



Co-deployment of Fibre Optic Cables (FOC) Infrastructure

RoW of Roads & Railways including Cross Border

Welcome

To

UN-ESCAP Workshop

Co-deployment of Fibre Optic Cables RoW of Roads & Railways including Cross Border

**Mobile & Fixed
Broadband &
ICT Penetration
For
Inclusive Growth**



Internet Kiosk in Remote Rural Area

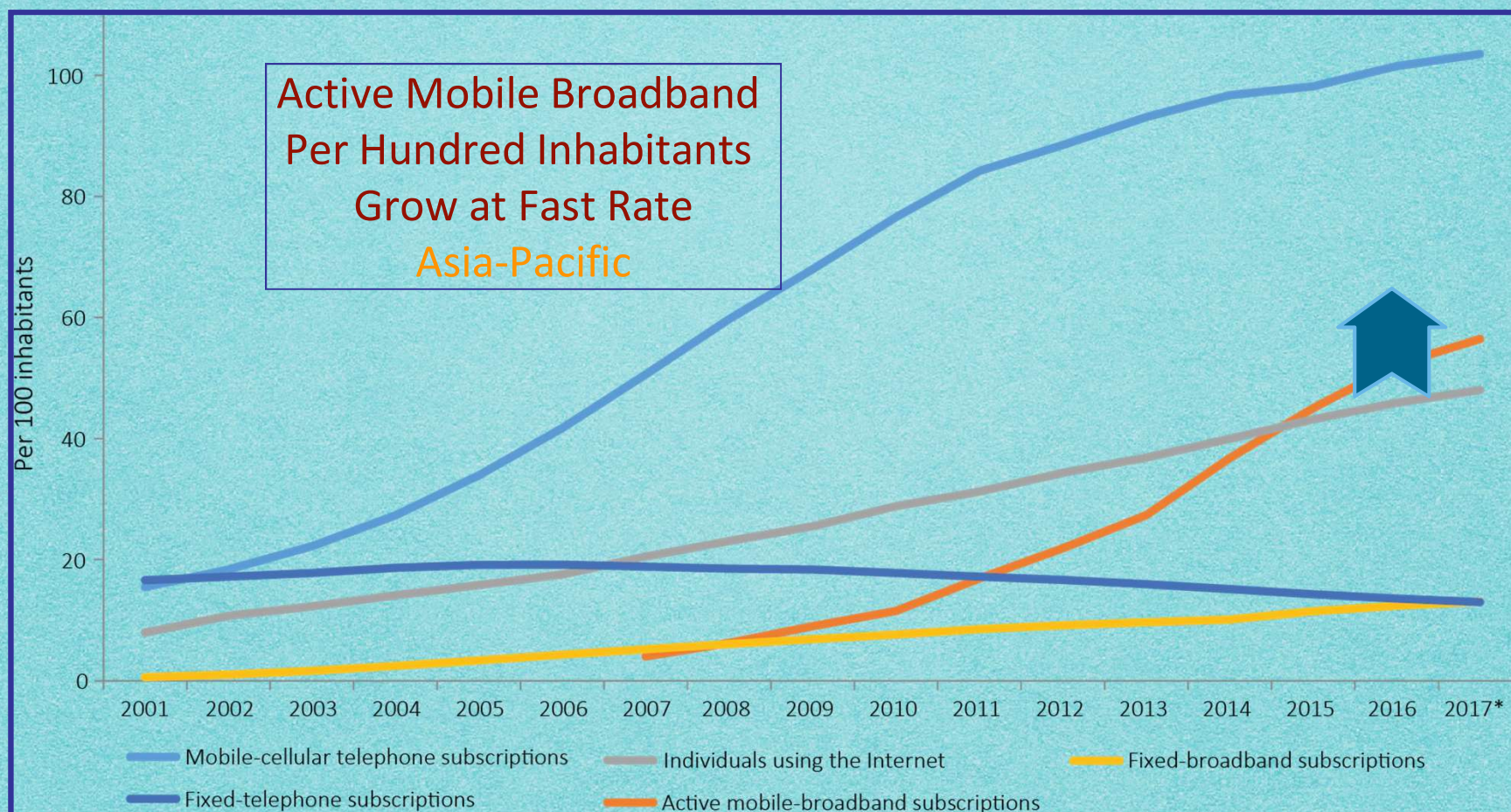
Study on Co-deployment of Fibre Optic Cables

