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Carl-Otto Gensch and Team
Oeko-Institut
Merzhauser Str. 173
79100 Freiburg
Germany

June 14, 2018

Dear Mr. Gensch:

Infinera is pleased to respond to the Oeko-Institut and Fraunhofer's Questionnaire related to the evaluation of Indium Phosphide. Infinera provides Telecommunications Service Providers and Internet Content Providers globally with a uniquely differentiated next-generation optical communications network that is dependent on Indium Phosphide. The analyses and resulting recommendations concerning the use of Indium Phosphide is of acute interest to Infinera. As Infinera is one of the top providers of Optical Networking capabilities to all corners of the globe, we firmly believe the prohibition of its use in relation to RoHS compliance would have devastating repercussions to the entire Optical Networking and Telecommunications industry. In addition, such inclusion would also have far-reaching impacts to a global society that has become accustomed to and reliant upon the underlying technology that powers today's communications infrastructure.

Enclosed herewith are our answers to the 1st Stakeholder Consultation - Questionnaire for Indium Phosphide (Pack 15). Most of our responses are specific for Infinera; however, issues regarding substitution, lifecycle analysis (LCA) and toxicology are fully applicable to the entire industry. In the last question for Further Information and Comments, we have provided an overview on how our products address the issue of Sustainability. As you will see, the technological and societal benefits from the use of Indium Phosphide specific for telecommunications industry are many. As such, we respectfully request an exemption for the use of Indium Phosphide in Optical Network Telecommunications Equipment should your evaluation warrant including it into the RoHS Directive.

If you have any questions or require further details about our responses, please feel free to contact our Compliance Engineer Edward Hou at ehou@infinera.com or call at +1-408-543-8083. We look forward to working with the Oeko-Institut on this important matter.

Sincerely,

James L. Laufman
SVP, General Counsel

1st Stakeholder Consultation – Questionnaire for Indium Phosphide

1. Applications in which indium phosphide is in use

a. Please provide information concerning products and applications in which the substance is in use.

i. In your answer please specify if the applications specified are relevant to EEE products and applications or not.

Indium Phosphide (InP) is a III-V compound semiconductor material that is employed in a wide variety of devices, products, and applications. The two most common application areas are optoelectronic devices for fiber optic communication systems and high-speed electronic devices for applications that are beyond the capability of silicon (Si)-based electronics. InP is also employed in other technologies including solar cells and photocathodes. Infinera is engaged in the manufacturing and sale of equipment for optical networks. These networks are based on dense wavelength division multiplexing (DWDM) at infrared (IR) wavelengths of approximately 1.5 µm, where the properties of optical fibers are ideal for long-distance transmission with minimal loss and dispersion. DWDM networks are uniquely capable of transmission of terabytes/sec (Tb/s) data rates over links which may exceed 1000 km and are widely employed for subsea and terrestrial communications networks around the world.

We only manufacture professional equipment for the optical telecommunications network industry, which includes enterprise equipment for long haul/subsea, metro and datacenters. Please review our website for more information about our products: www.infinera.com.

ii. Please elaborate if substitution of the substance is already underway in some of these applications, in relation to the properties for which indium phosphide is used (for example semiconductor and photovoltaic properties) and/or in relation to specific applications in which it is used (for example critical communication components).

Early in the development of optoelectronic devices for fiber-optic communications, an effort was made to extend Gallium Arsenide (GaAs)-based devices, which are ideally suited to 0.85 µm transmission, to operation at 1.3 or 1.5 µm. These efforts ultimately failed due to high-defect density that is inherent to highly-strained or lattice-mismatched, indium-containing alloys grown on GaAs substrates. Indium Phosphide was the substitute for GaAs devices and offered both better performance and less environmental concerns. Suggestions to use II-VI based devices (CdZnSe) were also made in the early history of optoelectronic device development but were abandoned in the 1990s due to high defect density and poor mechanical stability inherent in these materials. Even if GaAs or CdZnSe could be made viable at 1.5 µm, these materials would have undesirable toxicity characteristics relative to InP.

iii. Where relevant, please elaborate which chemical (on the substance level) or which technology (elimination of the need to use InP) alternatives may be relevant for this purpose.

