Agilent Success Story

A Customized DWDM Test Solution

Alcatel partners with Agilent to pioneer a customized DWDM test solution

Alcatel
Germany

Challenges
- Set up precise, high-speed test system for new 40-channel DWDM chip
- Reduce total testing time (handling, test time, and reports)
- Increase manufacturing throughput

Solution
- Partnership of Agilent and Alcatel to pioneer a new test solution
- Development of a single test solution that is used in research through production

Results
- Designed an integrated test system with a highly accurate laser testing for 50 GHz channel spacing
- Significant reduction of test time for a 40-channel test sequence
- Increased manufacturing throughput

Dense Wave Division Multiplexing (DWDM) has gained massive support as it provides a solution for extending the capacity of existing fiber cabling. The technology works by multiplexing multiple channels onto a single piece of fiber and de-multiplexing them at the other end.

As DWDM matures the number of channels that can be squeezed onto a single strand is rapidly increasing, bringing with it new challenges for the optical component manufacturers. Alcatel, a world leader in the high-speed access and optical transport market, is one such company feeling the new pressures in its R&D lab in Germany.

Challenges
The division's job is to develop new components, which will be manufactured in the company's French facilities. The current project is to manufacture DWDM chips capable of dealing with 16 or 40 multiplexed channels.

"We make devices that are fabricated on silicon, with glass laid on top. These devices are then integrated into optical components that act as either multiplexers or de-multiplexers," said Dr. Kurt Lösch, Manager for the Optical Systems Research Center at Alcatel.

The challenge with these devices is testing them for the correct specifications by testing the transmission of light through the device at the chip level. To do this Alcatel turned to Agilent Technologies, Inc. to develop a complete test solution.

"Our customers want us to provide them with a complete test solution that meets their needs, not just the 'off the shelf' equipment," said Werner Berkel, General Manager for the Optical Communication Measurement Division at Agilent. "Part of that process still, however, is to build the most accurate equipment, which is why it was interesting to partner with Alcatel on this project."

To bring the test solution to Alcatel it was realized early on that the test equipment could only be created if the two companies worked as a team, due to Alcatel's requirements that components be tested for polarization dependant loss (PDL). This collaboration offered interesting possibilities for both companies to pioneer new test equipment.

"We absolutely rely on the test system. It is not acceptable to send a product to a customer and then find that our measurement system is inaccurate; this would be a disaster. We have extreme confidence in the accuracy of the Agilent systems."

Johannes Koppenborg
Project Manager
Alcatel

Pioneering collaboration: (clockwise from left to right) Alcatel's Dr. Kurt Lösch and Mr. Johannes Koppenborg with Agilent's Mr. Eduward Linsenmann and Mr. Alfons Scheel. (Photography taken by bild.quelle-Stgt, Tom Pingel)

Building Partnership

"This was a unique way of working, as Alcatel became a close partner in developing the test solution," added Agilent's Berkel "In the beginning it was a trade-off of technology. By the end of the project, we gained much deep knowledge, while they netted a complete turnkey solution."

It became apparent that combining Agilent's expertise in test systems and Alcatel's specialization in optical components would result in the perfect test solution for Alcatel, while enhancing Agilent's proficiency.

Commented Rainer Schönhaar, Agilent test consultant, "In principle we tend to have 80% of the solution ready in equipment, which we tweak for the customer's needs. In cooperation with Alcatel we developed and improved test methods for its DWDM devices and provided a complete test solution that addressed their specific needs."

The teams began work early in 2000 and implemented a sequential Mueller matrix method – an efficient and quick way to parallel test multiple channels – for testing PDL that utilized an Agilent polarization controller.

This led to a test setup that could inspect any passive optical component, but it did not meet entirely Alcatel's needs. To do so, Agilent customized the new test solution to Alcatel's specifications. Alcatel chose Agilent as a partner because of its customization requirement.

"Usually, if we go to another company we would have had to perform the integration of the hardware and software ourselves," commented Alcatel's Lösch. "Our job is not to write software or integrate components, it's to make the devices."

Performing functions other than development prevents an R& D team from focusing on its core job. On this front Agilent is totally committed to providing a solution that considers a customer's individual needs, and not just for off-the-shelf products. "The future calls for complete solutions," noted Agilent's Berkel.

"Agilent is prepared for this challenge with the capability to provide a greater, more flexible software environment that's easily customizable."

Test Solution Deployment

To develop the correct test solution, Alcatel sent Agilent detailed specifications on system operations, requirements, and information on the current test systems. For this particular project, a major concern was to account for mass production of the product during the development stage. This is because the R&D lab does not only make prototype chips for development, but also for the manufacturing line.

