Optical Systems Design

Fiber Optic Communications

August 2019
Optical Systems Design Pty Ltd

About Us

- Australia based designer and manufacturer of fiber optic communications equipment founded in 1987

- ISO 9001: 2015 certified

- Export oriented: 40 ~ 60% of sales are overseas.

- Engineering based company means:

  - Competent technical support during project proposal, installation, commissioning and operational phases

  - Ability to customise products

OSD

OSD's Background

- 1987 Formed primarily as a consultant/trainer in fiber technology
- 1988 Started the development of video transmission systems
- 1992 Developed first multichannel systems using FM techniques
- 1997 Approx 50% of sales into China and SE Asia
- 2000 Supplied the backbone security links for Sydney Olympics
- 2002 Introduced video equipment using digital technologies
- 2006 Developed the first of a range of Ethernet equipment
- 2009 First broadcast products at the HD/SDI and 3G HD/SDI level
- 2013 First industrialised 10GbE switch demonstrated
- 2016 High power PoE products introduced

OSD Product Range

- Focussed on the provision of fiber optic systems for the transportation and security markets

- OSD products used worldwide in highways, railways, airports, safe city systems, prisons and WiFi networks to name just a few major application areas

- OSD products are extremely rugged and capable of operating reliably from less than -20ºC up to more than +75ºC

- Standard fiber optic systems available for video, data, audio, contact closure, Ethernet, CATV & RF

- Existing products can be modified or custom units designed

OSD's Main Markets (I)

- **Transportation Operations**
  - Highways
  - Railways
  - Airports
  - Seaports

- **Security**
  - Safe city systems
  - Prisons & detention centers
  - Airports & railways
  - Casinos

OSD's Main Markets (II)

- **Oil & Gas**
  - Offshore
  - On shore processing
  - Pipelines

- **Industrial**
  - Power stations, sub-stations & distribution
  - Mine sites, both surface & underground
  - Ship loaders

- **Telecommunications**
  - Outside broadcast
  - RF & CATV transmission & distribution
  - WiFi and wireless backhaul
  - Business premises connections

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OSD Quality & Approvals

- **ISO9001:2015**
  – Accredited since 2001

  EMC
  – RCM mark for products sold in Australia
  – CE for almost all products
  – Special approvals for some markets such as power stations, railways

  Safety
  – Meet Australian & European standards

- **Warranties**
  – Standard 5-year warranty

OSD's Geographical Markets

- Australia & New Zealand   ~ 40%

- China & South East Asia   ~ 20%

- India & Middle East   ~ 20%

- Europe & the Americas   ~ 20%

OSD Technologies (I)

- **Analog Video Systems**
  - Single channel video links, often with
    - Serial data
    - Contact closures
    - Audio
    - Ethernet
  - Multichannel systems from 2 to 128 analog video + ancilliaries on 1 fiber

- **IP Systems**
  - Single 10/100/1000BaseT to fiber media converters
  - PoE to PoE++available on many products with PoE+++ on a few
  - Switches from 3 to 40 ports for
    - 10/100/1000BaseT copper
    - 1GbE copper and fiber
    - 10GbE fiber

OSD Technologies (II)

- **OSD Layer 1 & 2 IP System Features**
  - Redundant ring operation that is much faster than Rapid Spanning Tree Protocol (RSTP)
    - 0.5mS per hop recovery time
    - Plug and play, ie no user setup required
    - Comes with a light network management system that provides all the information needed in most networks

  - Several OSD switches can interoperate with RSTP in mixed networks

  - Web browser GUI +SNMP available on most of OSD's latest products

  - Several OSD products are very small and suitable for use within camera housings

  - PoE, PoE+ and various levels of PoE++ are available

OSD Technologies (III)

- **OSD Layer 3 IP System Features**
  - Redundant ring operation using ITU G.8032 : Ethernet ring protection switching

  - Plug and play, ie no user setup required for basic operation but can be managed

  - Full management functions are available for both monitoring and control of network elements

  - Can interoperate with RSTP in mixed networks

  - SNMP available

  - PoE, PoE+ and various levels of PoE++ are available

OSD Technologies (IV)

- **Serial Data Transmission**
  - RS232, RS422, RS485 and several proprietary interfaces
  - Single and multiple channels on 1 fiber

- **Specialty Data Systems**
  - Vital railway signalling modems (for Alstom, Invensys/Siemens, Ansaldo/Hitachi)
  - Non-vital modems for SCADA, operator interfaces