Some commercial suppliers of 1.5 µm optoelectronic components employ Si photonics technology. Note that in Si photonics, the active devices are fabricated from InP and placed on a Si substrate for integration with other optical functions. Si photonics is a viable integration technology for InP-based devices, but it does not represent a substitution path for InP. Silicon by itself cannot be used for lasers or direct amplification. Also, silicon tends to operate as Coarse WDM (CWDM), with “free running” wavelengths that limits individual fiber connections to about 100Gb/s with limited range. Silicon is ideal for simpler, single wavelength applications, and for co-packaging with active devices in the "pluggable" market for client optics and metro transponders. Likewise, optoelectronic devices emitting at other wavelengths (IR, visible, and UV) may be fabricated from other III-V materials and may find other commercial applications. However, there is simply no alternative to InP for DWDM-based high-capacity, long-haul networks. The DWDM industry (component and system suppliers, including Infinera) continues to invest heavily in higher-performance InP-based devices for next-generation networks. InP is also the only material today that can be used to build large scale devices for super-channels.

b. *Please specify if you are aware, if aside from actual use of the substance, it may be reintroduced into the material cycle through the use of secondary materials.*
   i. *Please detail in this case what secondary materials may contain indium phosphide impurities and at what concentrations as well as in the production of what components/products such materials are used.*

We assume that this question is intended to address disposal or recycling of InP when equipment containing InP-based devices reaches the end of its useful life (typically >15 years).

There is essentially no value in reclaiming InP chips for recycling or reuse. The raw materials are very inexpensive, and InP is only viable as a starting material for optoelectronic device manufacturing if it is in the form of a large (>50 mm in diameter) substrate with an exceptionally perfect and clean surface. InP substrate pulled from finished products can never meet these criteria due to other materials deposited on its surface in multiple layers similar to semiconductors. Furthermore, the amount of InP in a finished product is minuscule; the combined mass of all InP in a typical line card is approximately 0.15 g on average. The InP used in our equipment is embedded in a robust and hermetically-sealed, optical module, which itself has virtually no reclaim or recycling value.

Note that the amount of InP produced and sold for DWDM networks increases sub-linearly with network bandwidth requirements. This is due to relentless investment and progress in terms of bandwidth per wavelength (bandwidth per laser). For example, our first and second-generation products carried 10 Gb/s/laser. Our third generation (introduced in 2012) carried 50 Gb/s/laser. Our fourth generation (introduced in 2016) carries 200 Gb/s/laser. Our product roadmap includes new technology that will operate at 800 Gb/s/laser within the next two to three years. As a result of this impressive improvement in data-carrying capacity, the volume of InP installed in the field for optical networks grows at a very slow pace relative to exploding bandwidth demands.

   ii. *If possible please provide detail as to the changing trends of indium phosphide concentrations in such secondary materials as well as the changing trend of use of the respective secondary material in EEE manufacture.*

See answer 1b-i above.

c. *Please specify in which applications indium phosphide is used as a material constituent, as an additive or as an intermediate and what concentration of indium phosphide remains in the final product in each of these cases (on the homogenous material level).*

Our products include InP-based photonic integrated circuits (PICs) which are manufactured in-house. Each line module supplied by us contains two PIC chips: a transmit chip which performs the function of electrical-to-optical (EO) conversion, and a receive chip which performs the optical-to-electrical (OE) conversion. These PIC chips include a variety of devices ranging from laser diodes to modulators to photodetectors, all fabricated together on InP substrates.

The core technology used by Infinera to create PICs is used by other companies to create discrete optical devices that operate in the 1.5 µm wavelength range, and these discrete devices can also be used to perform OE and EO functions in a DWDM optical network. In fact, all 1.5 µm DWDM optical networks employ InP-based devices. The amount of InP in the final products ranges from 50 to 200 mg depending on the generation of product (i.e., 500 Gb/s - 1.2 Tb/s line cards).

2. Quantities and ranges in which indium phosphide is in use

a. *Please detail in what applications your company/sector applies indium phosphide and give detail as to the annual amounts of use. If an exact volume cannot be specified, please provide a range of use (for example – 10-100 tonnes per annum).*

The InP substrates that form the foundation of our PICs is crystalline InP (i.e., the InP form is not quantum dots). The thickness is approximately 300-500 µm, and the chip area is <100 mm^2. Crystalline InP is an extremely stable and inert crystalline solid, with a melting point of >1000 °C. InP is generally considered to be a safer and less hazardous material relative to other III-V materials due to its mechanical and chemical stability, and there is no substitution effort underway.

For 2017, we estimate that the total weight of InP we shipped globally was 1.3 kg. For Europe, we estimate that the total weight was approximately 0.35 kg.

b. *Please provide information as to the ranges of quantities in which you estimate that the substance is applied in general and in the EEE sector in the EU and globally.*

For 2017, our estimate for the amount of InP placed in the global market attributable to the optical telecommunications network equipment industry is 26 kg. For the EU, our estimate is 9 kg.

