The following message is being analyzed with units featuring three sliding windows; i.e., a large slit, a narrow slit with leakage, and a narrow slit without leakage:

Message	Slit	Info. coming through	Displayed average
a b c d e	 Large	b c d	b
a b c d e	 Narrow with leakage	b c d	c
a b c d e	 Narrow without leakage	c	c

The large slit confuses the information, while the narrow slit with leakage produces noisy information. Of course, in the example above, if the letters are far apart, then all three scenarios will generate the correct result.

Parameters

In an OSA, there are several parameters to consider:

- The slit size is called **bandwidth**: smaller bandwidth, narrower slit.
- The leakage is called **optical rejection ratio** (ORR): higher ORR, less leakage.
- The **optical signal-to-noise ratio** (OSNR): OSNR measurements also depend on the noise floor and the input power. For example, even though an OSA has an ORR of 50 dB, if the input signal is at -20 dBm and the noise floor at -65 dBm, the OSNR measurement will be limited at 45 dB.

Several OSAs are available on the market. A narrower bandwidth and higher ORR imply better optical parts, as well as a more complex alignment and production, so the price tends to be higher. Therefore, it is important to know what you really need.

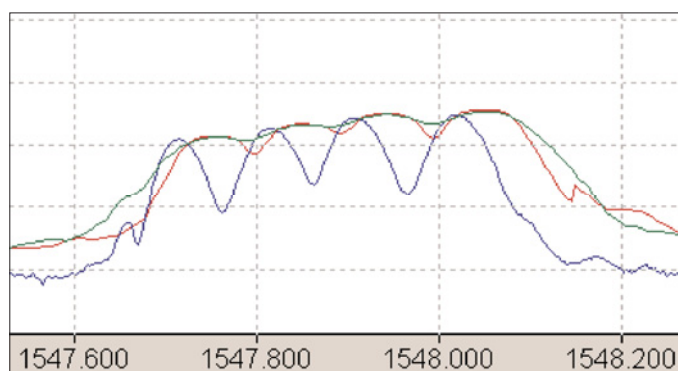
Your Needs vs. the Perfect OSA

Below are examples of typical OSA measurement scenarios, for which three different OSAs were used. The bandwidth for each of the units was 35 pm for the first, 70 pm for the second, and 100 pm for the third. Their respective ORR values were also different, as shown in the table below:

	Bandwidth	ORR at 100 GHz	ORR at 50 GHz	ORR at 25 GHz	ORR at 12.5 GHz
FTB-5240B	35 pm	> 55 dB	55 dB	50 dB	40 dB
FTB-5240	70 pm	> 50 dB	50 dB	40 dB	Not specified
FTB-5230	100 pm	40 dB	35 dB	Not specified	Not specified

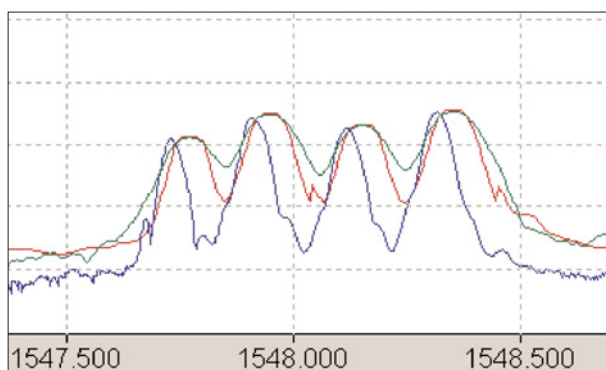
The numbers above clearly show that the FTB-5240B model offers a better performance than the others but, of course, being a better-quality unit it is also more expensive than the others. So when is this type of advanced OSA a necessity? Consider the following scenarios, taking into account that the peak power values for all the traces range from -15 dBm to -20 dBm.