Bridge Digital Divide to meet SDGs

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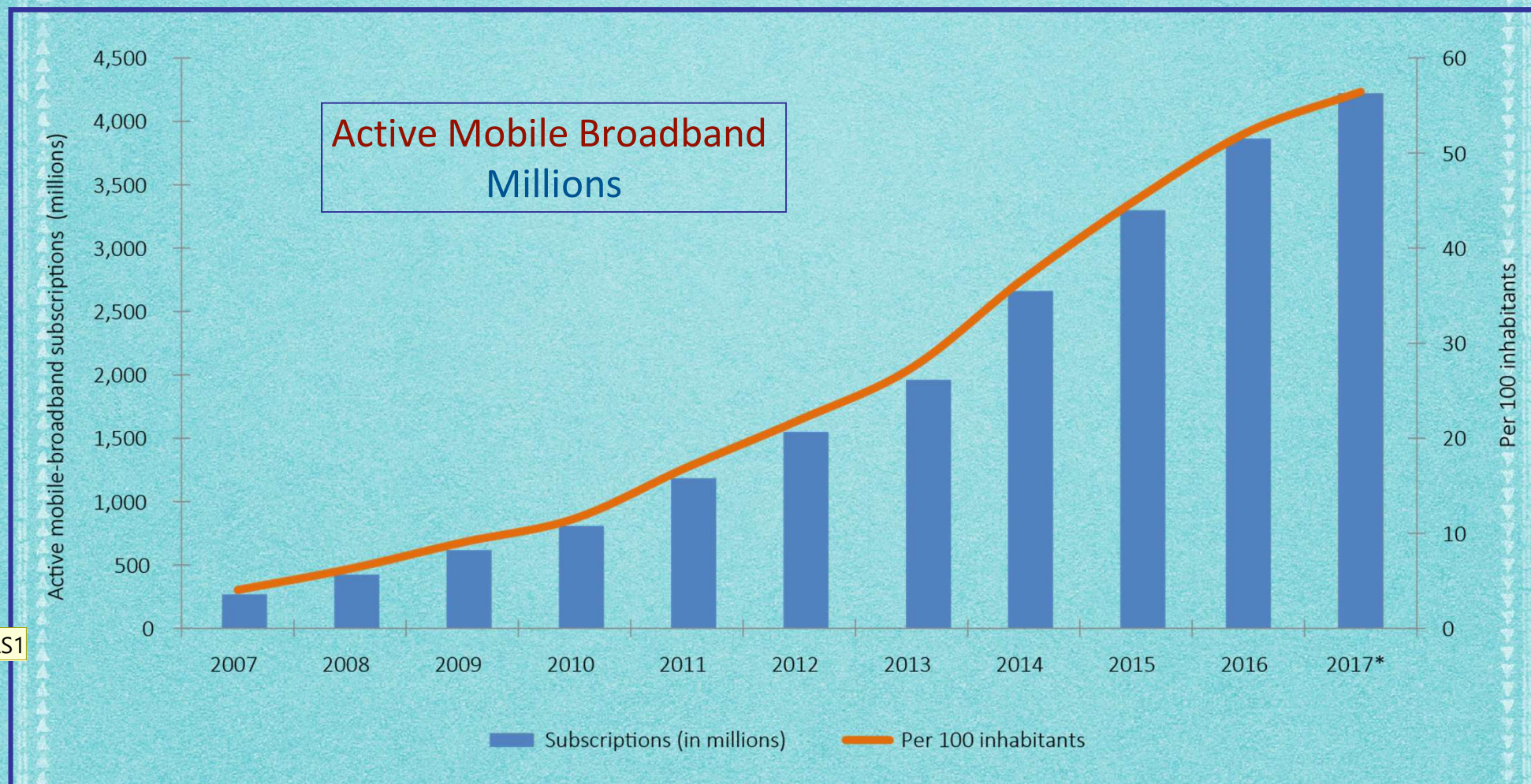
- Broad Band & Internet - World Scenario - Inadequate Internet & Broad Band Penetration - DIGITAL DIVIDE
- Background of Study Initiated by UN-ESCAP - Achieving Sustainable Development Goals (2030)
- Terms of Reference of Study
- Components of Broadband & Internet Access
- Presentations by National Consultants of China, Korea, Russia, Thailand & Turkey
- Indian Perspective, Cross Border Cases & Consolidated Conclusions & Recommendations

ICT Penetration - Status (ITU 2017)



ICT Penetration - Status (ITU 2017)