- **Industrial Networks**
  - Redundant ring systems for several serial interfaces

OSD Technologies (V)

- **Multimedia Systems**
  - HDMI
  - HD/SDI

- **Composite Systems**
  - Analog video/audio/data + HD/SDI
  - Custom variations

- **RF over Fiber**
  - 30 ~ 900MHz CATV point-to-point and point-to-multipoint systems
  - VHF/UHF radio links
  - Broadband 10 ~ 2500MHz links for mobile and satellite

OSD Technologies (VI)

- **Coarse Wavelength Division Multiplexing (CWDM)**
  - Enables up to 18 unrelated systems to share the same fiber
  - Simple way to multiplex many channels, eg video, onto 1 fiber

- **Dense Wavelength Division Multiplexing (DWDM) and Erbium Doped Fiber Amplifiers (EDFA)**
  - Enables transmission of at least 32 individual 2.5Gbps ~ 10Gbps channels over up to 200km without intermediate repeaters

Why do we use Fiber?

Copper Cabling Limitations

Distance: 100s of meters

EMC: Susceptible to EMI &
                can emit interference

Isolation: Not much!
                Can cause ground loop problems
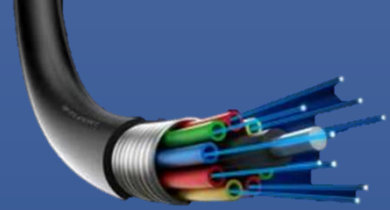
Fiber Cable Features

Wide bandwidth	High data rates
Low attenuation	Wide repeater spacings
Flat attenuation	Simple equipment design
Dielectric construction	Immunity to interference
	Electrical isolation
Small size	Small, easily handled cables
Low weight	Very rugged cables
High strength	Specialised weapons

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Multimode Limitations
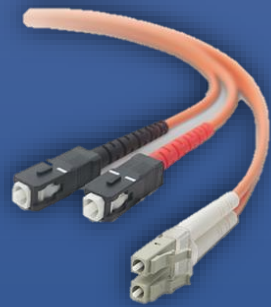
Several different multimode fiber types:

Type	Design	Loss (dB/km) (850/1310nm)	Bandwidth (MHz.km) (850/1310nm)
ITU G.651	50/125	2.5/0.8	500/500
OM1	62.5/125	3.5/1.5	200/500
OM2	50/125	3.5/1.5	500/500
OM3	50/125	3.5/1.5	1500/500
OM4	50/125	2.5/0.8	3500/500

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Advantages of Singlemode Fiber

- Lowest optical loss at all wavelengths

- Highest bandwidth

- Lowest cost fibers and cables

- Equipment costs comparable to multimode

- Some systems (eg RF, CATV) MUST use SMOF

New OSD Products

OSD2054P

- Two 10/100Base-T RJ45 ports and one SFP fiber port.

- Supports IEEE802.3af on one RJ45 port

- Non-PoE port useful for secondary devices or for technician system setup and monitoring

- Powered by non-critical 10 to 36VDC with 48VDC optional

OSD2153P

- One 10/100/1000Base-T RJ45 port and one SFP fiber port.

- Supports IEEE802.3af/at and PoE++

- Powered by non-critical 46VDC to 57VDC power supplies (≥52VDC recommended for PoE+ and ≥55VDC for 60W PoE++)

OSD2154P

- One 10/100/1000Base-T RJ45 port and one SFP fiber port

- Supports IEEE802.3af/at/bt

- PoE++ (60W) available on both RJ24 ports with 90W available as an option

- PoE current limits can be set manually using a built in web browser GUI.

- Automatically configures itself to work with Dual Signature or Single Signature Powered Devices (PDs) such as high performance cameras, Picocells, etc

