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Commercialization of optical interconnection is to start with embedded photo-electronic integrated board.

Interview of Makoto Shigematsu, President & CEO, Advanced Photonics Inc.

It was generally believed that commercialization of optical interconnection starts where electronic data transfer reaches the limit. Actually, however, it does not seem to be the case.
Optical interconnection is drawing increasing attention in the consumer electronics products where transmission capacity of 2Gbps or 1 Gbps data rate and even below this level is sufficient.

The reason for it is not limited to single factor. Of course, the aim includes less power consumption and significant improvement of performance. But, in addition, it should be noted that the photo-electronic integrated board developed by Advanced Photonics Inc. is acting as the pacesetter for optical interconnection.

As far as appearances go, it is same as FR4 board.Users may use it in the similar manner as FR4.The twist for better performance is embedded in the board.

Before the opening of JPCA Show, we interviewed Mr.Shigematsu, President & CEO, of Advanced Photonics Inc. for his view on the current status and future development.

Two market needs

OPTCOM: Last year, you announced the board which is capable of data transmission at 40G/ch x 4 , 160Gbps in collaboration with Advantest Corp. How has it been going thereafter ?

Mr.Shigematsu:
We are observing two kinds of market needs. On one hand, we have seen high end development needs from potential customers, going as far as 40G/ch, which we may call next-next generation product, although I can not give you details as we are bound by non-disclosure agreements. This is not surprising when we think of the fact that the researchers in our company are interested in high end development by their nature
At the same time, we have seen sharp increase of inquiries from consumer electronics area since last summer which we feel is to take a lead in optical interconnection.

"How much power consumption can you reduce by employing the optical interconnection ?" is the typical question they ask. When we ask the kind of application, they often say " 1 Gbps is enough".

We see the market interest in optical interconnection from consumer electronics sector is simultaneously increasing as the high end sectors show interest.
Advanced Photonics Inc is worried about shortage of development engineers as the development programs have kept coming in from both sectors and make everybody very busy, although I know I should not complain if I think of the current recession.

-- When we talk about consumer electronics sector, we often observe optical interconnection used across the hinge of a mobile phone in trade shows but we seldom hear it is actually used in the products available on the market. What is your assessment of the current situation ?

--I can point out at least two problems. One is that the older optical interconnection modules are too big.
Prof. Yoshiaki Nakano of the University of Tokyo who is concurrently the technology advisor and director of our company suggests that there is no need for an optical interconnection module to be so bulky.
Conventional OE-EO modules use mirror and lens and this inevitably results in objects standing out of the plane.
In the products developed by Advanced Photonics Inc, there is no mirror or lens.
Its appearance is the same as that of PCB. Its material is FR4.

The sample we made is consisted of four layers. The waveguide is embedded between the second and the third layers as a sandwich. When the waveguide and modules are embedded, the board permits mounting of other devices as ICs, which results in higher mounting density.
This is the board where both light and electricity exist.

Prof. Nakano wants users to employ optical interconnection without consciously bothering to use it, and this board is what we made his concept into reality.
Change of generations might require higher performance, and when that happens, what is needed to be done is to replace the board itself.
Makers of consumer electronics products can use optical interconnection without paying particular attention to light.

Role as a "Rescue Temple"

-- Which other sectors in consumer electronics need optical interconnection than mobile phone ?

--One of the development targets in consumer electronics is to utilize light in digital appliance. Game machine is one of the examples.
Other applications may include vehicle-mounted entertainment equipment and " infortainment" equipment.
It may also be used for medical equipment as the use of light can reduce noise level. I am finding more sectors are starting to use optical interconnection.

--There seems to be wider areas of applications. Do you think that the photo-electronic integrated board has brought about this result as it enables easier handling of light technology?

-- I think that credit may be given as the next step.
Actually, the world is in recession now, but business is destined to recover someday. People in consumer electronics have been searching for the products to be put on the market once it recovers. And many of them now feel that they have explored every means.
We may say they are stumbling around in the dark to find the next to develop. The problem of power consumption is receiving attention, and this is serving as a tail wind. The world is demanding less energy consumption.
If you can put on the market a new product which features lower power consumption, it has a strong impact.
By replacing a particular part of an existing product with optical interconnection, it can reduce power consumption and dramatically improve performance.
We are increasing self-belief at the accelerated inflow of inquiries from consumer electronics industry.
We hope economic recovery and taking-off of the market come together. We are finding ourselves increasing occupied , which is usually hard to expect in recession.

--Can we say that optical interconnection has increased recognition ?