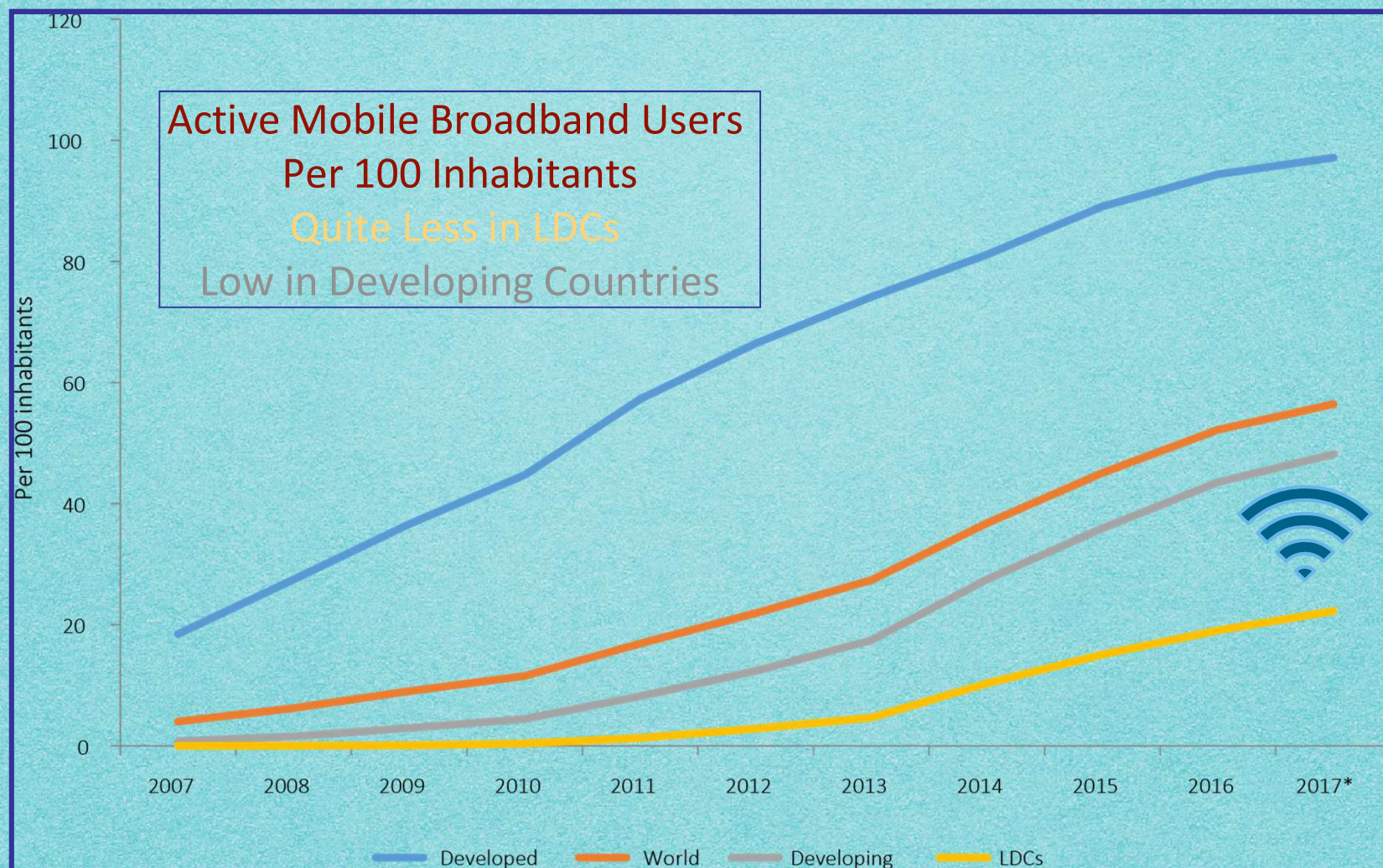
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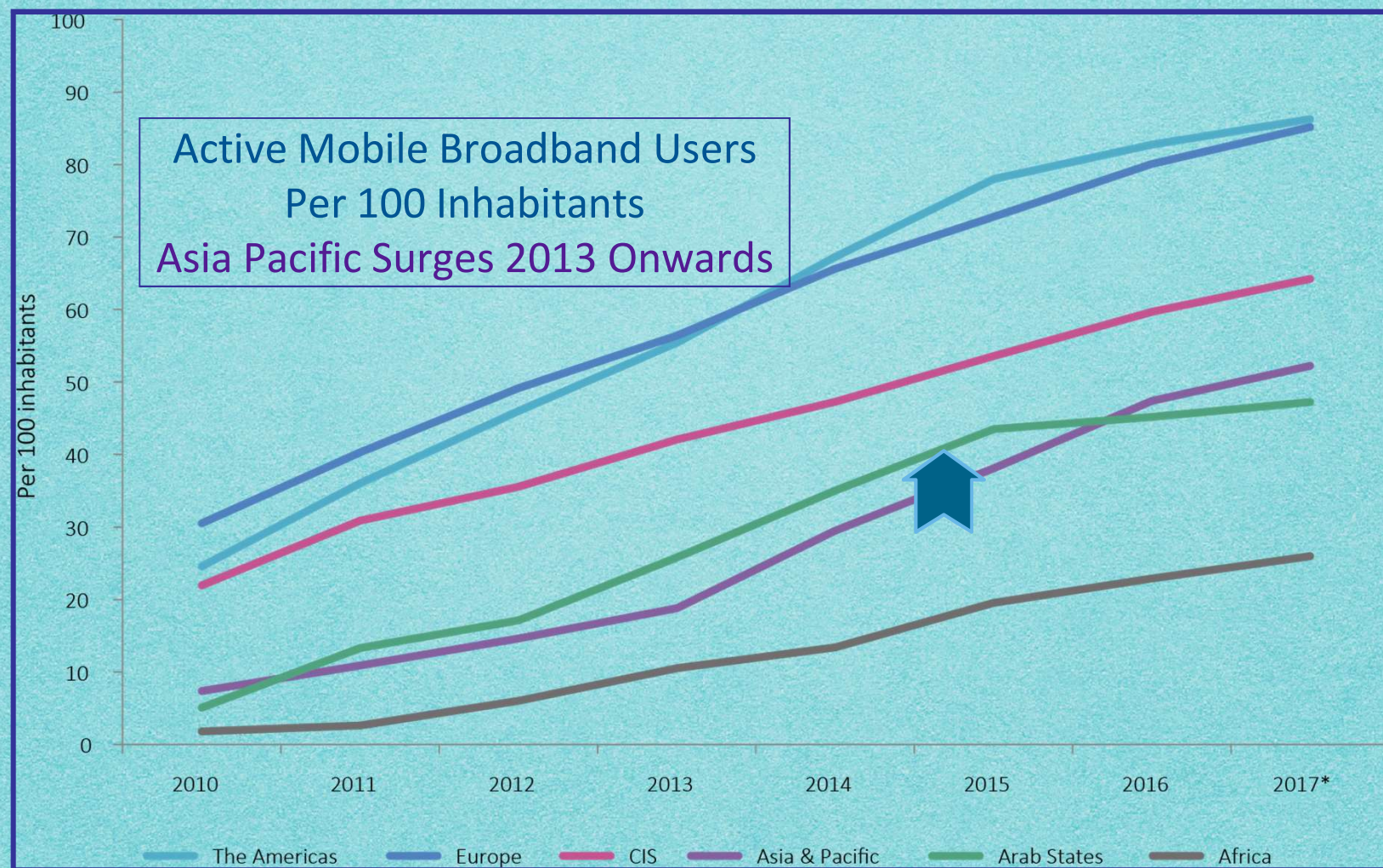
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AS1 In Last 5 Years or So, Active Mobile Broadband Users have Increased Substantially
Arun Saxena, 10-Nov-18

ICT Penetration - Status (ITU 2017)



ICT Penetration - Status (ITU 2017)



ICT Penetration for SDG

Progress Continues in Use of ICTs
in All Regions of World

Digital Divides & Inequalities, However, Continue

ICT Contributes Significantly towards Economic & Social Development
of Regions, Countries, Communities & Individuals.