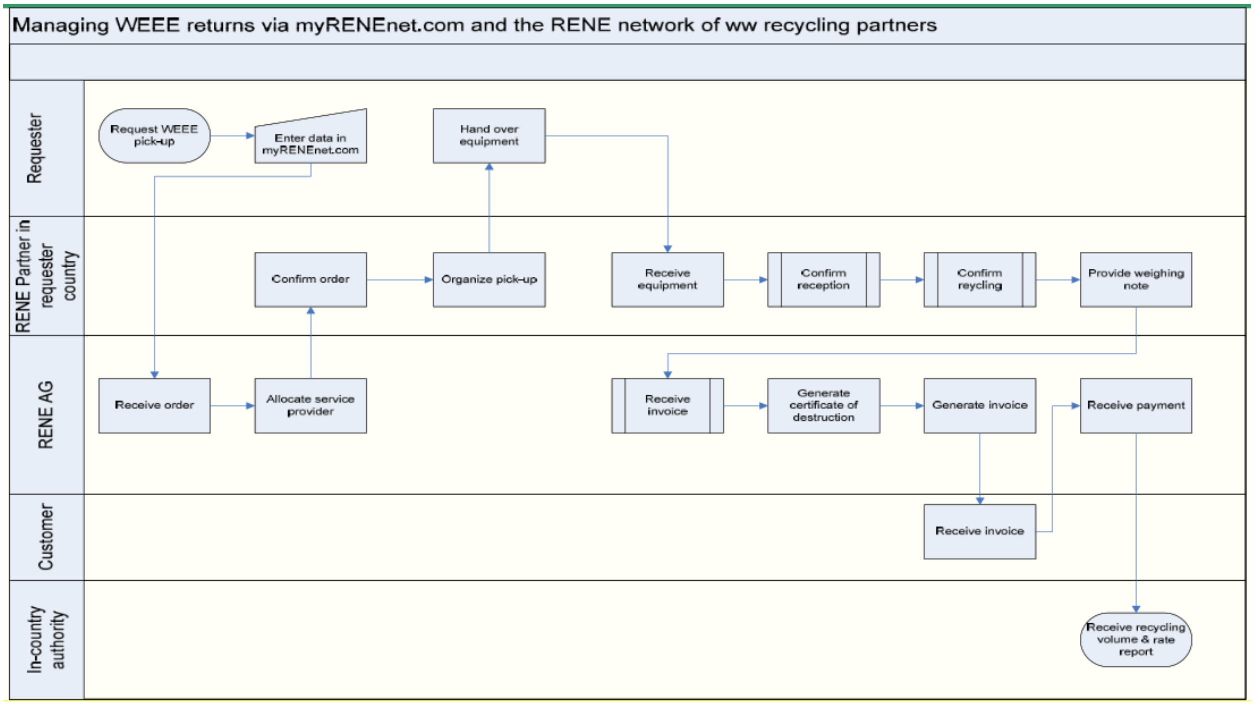
c. *If substitution has begun or is expected to begin shortly, please estimate how the trend of use is expected to change over the coming years.*

To our knowledge, substitution of InP has been neither suggested nor requested throughout the development history of InP-based materials. There is no viable substitution path, and no substitution under consideration by suppliers of InP-based DWDM communication systems. As noted above, growth in the amount of InP used is suppressed by continuous improvements in the transmission bandwidth for InP-based devices.

3. Potential emissions in the waste stream

a. *Please provide information on how EEE applications containing indium phosphide are managed in the waste phase (with which waste is such EEE collected and what treatment routes are applied)?*

For Infinera products, we have selected RENE AG as our Authorized Representative under Article 17 of the EU Directive 2012/19/EU for WEEE. Attached is RENE's process for WEEE collection and processing:



Based on the country and the pick-up location, RENE AG allocates a recycling company that is geographically closest and technically capable of handling the request. All partners are ISO 14001 certified. The RENE partner confirms the order and picks up the equipment (the WEEE) at the requested location.

As stated on our website, we also have a take-back program for customers where they can contact us directly for managing end-of-life product.

b. Please detail potentials for emissions in the relevant treatment processes.