Scenario 1: 12.5 GHz spacing



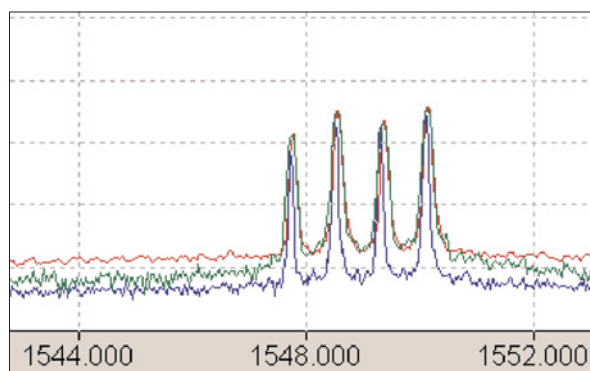
On these traces, one OSA clearly displays the structures, while the others nearly lose sight of them. The OSNR values measured by the different OSAs are as follows:

	OSNR Measured at 6.75 GHz
FTB-5240B	26 dB
FTB-5240	8 dB
FTB-5230	3 dB

Scenario 2: 25 GHz spacing

In this case, two OSAs display the structures, while the third does not. The OSNR values measured by each of the units are as follows:

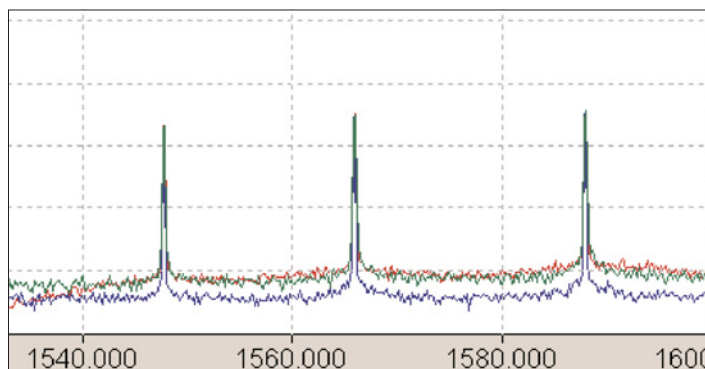
	OSNR Measured at 12.5 GHz
FTB-5240B	43 dB
FTB-5240	29 dB
FTB-5230	14 dB

Scenario 3: 100 GHz spacing

In this case, however, the spacing is quite wide, so the graph clearly illustrates that all OSAs give sufficient OSNR measurement to make accurate and reliable decisions:

	OSNR Measured at 50 GHz
FTB-5240B	53 dB
FTB-5240	46 dB
FTB-5230	46 dB

Scenario 4: **CWDM**



As seen in Scenario 3, all signals broader than 100 GHz will be sampled correctly by all three OSAs; therefore, since CWDM signals are broader than that, a low-end OSA will be just as reliable as a high-end unit for this type of transmission:

	OSNR Measured at 50 GHz
FTB-5240B	55 dB
FTB-5240	51 dB
FTB-5230	49 dB

Conclusion

As seen above, selecting the proper tool basically comes down to knowing your current and future needs as well respecting your budget. The following summary table provides a quick reference designed to help you select the perfect OSA for your applications:

OSA	Application				
	12.5 GHz U-DWDM	25 GHz U-DWDM	50 GHz DWDM	100 GHz DWDM	CWDM
FTB-5240B	Yes	Yes	Yes	Yes, but overkill	Yes, but overkill
FTB-5240	No	Limit	Yes	Yes	Yes, but overkill
FTB-5230	No	No	Limit	Yes	Yes

Corporate Headquarters > 400 Godin Avenue, Vanier (Quebec) G1M 2K2 CANADA | Tel.: 1 418 683-0211 | Fax: 1 418 683-2170 | info@exfo.com

Toll-free: 1 800 663-3936 (USA and Canada) | www.exfo.com

EXFO America	4275 Kellway Circle, Suite 122	Addison, TX 75001 USA	Tel.: 1 800 663-3936	Fax: 1 972 836-0164
EXFO Europe	Le Dynasteur, 10/12 rue Andras Beck	92366 Meudon la Forêt Cedex FRANCE	Tel.: +33.1.40.83.85.85	Fax: +33.1.40.83.04.42
EXFO Asia-Pacific	151 Chin Swee Road, #03-29 Manhattan House	SINGAPORE 169876	Tel.: +65 6333 8241	Fax: +65 6333 8242
EXFO China	Beijing New Century Hotel Office Tower Room 1754-1755 No. 6 Southem Capital Gym Road	Beijing 100044 P. R. CHINA	Tel.: +86 (10) 6849 2738	Fax: +86 (10) 6849 2662