--Actually not. It is true that the responsible persons for development in the companies, general managers of development department or research institutes have instructed their men to keep watching optical technology in anticipation of optical age to come someday.
But most of the people in the organizations are electricity specialists and the persons in charge are having hard time to find someone to consult with.
Then, here is Advanced Photonics Inc. which can collectively undertake development efforts. Advanced Photonics Inc. is playing the role of "Rescue Temple".
Of course, there are many companies which produce OE-EO modules and transceivers. Not a small number of companies have optical waveguide technology. Almost all chemical companies may be able to provide consultation for waveguide since they made studies waveguide materials in around 2000 when there was a communications industry bubbles. But, they do not know about circuit design.
The transceiver makers, on the other hand, suggest that chemicals makers should be consulted with regard to optical waveguide. Technology is cut to pieces.
We believe that the value of Advanced Photonics Inc. lies in the fact that it can give collective consultation, putting this piecemeal technology and knowledge together. Customers now are looking a company which can act as design consultants.
We have many new projects for development and we are suffering from shortage of researchers.

Collaboration for Open Innovation

--What are the development themes in consumer electronics sector? It seems to me, in the beginning there should be attractive price.

--The critical point is how to make it low-cost and small. The transmission rate of 2Gbps is enough, and customers are increasingly expressing the needs to employ optical technology to decrease power consumption rather than to increase speed of transmission.
When Advanced Photonics was established, its main theme to pursue was higher-speed and higher-capacity, but " lower power consumption" has emerged as another theme.
So far, we have not engaged in development below 10Gbps level, but to the consumer electronics sector, even this low level is excess specification and we may need development target be somewhat lowered.

-- Has the optical interconnection technology come to the level where it can meet the price level wanted by consumer electronics?

--The photo-electronic integrated board has fewer parts since it can do away with mirror and lens. I believe it has the potential to realize a low-cost product.
At the same time, however, we believe that our customers have more professional expertise when it comes to reducing product cost or designing less expensive product.
Advanced Photonics can offer proposals for custom-tailored specifications.
When customers say they want to reduce the size to this level, or keep the height to that level, we can offer suggestions in response to their need.
In general, it is important to make it small and to reduce the number of parts if you want to lower the final product cost.
For design, Advanced Photonics can take care of it.
We believe it is a good theme for joint development effort with open innovation method.

--Open innovation may be necessary, but actually what will influence the related parties into open innovation?

--Basically, closed innovation prevails in Japan. The traditional Japanese style so far is to make technology development in-house and put the developed new products into market. They were reluctant to take in the outside technology under open innovation. Companies feared that their technology might be stolen, and this made them take the self-sufficiency policy.

There are two factors that influence them into open innovation.
First, they cannot catch up with the rapid technological innovation under the self-sufficiency policy and lag behind.
This problem must be addressed.
In particular, you almost cannot find engineers in the area of short distance optical technology such as optical interconnection.
Second, the customers are not obliged to reveal their specialty technology when dealing with the proposals from Advanced Photonics.

When a customer demands that this block be made optical, we can make it. There is clear division of responsibility, and this makes it easier to pair up. The customer side is responsible for electronics technology, and Advanced Photonics is responsible for the conversion between photonics and electronics.
We have several joint development projects going on under this manner.

No priority on electronics, no priority on photonics but emphasis on optimum solution

--A little while ago, the shortage of development engineers and researchers was pointed out, but why the supply is insufficient?

--There are many electrical engineers. As for the optical technology engineers, there are many of them in long-distance optical technology.
If you depend on those engineers for development, it tends to end up with preference on either of the technologies.
For instance, in the conventional optical interconnection design, the prevailing idea was electricity, and electricity goes straight while light does not go straight. Since light does not go straight, it needs mirror and lens, which inevitably result in larger size and lower mounting density.

This is one of the principal reasons why the optical interconnection has not been widely used despite its long history.
In the technology of Advanced Photonics, the concept is that light goes straight while electricity bends. This eliminated mirror.
This is not to say that we put the light in the center of our thinking. Rather, it means we are not bound by the notion of electricity and make the best use of light.

The most important point is to look at electricity and light on the same footings. It is quite important to make the optimum design for the required specifications.
Unconditional priority should not be given to electricity or to light. It is imperative to think " What is the optimum design ?".
When encountered with photonics set as the main subject, people in "Electricity Village" tend to say " It is not correct way to do things".
On the other hand, people in " Photonics Village" tend to think that "In the beginning, there should be optical fiber" since most of them are long-distance optical engineers.
Short-distance optical engineers as required by Advanced Photonics are in acutely short supply.

-Could you tell us what is "Optimum Design" then ?

--On a board, there are various ICs and devices. If you can make a design which withdraws maximum capacity from each device, this is the "Optimum design".
It is not difficult to realize characteristics which are 10 times better than that from currently available board in just half of the size, if you use optical technology.

In Advanced Photonics design, output is in the form of electricity as OE-EO module is embedded. If a customer wants output in the form of light, we can comply with that request.

-- I understand it does not mean "Everything is all right if you use photonics technology". In which characteristics does your technology differ from the conventional optical interconnection ?

--Actually, an examination officer at the patent office told Prof. Nakano, " You can write this invention with a pen, but you cannot make it in a concrete form" when he submitted the patent application.

Then, Prof. Nakano determined his mind to have it in a concrete form at any cost. Song Xueliang, now a director and CTO of Advanced Photonics, made trial production and proved that it had good characteristics.