For our products, the InP devices are located on the populated printed circuit boards (PCB). The standard WEEE recovery process involves disassembling the hardware to where the PCB is separated from the chassis. The PCBs are then shredded to recover precious metals and other usable materials. During the shredding process, particulates are generated. Studies by Oliveira and Margarido [1] have shown the smallest particle size is 0.04 mm (40 µm). Although there are exposure risks at the WEEE processing stage, this risk is adequately managed through engineering controls and proper use of respiratory personal protection equipment. Standard respirators (e.g., N95) with HEPA filters help reduce the wearer's inhalation exposure to airborne particulates. These respirator filters have been tested and certified by NIOSH to be at least 95% efficient when tested against very "small" particles that are the most difficult size to filter (approximately 0.3 µm) [2]. Hence, respiratory exposure of InP is adequately controlled. On-site audits conducted by RENE AG confirm that the health and safety program at each recycler location is properly managed and maintained. Furthermore, none of the particles from PCB shredding are in the nanoscale intrinsic to quantum dots that are used in display technology. Quantum dots range from 2 nm (0.002 µm) to 10 nm (0.01 µm) [3]. Since no nanoparticles are generated, there are no risks to exposure to InP nanoparticles in the WEEE recovery stage attributable to PCB shredding and disassembly. Hence, emission risk of InP from our products to workers and surrounding communities are minimal, if any, and adequately managed by our certified recyclers.

[1]
https://www.researchgate.net/publication/271979106_The_Effect_of_Shredding_and_Particle_Size_in_Physical_and_Chemical_Processing_of_Printed_Circuit_Boards_Waste
[2]
https://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/GeneralHospitalDevicesandSupplies/PersonalProtectiveEquipment/ucm055977.htm
[3] https://en.wikipedia.org/wiki/Quantum_dot

4. Substitution

a. Please provide details as to the substitution of indium phosphide:

i. For which applications is substitution scientifically or technically not practicable or reliable and why.

Early in the development history of optoelectronic devices for fiber-optic communications, an effort was made to extend GaAs-based devices, which are ideally suited to 0.85-µm transmission, to operation at 1.3 or 1.5 µm. These efforts ultimately failed due to high-defect density which is inherent to highly-strained or lattice-mismatched indium-containing alloys grown on GaAs substrates. Suggestions to use II-VI based devices (CdZnSe) were also made in the early history of optoelectronic device development but were abandoned in the 1990s due to high defect density and poor mechanical stability inherent in these materials. Even if GaAs or CdZnSe could be made viable at 1.5 µm, these materials would have undesirable toxicity characteristics relative to InP.

InP-based materials have ideal mechanical, electrical, and optical properties, which are uniquely suited to optoelectronic devices operating in the 1.5 µm range. Key properties include direct bandgap for efficient light emission at 1.5 µm, ideal electrical properties for high-speed modulation, and ability to create low defect-density materials on a stable substrate for highly reliable device operation over long periods of time and under extreme operating conditions. No other materials possess these properties at these IR wavelengths.

Together with the rest of the opto-electronics industry, we are convinced that for high-speed, high frequency, long distance data communications it is impossible to substitute InP-based products. As outlined above, the original technology based on GaAs has been proven to be unable to match InP-based products. The Si-based solutions can be shown to roundly underperform InP-based devices to the point of being useless in long-range communications over data networks. As the only known possible alternative technologies, they predate the development of InP solutions, which would not have entered the market at all if these earlier proven technologies would have offered a viable solution. The uses for InP are also very specific to professional level networks and are not integrated into consumer articles.

It is our contention that for large scale telecommunications optical networks there is no technically viable, practical nor available substitute. Furthermore, from an environmental perspective, InP is preferable in any case to GaAs.

ii. *For which applications is substitution underway? Please specify in this respect which alternatives are available on the substance level (substitution) and which are available on the technological level (elimination). For example, which alternatives can be applied instead of indium phosphide used in solar cells and in semiconductor applications (e.g. gallium arsenide).*

There is no substitution effort underway for InP used in optical telecommunications. The core technology used by us to create PICs is used by other companies to create discrete optical devices, which operate in the 1.5 µm wavelength range, and these discrete devices can also be used to perform OE and EO functions in a DWDM optical network. In fact, all 1.5 µm DWDM optical networks employ InP-based devices.

iii. *What constraints exist to the implementation of the named substitutes in a specific application area (provide details on costs, reliability, availability, roadmap for substitution, etc.).*

See answer 4ii above.

5. Socio economic impact of a possible restriction

Please provide information as to the socio-economic impacts if indium phosphide is to be restricted under RoHS. Please specify your answers in relation to specific applications in which the substances are used and/or in relation to the phase-in of specific alternatives in related application areas. Please refer in your answer to possible costs and benefits of various sectors, users, the environment, etc. where possible; please support statements with quantified estimations.