- Powered by non-critical 46VDC to 57VDC power supplies (≥52VDC recommended for PoE+ and ≥55VDC for 60W PoE++)
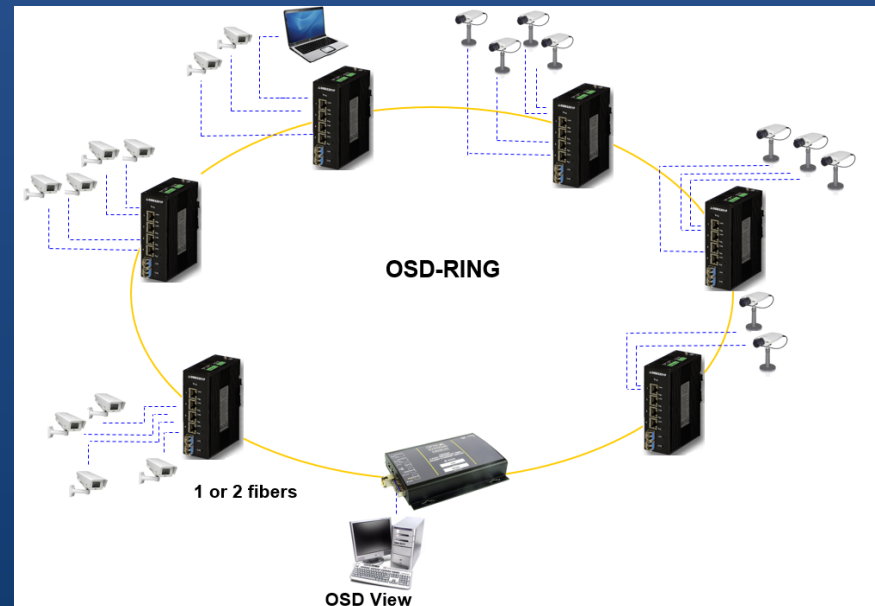
OSD2251 & OSD2251P

- 4- Port Redundant Ring Gigabit Ethernet Switch with optional PoE/PoE+/PoE++ Source

- Provides up to 120W total or 60W per port

- Web browser GUI enables flexible control of PoE functions

- Operates from -20 to +75⁰C

- SNMP available

OSD2254 & OSD2254P

- 6- Port Redundant Ring Gigabit Ethernet Switch with optional PoE/PoE+/PoE++ Source

- Provides up to 240W total or 60W per port

- Web browser GUI enables flexible control of PoE functions

- Operates from -20 to +75ºC

- SNMP available

OSD-RING

1 or 2 fibers

OSD View

OSD

OSD2258 & OSD2258P

- 10- Port Redundant Ring Gigabit Ethernet Switch with optional PoE/PoE+/PoE++ Source

- Provides up to 480W total or 60W per port

- Web browser GUI enables flexible control of PoE functions

- Operates from -20 to +75ºC

- SNMP available

OSD2139

- One 10/100/1000Base-T RJ45 port and one SFP fiber port

- One duplex RS232 and one duplex RS422/RS485 serial data channels

- Two duplex contact closure channels

- RS485 can be 2-wire or 4-wire

- Operates from -20 to +75ºC

OSD2175

- One 10/100/1000Base-T RJ45/GbE SFP combo port and one GbE SFP port
- Can operate as a copper to fiber media converter or as a singlemode to multimode fiber converter
- MAC address swapping for remote loopback
- Optional Synchronous Ethernet
- Optional PoE+ (30W)
- Available for either 48VDC or 240VAC powering
- Operates from -20 to +75ºC

OSD2176

- One 10/100/1000Base-T RJ45, one 10/100/1000Base-T RJ45/GbE SFP combo port and one GbE SFP port

- Can operate as a copper to fiber media converter or as a singlemode to multimode fiber converter

- MAC address swapping for remote loopback

- Optional Synchronous Ethernet

- Available for either 48VDC or 240VAC powering

- PoE+ (30W) on one port (AC version) or both (DC version)

- Operates from -20 to +75ºC

OSD2910

- PoE+ Gigabit Ethernet Extender

- No external powering required:

- Extends the range of PoE and GbE to 200 meters but with daisy chaining this can be as much as 500 meters

- Operates from -20 to +75ºC

OSD2930

- PoE++ or PoE+++ Gigabit Ethernet Extender

- Can be powered from the incoming PoE powered cable OR from an external power source in the range 20 to 60VDC

- Incorporates a DC-DC boost converter that ensures that its PoE output is **always** 57VDC

- Extends the range of PoE++ powered products such as Picocells or high performance cameras to at least 200 metres

- Operates from -40 to +75⁰C

OSD2971

- PoE+ Gigabit Ethernet Injectors

- 240VAC or 48VDC versions available

- PoE PSE compliant to IEEE 802.3at and 802.3af

- Operates from -20 to +65ºC

OSD2975

- PoE++ (60W) Gigabit Ethernet Injector

- Powered by non-critical 20VDC to 57VDC power supplies

- Supports both Single and Dual Signature PoE as well as legacy PoE

- Operates from -40 to +75⁰C

Power over Ethernet (PoE) (I)

PoE is a technology that lets network cables carry electrical power.