There is no reflection since there is no mirror no lens. Signal level is high because in principle the optical path length is short.
These sound no wonder, but they were proved only after the trial production succeeded in creating the concrete object.
We were able to understand by subsequent establishment of theory that the signal level was good because the optical path length was short.

--Do you have any other point for development?

--We tried patiently to make it small.
We designed the connectors by ourselves and made a small 4ch connector since the connectors available in the market are too large.

We change the number of channels as appropriate. The pitch in the waveguide is usually 1 μ m but we can make it half-pitch if requested by customers.

The difficult point in design is coordination of modules and the total design.
We believe this is where Advanced Photonics can show its strength and differentiation capability.

Hazardous nature of licensing business

-- Selling an idea can be a form of business. What made you set up a company and carry out the actual business including collaboration with client companies ?

--In optical interconnection technology, what is needed now is OE-EO module, and we believe the ultimate goal is silicon photonics.
However, it may be a long way off, possibly 15 years later.

On the roadmap of the company, our plan is to achieve Initial Public Offering (IPO) of the stock market, and secure some capital gains and then utilizing that capital gain, we aim at development of silicon photonics. For this purpose, we believe the first thing to do is to establish ourselves as the leading supplier of photo-electronic integrated board.

One more thing. We do not believe we can achieve success if we employ the business model of selling ideas.
Namely, we may not reach the stage where we are engaged in development of silicon photonics.

--Do you mean you cannot gain the capital gain under that business model?

--Advanced Photonics does not have the material nor device. We buy the best available products from outside sources.
We think that our core competence lies in the ability to make the optimum design for both electricity and light, that is, photo-electronic integrated board.

However, we set aside design know-how and manufacturing know-how from the patent coverage.
If a venture company like ourselves does not have any patent, it will not be able to secure high confidence in it from customers. So, we covered only critical points by patent, and we have built up our defenses by leaving other part as know-how.

We made a setup so that our competitors cannot find the way to manufacture our photo-electronic integrated board by way of reverse engineering ,even if they somehow get and bring it to their company.
We do not believe that we will achieve success if we cover everything by patent and let them licensed for royalty as a license business.

At one time, a business model of license business was trumpeted, but it is only for several years that patents could earn royalty.
Then, there appear products which skillfully circumvent the basic patent.

-- A little while ago, we asked about open innovation in relation with commercialization of optical interconnection. What do you think of the innovation for the core technology of Advanced Photonics ?

--We keep on building up defenses for our know-how to secure first-mover advantage, but have no intention to keep them secret forever.
Every technology is destined to become obsolete at some stage. Advanced Photonics is determined to focus on the next technology development. We believe any company without innovation will perish.

Editorial

Does optical interconnection help you get two rabbits?

People working in optical technology all know that the expectation for optical interconnection has continued for more than 10 years up until now.
It is not difficult to list up reasons why optical interconnection has not been put into full commercial use after 10 years, but all the people are aware that “the reasons” listed there may not be able to cover every single reason for it.
People related with the technology list such factors as the speed of technology progress in electronics interconnection, price, size and the steps to be taken before adoption against the wider use of optical interconnection.

The interview posed on the top of this issue suggests that those problems can be solved, or already solved.
The end of electronics is already noticed, optical interconnection module has become sufficiently small and the process of adoption is not different from that of electricity.

Then, the only remaining problem is price, and for this, the same view of “ Mass production can reduce the price” is repeated as before.
Actually, this logic of “ Mass production can reduce the price” is tricky when we talk about adoption of a new technology.
It tends to result in that familiar barren controversy – Which comes first, chicken or egg.

Some of the companies in other industries in Japan adopted such strategy as " First, lower the price and get the market, even without mass production". It was observed in the history.
Needless to say, this is a "Strategy", and from the viewpoint of company behavior , it is "Investment".
In some cases, people might call it "Speculation".
This action of taking the market was possible because the company acknowledged that most of the problems other than few exceptions had been already solved and that the hurdles had lowered or had been lowered.

In the case of optical interconnection, too, the action to be taken should be "Strategy" or "Tactics" for wider use of that technology, if it is acknowledged that the problems other than "Price" have already been removed.

But, one must stop once here.
There is no guarantee that an excellent technology should prevail.
Researchers may wonder why their excellent technology is not supported by others, but for commoners, it is not possible to support unfamiliar technology.
There might be a behavior pattern where people buy something because it is excellent, but more popular pattern in goods market is that I buy it because others buy it.

If this behavior pattern is more popular, "Tactics" to let the product be known to the market is also necessary, in addition to the "Price" strategy.
Fortunately, the trend of the times now is heading toward "lower power consumption" and "lower heat generation".
Beyond that, there is another target- " Green IT".
It is reported in the consumer electronics that more and more companies are chasing two rabbits, dramatic improvement of performance and lower power consumption.

As a warrior in the consumer electronics where severe competition is staged, they have every reason to chase "two rabbits".
Thus, an ideal market condition with "a tail wind" has shown up before the people engaged in optical interconnection.

Now, do they have "Strategy" ? Do they have "Tactics"? Is the optical interconnection market going to explode?