Environmental Impact of InP Replacement Technologies:

Elimination of InP would have exceedingly serious consequences in terms of cost and environmental impact for long-haul (>100 km) communications networks. Alternative network technologies and architectures would be required. Alternatives might include a dramatic increase in the number of network nodes in a terrestrial network (each node requiring land, power, etc.), with each node consisting of short-haul optical transmission equipment (GaAs-based optoelectronic devices communicating over <10 km links) operating over plastic optical fiber (to be installed between nodes). Another candidate architecture could be based on massive wireless or satellite infrastructure, assuming adequate bandwidth could be procured and safety, reliability, and security concerns could be addressed. It's difficult to see any viable path forward that would reduce the environmental impact. The required expenditures and environmental impact (including massive construction projects and much higher power consumption) would make this type of conversion highly unattractive.

LCA Ramification of Non-use of InP in Optical Telecommunication:

From a lifecycle analysis (LCA) perspective, InP is the only material that can create lasers that have the optical frequency stability required to carry data over hundreds of kilometers through fiber optics cables. An alternative laser technology (e.g., GaAs) will be limited to a range of approximately 80-100 km. We have reviewed several long-haul, metro and datacenter interconnect networks in the EU that use our InP equipment. If a GaAs technology is used instead of InP, the additional lasers that are required to duplicate today's network capabilities will increase by two- to fifteen-fold depending on the network, with an average of a six-fold increase. Furthermore, these GaAs lasers and associated modules are more expensive, will require more power and the resulting hardware will require more rack space in datacenters. Based on our calculations, a nationwide and pan-European network using GaAs technology will have these characteristics:

- Five times (5X) more expensive than current networks with InP lasers
- Uses five times (5X) more power than current networks with InP lasers
- Occupies five times (5X) more rack space in datacenters than current networks with InP lasers

As an example, for an average pan-European network, the power increase per year would be approximately 50 million KW-hour.

Toxicological Analysis of Substitutions for InP:

As detailed in the previous answers to Oeko's questions, it has been shown through years of research on III-V devices specific for optical telecommunications that substitution of InP is not viable. InP has unique bandgap and stability properties that makes it ideal as the substance of choice for optical telecommunications lasers. Even if substitutions could be made, the toxicological and negative environmental impact of InP substitutions have been studied. One compound that is often mentioned as a substitute is Gallium Arsenide (GaAs). GaAs is used in various applications for semiconductor and optical components. However, it has been shown by Jiang et al. [1] that GaAs has greater toxicity relative to InP. A summary of their study can be found on YouTube [2]. Arsenic ions can dissociate from GaAs and become the principle factor in extracellular and intracellular toxicity. Indium ions were the least toxic. This study further validates the lack of substitution alternatives for InP and, likewise, illustrates that InP is the least toxic choice among III-V compounds.

Aluminum Antimonide (AlSb) used in near-infrared devices is also less toxic relative to GaAs due to its insolubility in water. However, AlSb lasers do not possess the optical properties required for long-range, optical telecommunications. Currently, no vendor is using AlSb for telecommunications purposes. AlSb has been used primarily for tunable laser spectrometry [3].

[1] https://pubs.acs.org/doi/abs/10.1021/acsnano.5b04847
[2] https://www.youtube.com/watch?v=m5c_8HhURHE
[3] https://en.wikipedia.org/wiki/Interband_cascade_laser

Cost of InP waste management

We ship only a minimal amount of InP into the European Union, and through discussion with other opto-electronics manufacturers we are convinced that the total industry accounts approximately a dozen kilograms per year sold into the European Union for these laser-based technologies. If we presume a worst-case scenario of 30 kg, which needs to be totally landfilled in a manner appropriate for hazardous waste, the following statistics provide insight on landfill impact:

1. According to Eurostat, the total amount of hazardous waste treated in Europe is in the range of 72 million tons [1] of which approximately half can only be landfilled.

2. Several studies [2] indicate that equipment waste accounts for 10% of such landfill waste. This still means that the waste created by opto-electronics components containing InP is less than 0.001% of that waste stream.

3. There are ranges available for the cost of landfilling hazardous waste in the EU; the studies vary but generally arrive at a cost of €100/ton [3]. The highest estimates are around €250/ton, which means that the opto-electronics equipment accounts for less than €7.50 per year across the EU-28 in landfilling costs.

[1] Eurostat Treatment of waste by waste category, hazardousness and waste operations
[2] Hazardous waste review in the EU-28, Iceland, Norway, Switzerland and Turkey, Generation and treatment, June 2015, p. 28; Statistics Norway, Hazardous waste, 12 December 2017
[3] Waste & Resources Action Programme (WRAP), Comparing the cost of alternative waste treatment options, Gate Fees Report, 2012; European Commission (DG ENV), Use of Economic Instruments and Waste Management Performances, 10 April 2012

6. Further information and comments

The information compiled on this substance for the stakeholder consultation has been prepared as a summary of the publicly available information reviewed so far. If relevant, please provide further information in this regard, that you believe to have additional relevance for this review, as well as references where relevant to support your statements.