Why PoE?

PoE converges the electric power and communication control network onto a single infrastructure.
But remember, you still have to install power supplies somewhere in the system!

OSD

Power over Ethernet (PoE) (II)

PoE is safe; it doesn't require an electrician

PoE switches provide clean, stable, reliable DC power

Ethernet is a global harmonized standard. Customers can use the same products anywhere on the planet.

Power over Ethernet (PoE) (III)

IEEE Standards

IEEE802.3af specifies output of 15.4W

IEEE802.3at specifies output of 25.4W

IEEE 802.3af and IEEE802.3at standard support two alternatives for power injection

- Alternative A, where power is supplied via the center taps of the coupling transformers on data pairs 1/2 and 3/6.

- Alternative B, where power is transmitted over pairs 4/5 and 7/8

Power over Ethernet (PoE) (IV)

Network elements compatible only with IEEE802.3af are classified as Type 1, and elements compatible with IEEE802.3at are listed as Type 2.

- Type 1 (over two pairs) – The PSE can supply a maximum of 15.4W over a voltage range of 44 to 57 VDC using Category 3 cabling or better. This type provides support for legacy installations

- Type 2 – The PSE can supply 30 W (over two pairs) or 60 W (over four pairs) over a voltage range of 50 to 57 VDC using Category 5 or better cabling.

OSD products are designed to be compatible with Type 1 and Type 2.

Power over Ethernet (PoE) (V)

Future of PoE

PoE++ = 60W up to 100W

IP cameras with PTZ, heaters and blowers, and dynamic IR may require up to 95W PoE (sometimes known as PoE+++)

Telecommunications Base Stations may require up to 75W PoE.

A Reminder

As convenient as PoE is, with products needing 60 to 100W of PoE, a power supply is still required which will support these high powers.

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Power over Ethernet (PoE) (VI)

Current Situation with PoE++

PoE++ was ratified in early 2019 and is known as IEEE802.3bt

802.3bt supports 4 pair operation and single or dual signature PD operation

Dual signature detection is useful where a PD derives power from two PSEs (Likely??)

Currently all PoE++ implementations are flying in the dark to some extent: OSD has come across a number of different interpretations which need to be resolved, almost on a case by case basis

Power over Ethernet (PoE) (VII)

OSD Approach to PoE++

OSD will continue to work with its customers in the supply of PoE operating at >30W

OSD currently uses Linear Technology chipsets which are widely accepted by most PDs

OSD will offer IEEE802.3bt when it is ratified and this will include single and dual signature detection

OSD has developed a smart signature detection design which automatically configures the PSE function for single or dual signature operation

Power over Ethernet (PoE) (VIII)

Current OSD PoE+++ Products

Media Converter: OSD2153P/90

Ethernet Switches introduced in Q3 2018 to Q1 2019:
- 6 Port OSD2251/90
- 6 Port OSD2252 which operates from supplies of 20 to 60VDC
- 8 Port OSD2254/90
- 10 Port OSD2258/90

Telco Media Converter: OSD2175/90

10G Media Converters and switches

OSD

IP Camera Bandwidth Considerations (I)

What camera manufacturers tell you:

Standard definition IP cameras using H.264 - to 2Mbps

High Definition (1080p), using H.264 - 4 to 6Mbps

5 Megapixel using H.264 – 6-10Mbps

The values given by cameras manufacturers are average values measured over the course of the time period of seconds to minutes.

Because of the nature of H.264, the video feed may burst to much higher values with some products (not all).

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IP Camera Bandwidth Considerations (II)

What bandwidth do IP cameras really need??