Use of ICTs Require Fixed or Mobile Broad Band Access to Terminal

Important Component of Broadband Includes Long/Back Haul FOC Network,

FOC Broadband Access in Rural Area

Number of Broadband Subscribers in Rural Hinterland
in Most Countries is Low

Paying Capacity of Subscribers in Developing Countries & LDCs is
Less & Availability of Smart Phones/Laptops & PCs is Poor

Installation, Operations & Maintenance Costs for ISPs/TSPs of
Broadband Systems are High

Returns on Investment are Not Adequate



Cost Effective FOC Technology Solutions,
Sharing & Management of Infrastructure,

Government/State Financial Support for Viability Gap

Public-Private Participation Strategies are Required

FOC Network for Broadband

- ICT Applications Require Fixed or Mobile Broadband Terrestrial Links for Resilience & Latency (International Internet through Submarine Cables)
- **Components of Broadband Include:**
 - Long/Back Haul FOC Network,
 - **Access Network** (Copper Cable, FOC or Wireless,
 - **Data Terminal** (Smart Phone, LapTop, iPad etc)
 - **Applications**^{AS2} **Content in Local Language &**
 - **Affordability** (Rural Area & Hinterland)
- **Broadband Strategies** - Seek to enable Access for all Households to Internet using FOC - FTTH, FTTB, FTTx & Long Haul at LOW COST

AS2

RAILWIRE SOLUTION OF RAILTEL

Arun Saxena, 07-Aug-18

FOC Backbone Network Issues

- Deploying FOC Network Intra & Inter City Cumbersome:
 - Multiple Permissions for RoW,
 - Delays in Processing,
 - License Fee/Lease Charges Not Transparent,
 - Damage to Utilities & Restoration Works/Costs
- Absence of Common Utility Duct or Pipes for Sharing between Entities & Non Availability of Information Transparently
- Co-deployment & Sharing of FOC System laid along Transport (Roads/Railways) Infrastructure, Electric Power Transmission Lines & Gas/Oil Pipe Lines

Co-habitation or Co-deployment

FOC Relevant Definitions

- **Co-habitation** - Existing Together on same RoW -
Co-habitation of FOC along Highway/Road or Railway – Provision of FOC along Transport Infrastructure using Land acquired for Highway/Road or Railway.

Present Practice in Most Countries as FOC is Later Entrant

- **Co-deployment** – Mutual, Integrated or Common (Together) Deployment of FOC & Highway/Road or Railway – on Land acquired for Transport Infrastructure; Individually or Jointly by Sector Entities.

Strategy for Optimising Costs on FOC Network Provision along New Roads/Railways or Where Capacity Augmentation is Envisaged

FOC Co-deployment

Variants

- **Aerial** - ADSS Optical Fibre taken Overground hanging on Masts & Poles (Limited Deployment)
- **Along Pipe Lines** - By Side of Gas or Water Pipelines for Asset Monitoring.
- **On Power Transmission Lines** - Using OPGW on Earth Wire (Power Transmission Entities)
- **Directly buried** - Taken through Underground HDPE Ducts within RoW. (Present Practice in Most Countries)
- **Pipes/Conduits** – Integrated or Common Deployment of FOC – on Land acquired for Transport Infrastructure.
- **Utility Concrete Ducts** - Strategy for Optimising Costs on FOC Network & ICT Provision along Work of New Roads/Railways or Expansion

FOC Network along Roads - India

Entities	Route Kms Provided
Public Sector Units (Government)	
BSNL + MTNL	473124
PGCIL	33282
GAIL	13000
BBNL	272000
Sub Total	791406
Private Sector Units	
Reliance Com	179318
Reliance Jio	192487
Bharati AirTel	183795
Tata Telecom	57807
VodaPhone	177187
Idea	57732
Ors	69635
Sub Total	917961
Gand Total	1709367

More than 1.7 Million Kms
Network in India to be made More
RESILIENT by SHARING
Space in Ducts & Pipes
Fibres & Bandwidth

Updated from TRAI



Bharat Net - National Optical Fibre Network (NOFN)

NOFN will provide a minimum of 100 Mbps Broadband Connectivity to **250,000 Gram Panchayats (GPs)** in India

covering nearly **625,000 Villages**

for Digital India Initiative.

BharatNet is world's largest Rural Broadband Connectivity Program.

Bharat Broadband Network Limited (BBNL) Set Up to Undertake Work of NOFN Implementation & to Own Network.

RailTel has been selected as one of Implementing Partner (along with BSNL & PGCIL)

BBNL has allotted 11 states comprising of 36,000 panchayats to RailTel.

Bharat Net - National Optical Fibre Network (NOFN)

Status Nov 2018

STATUS OF BHARATNET AS ON 05.11.2018

Description of Work	Status
Pipe Laid	2,81,628 Kms (1,21,453 GPs)
Optical Fibre Cable Laid	2,92,170 Kms (1,20,017 GPs)
Tenders Finalized	3291 Blocks / 1,22,828 GPs
Work Started*	3285 Blocks / 1,22,379 GPs
Current Weekly Performance of FOC Laying	481 Kms
Current Weekly Performance of Pipe Laying	343 Kms
Optical Fibre Cable Delivered on Site	3,41,568 Kms
Service Ready GPs	<u>1,15,958 GPs</u>