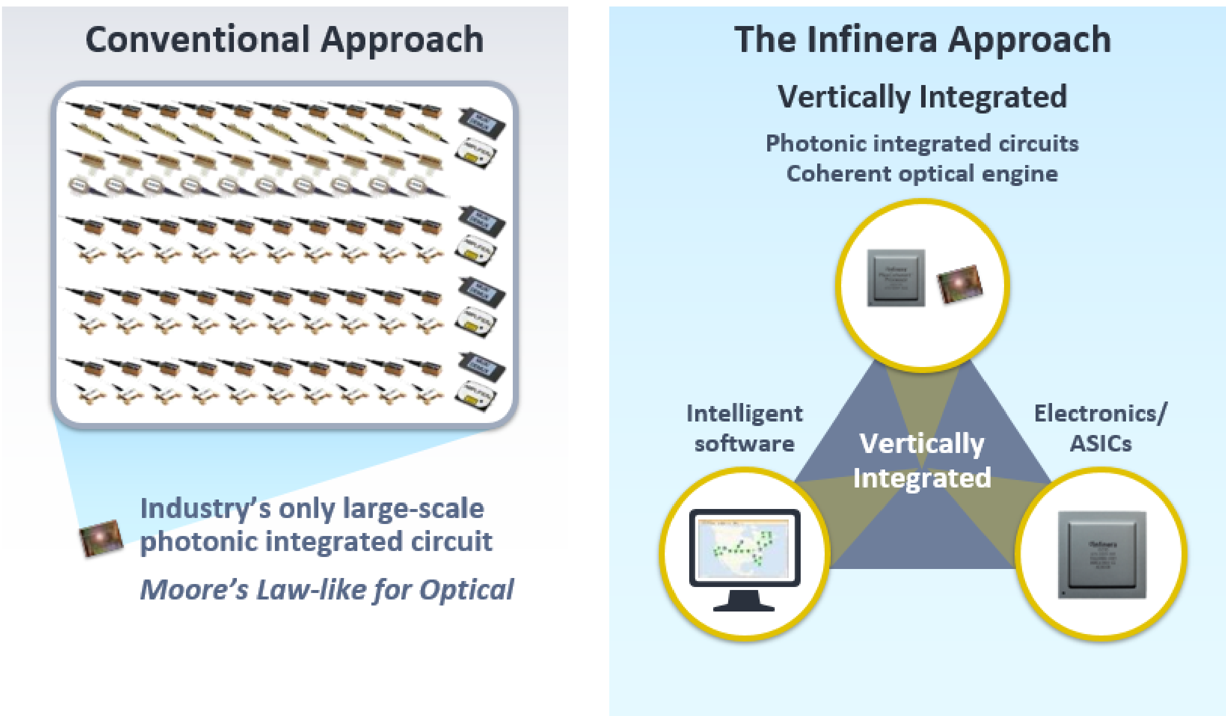
Infinera Corporate Overview

We are a publicly traded global company (NASDAQ: INFN), headquartered in Sunnyvale, CA, USA, that provides our Indium Phosphide-based telecommunications hardware to service providers, cloud operators, governments and enterprises across the globe. With hundreds of deployments at leading carriers, cable operators, research and education network operators and Internet service/content providers, we have demonstrated the ability to meet the service requirements and infrastructure needs of today's most advanced service providers and the ability to support them across the globe.

Select Infinera Customers

Technology Innovative Through Photonic Integration

The DTN-X platform architecture is enabled by our unique large-scale PIC technology that uses InP as the key material. Our first generation PICs supported 100 Gigabits per second of transmit and receive capacity and combine the functionality of more than 60 discrete optical components into a pair of InP chips. In 2012, Infinera extended PIC technology with the launch of the DTN-X that is powered by a 2nd generation PIC that combines over 600 discrete optical components and delivers 500 Gb/s of transmit and receive capacity from a single line card. Our third generation (introduced in 2012) carried 50 Gb/s/laser. Our fourth generation (introduced in 2016) carries 200 Gb/s/laser. Our product roadmap includes new technology that will operate at 800 Gb/s/laser within the next 2-3 years. Hence, the advantages of a PIC from an LCA standpoint is obvious.



In addition to dramatically reducing the cost and complexity of deploying high capacity optical networks, PIC technology also enables industry leading reliability. DTN-X DWDM line modules offer a reliability that exceeds industry standards by 9X. Thereby, further reducing the need for replacement parts, site support and waste generated in the WEEE stage.