OSD has measured a 2Megapixel IP camera with a peak traffic burst of more than 60Mbps. Even when set to constant bit rate! While this may not be typical, it does suggest that network design should be very conservative

With IP cameras now coming out supporting 4k resolution, it is clear that 100Mbps is no longer suitable for backbones and while Gigabit is necessary now, we will start to see 10GbE requirements for projects with as little as 30 to 100 very high resolution IP cameras

10 Gigabit Ethernet

OSD2890/2890SFP

- OSD2890: Layer 3 Fully Managed 24 x 10/100/1000BASE-T (RJ45) and 4 x10G (SFP+) Ethernet Switch

- OSD2890SFP: Layer 3 Fully Managed 24 x 100/1000BASE-T (SFP) and 4 x10G (SFP+) Ethernet Switch

- Operates in severe uncontrolled environments

- Utilises ITU G.8032 : Ethernet ring protection switching so can be incorporated into extremely large rings (ie >40 nodes)

OSD2892

- Layer 3 Fully Managed 36 x 10/100/1000BASE-T (RJ45) and 4 x10G (SFP+) Ethernet Switch

- Operates in severe uncontrolled environments

- Utilises ITU G.8032 : Ethernet ring protection switching so can be incorporated into extremely large rings (ie >40 nodes)

OSD2801

- One 1G/10GBase-T RJ45/SFP combo port and one SFP fiber port

- Can operate as a copper to fiber media converter or as a singlemode to multimode fiber converter

- Operates from -20 to +65ºC

Recent OSD Projects

T2T Road Adelaide, Australia

- 4km non-stop roadway incorporating 3 km lowered motorway

- PoE Cameras up to 60W using OSD2153P

- Fixed PoE cameras using OSD2053P

- Lane management, Variable Message Signs and Traffic Detection using OSD138

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Telstra Air WiFi Rollout, Australia

- Over 6000 public WiFi installations across Australia

- The OSD2971 PoE injector and OSD2175MP PoE+ media converter are used

- Reliable operation above +65degC required

Rio Tinto Obstacle Detection, Australia

- Ansaldo designed a Scanner and PLC for detecting trains or any obstacle on the rail track.

- The OSD159 was used to provide the transmission of contact closures over fiber.

- OSD modified the OSD159 to work in a fail-safe mode switching from 0 to 24VDC from the scanner.

OSD

Khazzan Oman Gas Processing Facility

- OSD8817 used for Analog PTZ camera Surveillance

- +75degC temperature compliance

- Remote data configuration

- Optional SNMP

OSD

Sunway Montana, Melawati, KL, Malaysia

- OSD732S used for Help Telephones and Alarms

- The OSD732 was modified to include SFPs, Contact Closure Channels and a 2ch Rx card which halved the number of 3RU chassis and power supplies needed in the control room

GRTgaz Natural Gas Transmisison Network France

- OSD2051P for surveillance

- Fixed IP PoE cameras

- OSD2051P chosen due to small size

Simhapuri Expressway India

- 183km ITS Highway

- All IP cameras and Variable Message Signs connected to OSD2251 redundant ring network

- SNMP for remote monitoring

Case Study IP CCTV
Paradip Refinery Project
Indian Oil Corporation Limited (IOCL)

- Refinery site is spread over a total area of 3344 acres

- OSD2041 based fiber optic links for more than 500 IP cameras

OSD

IOCL Paradip Refinery Features

- High temperature rating (+75ºC)

- 1-fiber solution for simple configuration and fiber reduction

- Very rigid bidding process proving the OSD2041 had been used in multiple petrochemical projects.

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Case Study IP CCTV
Power Grid Corporation of India Limited (PGCIL)

- PGCIL has 186 substations throughout India

- OSD2041PSS based fiber optic links for the transmission of CCTV around these substations

PCGIL Features

- OSD2041PSS specifically developed for this project

- EMC compliance of IEC 61000-4-4, IEC 61000-4-18, IEC 61000-4-11, IEC 61000-4-8 and IEC 61000-4-17.

- Strict approval process with external audit testing

Case Study IP CCTV
King Khalid International Airport

- One of the largest airports in the world

- OSD2244V used to transmit CCTV on fiber from the perimeter fences of the airport due to the vast distances

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King Khalid International Airport Features

- Redundant Fiber Optic Network

- Virtual Local Area Networks (VLANs) provide network stability by limiting broadcast traffic

- Industrial Ethernet switches used to withstand summer heat

- OSD2244 used with 10km,20km and 40km SFPs

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Case Study HD/SDI CCTV
Hong Kong International Airport

- Currently one of the world's busiest cargo and passenger airports

- HD/SDI cameras used for specialized CCTV

OSD

Hong Kong International Airport Benefits

- Fiber optic transmission provides immunity to electrical interference

- Uncompressed digital video transmission running at 1.485Gbps

- HD/SDI allows allows viewing excellent high definition images at 1080P while also allowing the video analytics to work with full 1080P frames.