<http://www.bbnl.nic.in/index1.aspx?Isid=570&lev=2&lid=467&langid=1>

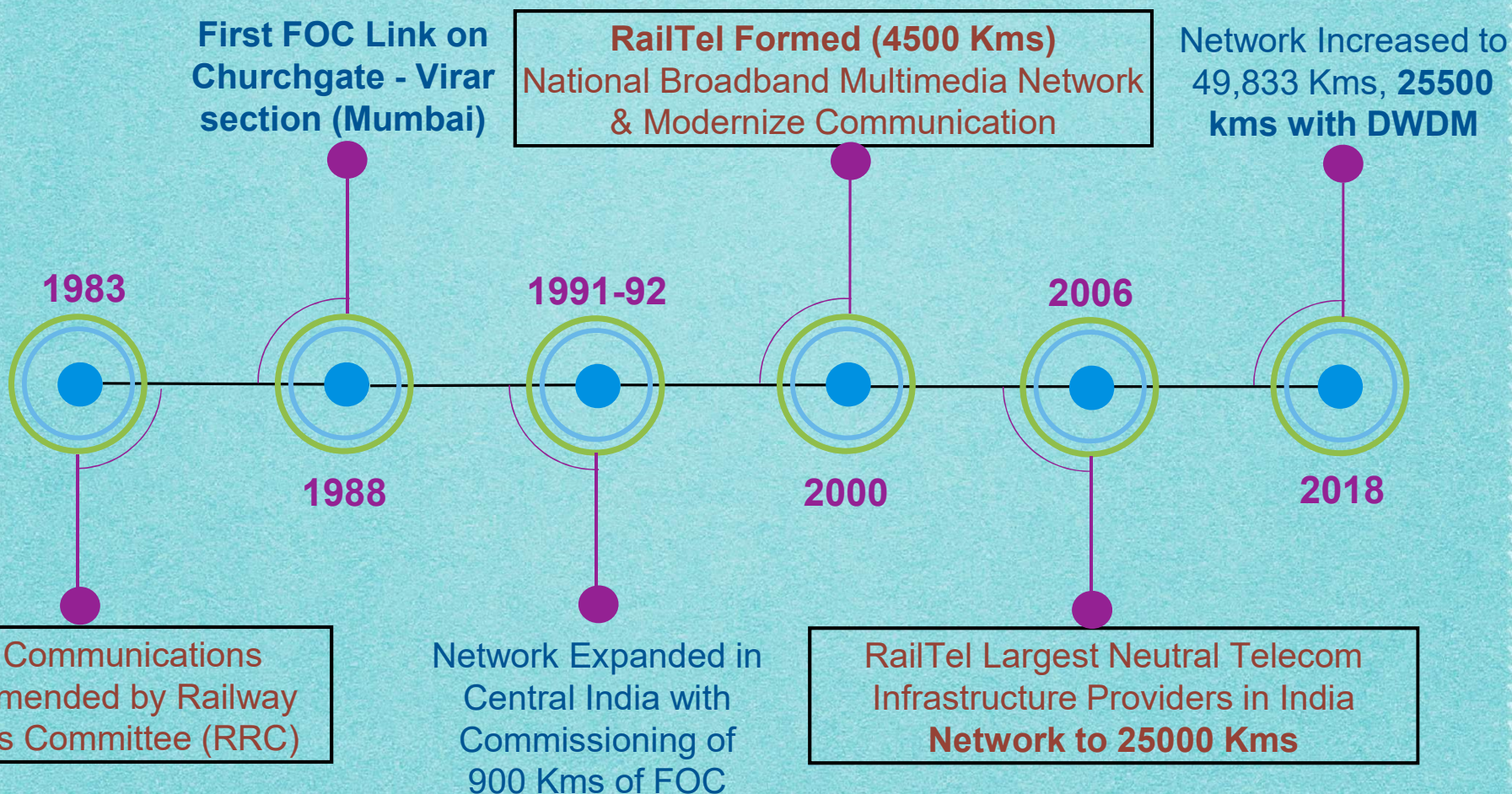
FOC Network along Railways - India

FOC Network Entities	Total Route Kms Provided	Or Details
RailTel	49,833	4500 PoPs at Stations along RoW of Railway (51247 on IR)
Indian Railways (Or)	3,822	
Gand Total	53,655	

Indian Railways (IR) - FOC on **53,655 Kms** Out of Route Track Length of **67,368 Kms**

Planned for Covering Remaining Sections.

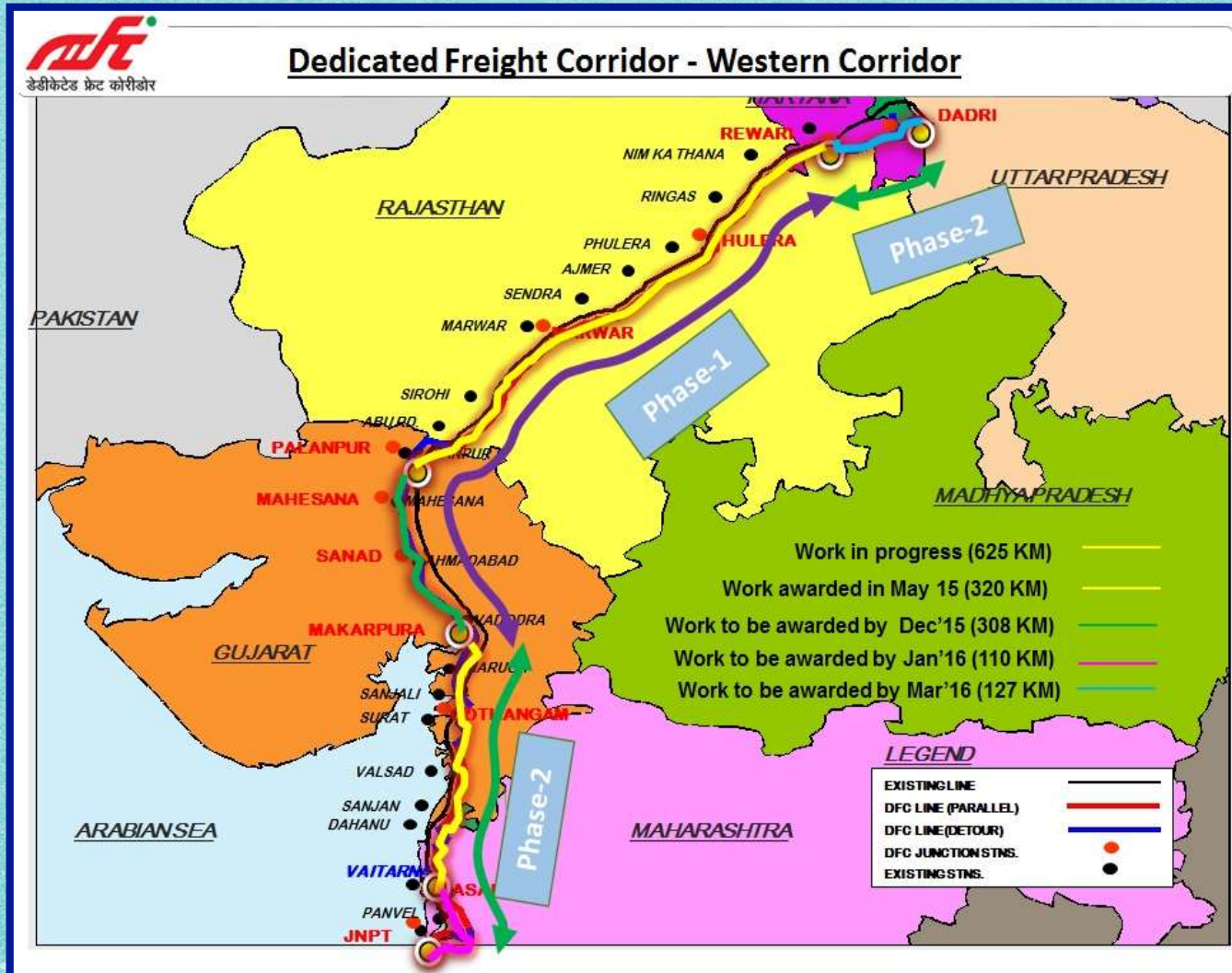
Evolution of FOC Network - Indian Railways (Timeline)