Our solution combines the benefits of PIC technology with both optical and digital ROADM architecture and GMPLS service intelligence to provide significant benefits in terms of rapid bandwidth provisioning and service activation, reducing first and incremental cost, reduced operating expenses, network architecture simplification, and support for a wide range of existing and new services.

As we move into the future, we continue to innovate with a two-year cadence that will drive additional reach and bandwidth increases. Reflecting on the impacts of InP to this statement it is important to understand that by increasing reach, it allows the distance between datacenters/telecom offices that are manned to be increased to hundreds or even thousands of kilometers.

In the absence of InP technology, the distance would be limited to approximately 80 kilometers. This could result in a 10x factor of the number of datacenters/telecom offices required, resulting in significant environmental impact, including the following:

- Transformation of networks to require manned locations *every* 80 km.
- These new locations would need to be constructed and maintained, thereby impacting the business model for all telecommunications service providers.
- Additional human resources would be required to staff each new location (e.g., IT, engineering and logistics).
- Increase in commuting workers would strain transportation infrastructure.

Hence, the carbon footprint increases due to additional telecommunications hardware at each location, dramatic increase in building construction, higher energy demand that impact power grids and increased infrastructure due to commuting/parking would be considerable if a non-InP network is used.

Packet-Optical Transport
Packet-aware transport lowers capital and operations costs and gives operators the potential for additional revenues by enabling differentiated services and providing end-to-end operations, administration and maintenance (OAM). Costs would increase significantly if InP technology is not used or available.

European Customer References
The following sections reference European customers by market segment with a brief description of their specific application and why they chose Infinera. These customers and their business models are successful and profitable due to the technological advances of InP lasers in our industry:

<u>Subsea Service Provider</u>
- Telecom Italia – MedNautilus, the Mediterranean operations of the Telecom Italia Sparkle Group, operates a submarine cable network connecting Israel and Cyprus. Telecom Italia deployed the DTN-X platform, enabling 100Gb/s services.
- Telefónica – has deployed the Infinera submarine solution on its SAM-1 submarine network around Latin and South America, for a total of 25,000 route-kilometers.

<u>Long Haul Service Provider</u>
- Deutsche Telekom (DTAG) – Pan-European network spanning 9,000 km and linking Germany to most European cities. DTAG picked Infinera for its advantages in improved scalability, flexibility, and speed of service delivery.
- Vodafone – Vodafone has deployed Infinera's DTN-X platform for its Europe Persia Express Gateway (EPEG) network, delivering a reliable, high capacity network connection between Europe and Asia.
- Telia Carrier – International provider of telecommunications services in Sweden and Finland, has deployed Infinera DTN and DTN-X for a nationwide network in Sweden.
- BICS (Belgacom International Carrier Services) – A global provider of international wholesale carrier services, BICS deployed the Infinera DTN-X platform to upgrade BICS' 9000km Pan-European network.

- OTE Globe – The international wholesale arm of OTE Group and the leading wholesale carrier in S.E. Europe, has deployed Infinera DTN and DTN-X for the scale, speed, and flexibility.
- Covage – A wholesale bandwidth services provider to telecom operators deployed Infinera DTN for a nationwide optical network in France.
- EWETel – German optical backbone deployment in Lower Saxony and Brandenburg states. Backbone used for supporting multiple services such as high-speed Internet, voice, enterprise services.
- Bulgartel – A wholesale carrier in Bulgaria has deployed a nationwide network with Infinera DTN.

Metro Service Provider

- T-Mobile Austria – Subsidiary of Deutsche Telekom, T-Mobile Austria selected the Infinera Metro optical solution to increase the capacity on its Austria-wide fiber network to meet the growing needs of its mobile service customers. Despite many possible choices, T-Mobile Austria selected Infinera's solution on the basis of its advantageous technical performance and rapid projected return on investment.
- Magyar Telecom – The largest Telecom Service Provider in Hungary, and member of the Deutsche Telekom Group, selected Infinera XTM Series CWDM solution to build a nationwide Hungarian network.
- Telenor Group – A Norwegian global telecommunications services provider deployed Infinera's metro WDM equipment to build an optical metro core network in Norway. Telenor is deploying Infinera's XTM Series throughout 200 sites in order to meet the increasing demand for capacity from both fixed and mobile broadband traffic.

Wholesales Carriers

- COLT – Colt, a leading European provider of business communication operating a 13-country, 25,000 km network, selected an Infinera Digital Optical Network for its pan-European network. Infinera enables it to deliver a broad range of service to customers more quickly than ever before.
- Interoute – Deployed DTN and DTN-X in their pan-European DWDM network (35,000 fiber-km).