Alcatel's Mr. Koppenborg observes AWG alignment, which requires precise management and highly accurate test equipment. (Photography taken by bild.quelle-Stgt, Tom Pingel)

Test Expertise Makes the Difference

Agilent leaps ahead of its competitors in the area of production test. "Start-ups often need to gain experience of mass production technology rather quickly," noted Agilent test consultant Schönhaar. "And since Agilent already has the expertise, we can readily provide this service."

The problem that development labs tend to face is that test providers find it very easy to provide a solution that works well in the lab, but as soon as it comes into mass production the methods prove too slow.

Said Alcatel's Lösch, "From an R&D perspective we needed to get it right in the first step and not leave the problem of speeding the process with manufacturing. That's not our philosophy here."

To speed the test times, Agilent needed to look closely at the alignment of the chips on the Alcatel component. Testing in R& D must be at the chip level, which is a more complex step. In contrast to module level testing in which fiber pigtails on modules can be connected to a measurement system, chip level inspection requires alignment of inputs and outputs to transmit light through the chip.

Said Alcatel project manager Johannes Koppenborg, "Other equipment on the market has test lasers that sweep nonstop and can't be paused for alignment. Testing DWDM devices is a specialized task because we need to determine for each output the correct ITU wavelength and then perform the alignment at that wavelength. We concluded that testing at the chip level could only be solved with an Agilent test solution."

Even so, this procedure is a time-consuming part of the process because DWDM chip alignment occurs in two steps: first, the input is aligned once; second, the output is aligned for each channel. For example, in the new 40-channel Alcatel device, these steps are repeated 40 times.

Agilent and Alcatel decided that the best option was to integrate the alignment procedure into the test software. This ensures that the result is a single test solution.

Said Agilent test consultant Schönhaar, "By incorporating the alignment software into the total solution, we accelerated the alignment, which in turn made the entire test procedure significantly faster. The measurement time is expressed as the alignment time plus the measurement time. Failing to account for either one or these steps means that the true measurement time is not captured."

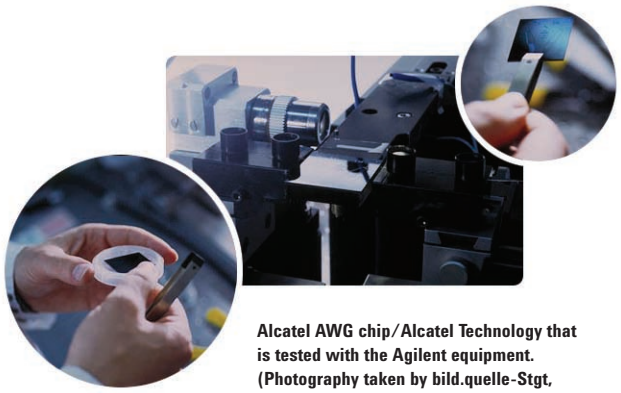
Reduction in Total Test Time

Thanks to the joint development, Agilent and Alcatel finished three months early, and deployed the solution in only three months. It has been running now for six months, with only a few software bugs to iron out.

However, as Alcatel's Koppenborg pointed out, "This is a normal part of software development, and Agilent was very good at sorting everything out. Agilent assigned a resident software support consultant twice a week to our labs at the start of the project to make sure everything was running smoothly. We find that support from Agilent is very good, and they're very responsive to our requirements."

With the system in place, Alcatel is very pleased with the results, which showed a 40% improvement in test time. For example, Alcatel's former test process took 90 minutes to test a sequence for a 40-channel DWDM. The significant reduction in testing time gives Alcatel the confidence in a manufacturing environment to say "yes" or "no" quickly to a component.

"We absolutely rely on the test system. It is not acceptable to send a product to a customer and then find that our measurement system is inaccurate. this would be a disaster," said Alcatel's Koppenborg. "We have extreme confidence in the accuracy of the Agilent systems."



Alcatel AWG chip/Alcatel Technology that is tested with the Agilent equipment. (Photography taken by bild.quelle-Stgt, Tom Pingel)

Partnering for the Future

Now that the first phase is completed, Alcatel plans to continue the partnership and product development to improve further the total test time. The company intends to implement a parallel test solution that can test all of the channels simultaneously.

Both companies are eager to continue as partners and in the provision of the best test solution for Alcatel's manufacturing facility. Alcatel has no doubt that everything will go better than planned.

Concluded Alcatel's Lösch, "I have the general impression that promises made by Agilent can be wholly trusted. And, in most cases the final system performs much better than the initial specifications."

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