Western Dedicated Freight Rail Corridor (WDFC) - India

FOC Co-Deployment (Construction Together)

WDFC
Length
1503 Kms
Double Line
Dadri/Rewari
SonNagar
Vadodara
Mumbai
(JNPT)



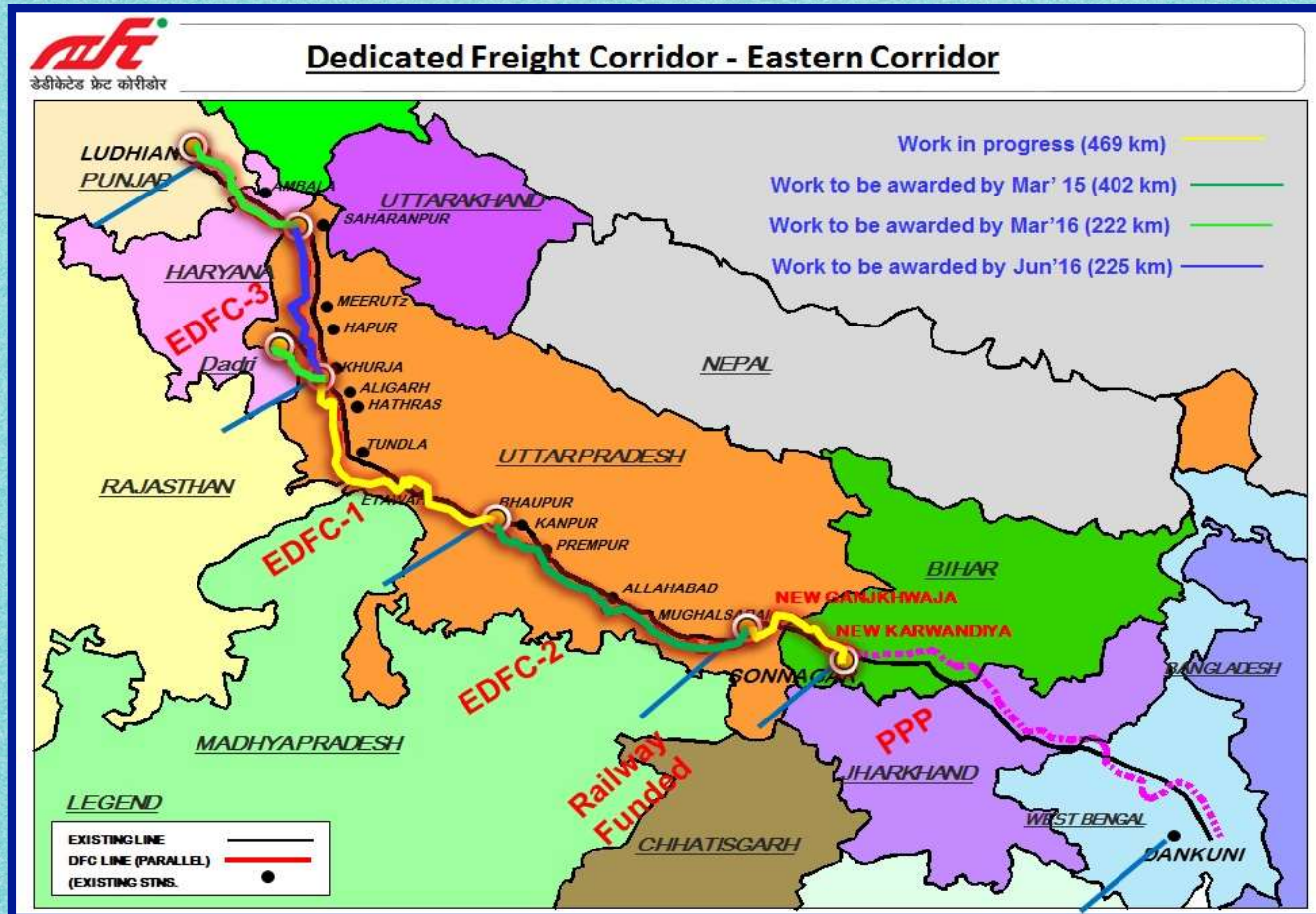
24 + 48 Cores
FOC in HDPE
Pipes
Up & Down
Sides of Track
SDH - STM1/4
All Stations &
OCC