Cable Companies

- Agder Breiband, a Nordic region cable operator, has deployed the Infinera DTN and ATN platforms for the flexibility, scalability and simplicity of Infinera's Digital Optical Network solutions
- UPC Cablecom, is the largest broadband cable operator in Switzerland and part of Liberty Global Europe's UPC Broadband division, chose Infinera's Switched Video Transport because of its ability to optimize multicast traffic to cope with explosion in traffic generated by High Definition TV. The completed network consists of four interlocking rings, covering all regions of Switzerland. The network serves at least 2.1 million households, as well as 240 smaller broadband cable operators.
- Telemach upgraded its national network, spanning over 4,000 km and comprised of optical and coaxial components, with Infinera's XTM Series metro equipment. Telemach is the primary provider of cable TV, telephony, and broadband internet services for Slovenia.
- Virgin Media selected Infinera to be the preferred supplier for its national, next-generation Metro Optical WDM deployments. Infinera supplies Virgin Media across multiple Layer 2 solution objectives, including extending backhaul services and the wider deployment of high speed connectivity services, while helping Virgin Media expand its current business with UK-wide deployments.

- Casema, the Dutch Cable TV operator with over 1.4 million subscribers, deployed Infinera equipment to support Triple Play services in The Netherlands. The Infinera enabled network will provide Gigabit Ethernet and SDH capacity to support Casema's expansion in existing triple play services, while also supporting high-capacity services directly to large enterprise customers.

Government, Research & Education
- DANTE (Delivery of Advanced Network Technology to Europe), an operator of advanced networks for research and education, has deployed the Infinera DTN-X for the pan-European GÉANT network it has built and operates on behalf of Europe's national research and education networks (NRENs)
- Retegal – the regional network operator owned by the Galicia regional government in Spain has deployed the Infinera ATN metro WDM transport platform for a regional network delivering services throughout Galicia in northwest Spain.

Internet Content Providers & Managers
- OVH – The largest web hosting company in Europe using Infinera DTN and DTN-X for linking data centers throughout 10 major European cities in seven countries.
- freenet.de – 1800 km nation-wide core DWDM German backbone

Mobile
- Carphone Warehouse – Europe's leading mobile phone retailer and one of the UK's leading Internet service providers deployed Infinera DTN in a national network to support Fast, Reliable UK-Wide Broadband Service.

Conclusion
In the light of the above, we would like to conclude with two key points that we believe are essential to decide on the future of InP under the RoHS directive:

- A ban on InP would have a direct and immediate impact on the telecommunications industry and global internet service provision. This effect cannot be underestimated and will be extremely disruptive leading to lower standards of quality of information technology networks in Europe.

- The amount of InP material concerned is extremely small compared to the volumes that were spoken of for the classic RoHS substances. It seems disproportionate to legislate such a tiny volume of material through such a heavy regulatory instrument.

We do not know why InP was initially targeted under RoHS. Some sources point to its use as in TFT screens (e.g., quantum dots) or other consumer devices. This use is not within the scope of our business. Furthermore, we believe quantum dots technology is being supplanted by OLED technology, which does not have this substance toxicology risks. In the optical telecommunications industry however, a replacement is not possible. Instead, InP uses are small but highly necessary for it to be the most crucial "nuts and bolts" part of our information society.

The volumes of InP in use for the telecommunications industry will remain small as we have shown that even with higher sales, new developments will provide higher performance with approximately the same amount of InP in the devices.

For these reasons, we would conclude that there are not any reasonable grounds to ban InP under the RoHS directive. If it would nevertheless be deemed expedient to do so, we would contend and suggest that a wholesale exclusion for high-speed, high frequency professional-use telecommunications network should be implemented. As set forth above, substitution is not possible and based on the physics of the materials, it is also very unlikely to be discovered from some as yet unknown source. The products containing InP for these purposes have exclusively professional users and therefore take-back and recycling or disposal is equally professional.

Based on our answers and information provided to Oeko, we have demonstrated that the use of InP in optical telecommunications hardware equipment has immense technical, environmental, social and commercial benefits. This material is a technology catalyst to the entire telecom industry and web-enabled world. It squarely fits in the sweet spot where the concerns of people, planet and profits are all properly addressed. It is our belief that eliminating the use of InP in optical telecommunications will have severe consequences in all of these categories. If an exclusion from RoHS cannot be warranted by Oeko, we would like to respectfully request consideration for an exemption for the use of InP in optical telecommunications hardware electronics and electrical equipment.