- OSD products used - OSD8327 & OSD8224

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Case Study Analog & IP CCTV Yamuna Highway India

- Yamuna Expressway is India's longest access controlled expressway and links Delhi to Agra (Taj Mahal).

- OSD products provide the fiber optic backbone for the highway's state of the art Intelligent Transport System (ITS).

- Total length of the network is 165km.

Yamuna Highway Features

- Redundant fiber optic links

- Minimal fibers are required because Coarse Wavelength Division Multiplexing (CWDM) technology is used

- Longest unrepeatered link exceeds 135km

- OSD Products used – OSD860S , OSD2244M, OSD2700F

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OSD the Company

Key OSD Advantages

- Very cost competitive with European & US brands

- Most OSD products are very flexible in their functionality

- OSD is large enough to guarantee reliable, consistent quality

- OSD is small enough to be able to customise products

- Very high design & build quality

- OSD can develop completely new system products

Why Use OSD?

- A PRODUCT RANGE WELL SUITED TO MANY MARKETS
    - Total solution or one-stop shopping
    - Easier on-going maintenance & service

- FLEXIBLE & COST EFFECTIVE SYSTEM CONFIGURATION
    - Modular product function design applies to almost all OSD products so you can often use less boxes and/or less fiber

Why Use OSD? (ctd)

- PRODUCT QUALITY & RELIABILITY
  - Designed and manufactured under a quality endorsed system.
  - Only high quality components & processes are used.
  - Product performance complies with announced specs.

- ENGINEERING BASED COMPANY
  - Technical & sales support comes from the factory.
  - OSD engineers can help you design a smarter, more cost effective solution, particularly if they are involved early in the project/system design process.
  - And, if your requirements just cannot be met with standard products, OSD can custom design a solution for you.

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OSD Product Roadmap

- **EXISTING PRODUCTS**
  - Most current products , especially OSD's range of analog video and RF over Fiber products, will be retained, maintained and in some cases extended as necessary for the next several years
  - OSD will develop further non-IP products, eg for railway signalling, when these make commercial sense but most emphasis will be on IP products

- **ETHERNET (IP) PRODUCTS**
  - Current range extends from basic media converters to 40 port switches operating with 10Gbps optical ports
  - 95% of OSD's Ethernet gear is intended for industrial sites that usually have no air conditioning
  - OSD has a broad and growing range of Power over Ethernet (PoE) media converters, switches, extenders and injectors

OSD Product Roadmap

- INDUSTRIAL SWITCHES AND MEDIA CONVERTERS
  - An increasing emphasis on Layer 3 managed 10G media converters and switches of anything from 4 to 52 ports
  - PoE will be optionally available on almost all new products

- SPECIALITY INDUSTRIAL NETWORKING PRODUCTS
  - Small port count switches that are EN50155 compliant (for railway application) will be introduced mid 2020. These will be physically and electrically hardened versions of then current OSD products
  - Likewise selected products will be enhanced to meet IEC61850 in order to qualify for use with power stations and substations

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OSD Product Roadmap

- ENTERPRISE CLASS SWITCHES
  - By mid 2020 OSD will be offering 40G and/or 100G media converters and small switches suitable for dark fiber commercial networks

- TELECOMMUNICATIONS ORIENTED PRODUCTS
  - Development of OAM software modules suitable for small to medium size switches/media converters
  - Currently OSD has several small 1G switches/media converters developed especially for Telcos
  - These will be extended to 10G in 2020 and some versions will include encryption needed for sensitive communications
  - By late 2020 – mid 2021 OSD will be offering 100G switches for 4G/5G wireless fronthaul and backhaul

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OSD Product Roadmap

- POST 2020 PRODUCT SOLUTIONS
  - As of mid 2019, the development paths for widely touted technologies such as 5G (particularly mmWave based 5G) and IoT are still not clear. IoT is likely to be a vast number of independent IP based networks rather than just one true internet. Likewise, while initial 5G offerings are a development of 4G and operate at lower GHz frequencies, the future mmWave 5G network presents huge technical challenges and, as significantly, the cost justifications seem a bit optimistic. It will be at least a further year or two before standards emerge and real network operator investments start
  - OSD will have by 2020 a very solid technology base in carrier class products for the edge and, combined with its historical focus on rugged industrial oriented solutions, will be able to respond quickly to opportunities as they arise
  - And as always, OSD will be responding to specialist requirements from our traditional industrial and defence customers

Thanks for Your Time!

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