Project Funded by JICA

Eastern Dedicated Freight Rail Corridor (EDFC) - India

FOC Co-Deployment (Construction Together)

EDFC
Length
1856 Kms
Double Line
(1409 Kms)
Dankuni
SonNagar
Mughalsarai
Bhaupur
Khurja/Dadri
Ludhiana



24 + 48 Core
FOCs in HDPE
Pipes on Up &
Down Sides of
Track
SDH - STM1/4
All Stations &
OCC

Project Funded by World Bank

Cross Border FOC Deployment

FOC Network Entities

PSUs

BSNL

PGCIL

TCIL

Private Units

Reliance Com

Reliance Jio

Bharati AirTel

Tata Telecom

Some Public Sector Units & Private Entities have deployed FOC Cross Border for extending ILD & Internet Connectivity to Neighbouring Countries

(China, Bangladesh, Bhutan, Myanmar, Nepal)

Cross Border (Terrestrial) FOC Deployment

Country	Unit	Terrestrial Link with INDIA
China	Private	<ul style="list-style-type: none"> Reliance Comm & China Telecom - Link Commissioned in 2009 - Capacity 20 Gbps between Siliguri India to Yadong, China. Bharti Airtel & China Telecom - Link Opened in Dec 2010 - Capacity 40 Gbps between Yadong & Siliguri via Nathula. China Telecom & Tata Comm also Opened an FOC Link in 2010.
Myanmar	PSUs	<ul style="list-style-type: none"> BSNL & Myanmar Post & Telecom (MPT) - 640 Kms FOC Link Completed in 2010 - Cost of 7 Million USD - Capacity of STM-4 (622 Mbps) between Mandalay, Myanmar & Moreh, India. Cable is owned BSNL & MPT but Installation by Telecommunications Consultants India Ltd. (TCIL)
Bangladesh	PSUs	<ul style="list-style-type: none"> PTCL & BSNL - 95 Kms Link between Dargah, Bangladesh

Ref: Terabit

Cross Border (Terrestrial) FOC Deployment

Country	Unit	Terrestrial Link with India
Bhutan (Land Locked)	PSUs & Private	<ul style="list-style-type: none"> FOC brought in Service between Jaigaon, India & Phuentsholing, Bhutan Assam, India to Galephu, Bhutan, Commissioned in 2011.
Nepal (Land Locked)	PSUs & private	<ul style="list-style-type: none"> Nepal Telecom Links with Indian Operators - Airtel, BSNL & reliance at Birgunj-Raxaul & Birtatnagar-Jogbani Border Crossings. Tata Comm Connects Network of UTL via links at Birgunj-Raxaul Border as well as at Bhairahwa & Sunauli.
Pakistan	PSUs & Private	<ul style="list-style-type: none"> FOC Terrestrial Link between India & Pakistan, linking Indian network of Tata Comm in Amritsar to Network of PTCL in Lahore, via Wagah Border - Installed & Activated. Agencies may agree to allow Voice

Ref: Terabit

Cross Border Co-Deployment Cases

Co-Deployment of Fibre Optic Cable (FOC)

**Passive Infrastructures
(Pipe & Transmission Lines, Roads & Railways)**

Long-Standing Practice

Within Countries & Across Borders.

Utilization of Business Practices & Technology

Would Help in Narrowing Digital Divide in Region

Provide Greater Resilience to Critical Infrastructure

Information Collated by UN-ESCAP ICT Division

Cross Border Co-Deployment - Turkey

Case Studies

Turkey is an Important Interconnecting Link & Junction
between Europe & Asia

Bilateral & Regional Level Vital FOC Routes pass through
Turkey, Important Case Study

Similar to or Countries, Turkey also follows Co-deployment for
National Telecom Network.

Cross Border also, Turkey adopts Co-deployment with
Neighbouring Countries.

FOC Link Route along E99 (AH84) Provides Connection for
Azerbaijan to Diversify Connectivity Infrastructure & Enhance
International Bandwidth Capacity

Gulf Bridge International link, known as GBI-North
Terrestrial Link on Southern Border to Connect with Iraq & European
Networks in North

Cross Border Co-Deployment - Turkey

Azerbaijan (Nakhchivan Autonomous Republic) - Turkey	
Date	2008
Length	145 kms
International Connectivity	Turkey to Nakhchivan via Hasret (Longing) Bridge over Aras River
Main Nodes	Nakhchivan
Capacity	STM 4 (622 Mbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	Azertelecom/ Delta telecom & Turk Telecom
Along Rail/Highway	E99 Highway (Igdir-Nakhchivan Yolu) <u>AH84</u> in Turkey Sector
Notes	Installed in 2.5 Months in Late 2007 by Turk Telekom Earlier Link to Nakhchivan was via Islamic Republic of Iran.

Cross Border Co-Deployment - India

Inter Governmental Agreement for Transport & Telecom Connectivity

**Bangladesh Telecom Company Limited (BTCL) Established FOC link with
Bharat Sanchar Nigam Limited (BSNL)**

**RoW of Road between Akhaura & Agartala, in Tripura (India) Terminated in
Hand Hole/Joint Enclosure in Integrated Check Post (ICP)**

Work Commenced in July 2015 & Completed in Jan 2016

**ILD Gateway & Integrated Check Post has been set up at Agartala along with
associated equipment for Lawful Interception & Monitoring of Data Traffic**

**Provides Third International Internet Gateway (IIG) through Cox's Bazar in
Bangladesh. FOC, between Akhaura & Brahmanbaria, a distance of about 30
kms, Laid by BTCL.**

Cross Border Co-Deployment - India

Agartala (India) & Akhaura (Bangladesh)	
Date	2016
Length	45 kms
International Connectivity	Agartala, India via Brahmanbaria & Akhaura, Bangladesh to Cox's Bazar
Main Nodes	Agartala
Capacity	10 Gbps (Extendable to 40 Gbps)
Technology	SDH
Developers/Owners/Operators	BSNL, India & BTCL & BSCCL, Bangladesh
Along Rail/Highway	Agartala - Akhaura Road
Notes	ILD Gateway & Integrated Check Post (80 Million INR) Setup at Agartala along with Associated Equipment for Lawful Interception & Monitoring of Data Traffic. Caters for 3rd

Cross Border Co-Deployment - India

Along Transmission Lines

▶ Power Grid Corporation of India Limited (**PGCIL**), 'Central Transmission Utility (CTU)' owns & operates one of largest Power Transmission Networks & carries more than 50% of Power Generated in India have FOC Links using **Optical Ground Wire (OPGW)** on High Voltage Power Transmission Lines.

▶ POWERGRID has commissioned Inter Country Power Transmission Lines with OPGW to some countries on a few routes

- Routes to **Bhutan** are between Gelephu – Bongaigaon (India) & Malabase – Siliguri (India)
- Routes to **Bangladesh** are between Bheramara – Behrampur (India) & Comilla – Agartala (India)
- Routes to **Nepal** are between Dhalkebar – Muzaffarpur (India) & Mahendranagar – Ranakpur (India)

Cross Border Co-Deployment - India

Other Cases

Telecom Corporation of India Ltd (**TCIL**), a Government of India PSU, has executed an FOC from Tamu, a Burmese City near Indian Border to **Mandalay**, second largest city in Myanmar, a distance of about 475 Kms. On Indian side, **BSNL** were to link at Tamu from city of **Moreh** in Manipur. This is first Land Link between **Myanmar** & India in Southeast Asian Region.

This Land Link will serve as a **Backup to BSNL/MTNL Submarine Link** to Singapore planned by a **JV, Unit Millennium Telecom Ltd.**

Cross Border Co-deployment - India

Private Sector Cases Continued

- **Bharti AirTel & Tata Telecom** have laid FOC & have established Links with International Terrestrial Cable (ITC) Operators at Benapole - Petrapole, West Bengal (India) border with **Bangladesh**.
- Bharti Airtel Asia's leading Integrated TSP launched a new **Terrestrial Cable Network to Bhutan** as a part of Network Expansion Plan to open up new Cross Border Connectivity solutions for South Asian countries. Airtel inked an MoU with Royal Government of Bhutan to extend fibre connectivity to Himalayan Kingdom.
- **Reliance** to build new India-Bangladesh fibre links in September 2009. Indian TSP **Reliance Communications (RCOM)** improved links between remote northeast of India with rest of country by deploying new terrestrial fibre-optic routes passing through Bangladesh

Cross Border Co-Deployment - India

Other Cases

- BSNL to extend FOC Connectivity to Internet Gateway & Bhutan & Bangladesh & International access through undersea FOC to reduce dependency on Satellite links in land locked Nepal
- BSNL has established connectivity to Bhutan through Hashimara (India) & Phuntsholing (Bhutan) extending 8 streams of 2 Mbps Bandwidth for ILD

Consolidated Benefits & Opportunities

Roads & Highways

Railways

Cross Border

FOC Co-deployment along Roads

Benefits & Opportunities

- Reduce Damage to FOC due to Construction & Farming

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- RoW is Secured to allow Civil Works as Concrete Conduits Demarcates Land Boundary. Prevents Encroachments.
- Existing Utilities - Overhead Telecom Cables, Power Transmission Lines & Or Utilities - Coming in way of Civil Works - Diverted thereby providing space for smooth execution
- Save Costs over Life Cycle minimising Civil Works & Repairs. Saves Land Requisition & Conduit/Pipeline Construction Cost.
- Efficient Allocation of Resources by sharing Infrastructure in a Transparent & Competitive Manner.
- Prevention of Improper Urban Development. Minimise Disturbance to Road Traffic & or Utilities during house of work &/or maintenance.

AS3

Interaction with GM NHA

Arun Saxena, 11-Sep-18

FOC Co-deployment along Railways

Benefits & Opportunities

- Provides Reliable Media for **Signalling, Train Operations Control, Predictive Maintenance, CCTV, Passenger Information & Management** of Services for Safe & Efficient Operations & Opportunity to Deploy ICT Applications.
- **ICT Services along Highway (ITS) & Adjacent Rural Hinterland. Sensors** to warn of Developing Faults.
- Additional **Financial Benefits by Leasing Out** Spare Conduits or Ducts/Pipes, Racks, Dark Fibre & Bandwidth to TSPs for Commercial use.
- Opportunities to earn high **Profits with Minimum Investments** by building FOC network without need of Land Acquisition saving Costs over Project Life Cycle

FOC Co-deployment along Railways

Benefits & Opportunities (Continued)

- Provide **Telecom Services in Lesser Time** in Remote Rural Areas, Increasing Market Share & New Demands based on “Single Installation, Multiple Use” or “Dig Once, Use Many Times” Concept.
- Yields New Jobs - Promoting & Strengthening Sustainable Development for Economic & Social Benefits.
- **Civil Works Start Smoothly** - RoW is **Secured & Made Free** from Obstructions. Concrete conduits help in clearly demarcating RoW & in preventing further encroachments. **Existing Utilities** - Overhead Telecom Cables & Power Lines, Water & Gas Pipes in the way of civil works get **Diverted** into these concrete conduits.
- Co-deployment provides a **Resilient & Reliable FOC Network** for Railway ICT by Providing Protection Circuit through Backup in case of Accidents & Damage to FOC system.

FOC Co-deployment - Cross Border

Benefits & Opportunities

- **Intelligent Transport System**, Traffic Control Signals, Fleet Control, Asset Monitoring & Operations Control; specially for Vehicles Crossing into or Countries.
- **Save Costs over Life Cycle** minimising multiple Civil Works & Repairs for Laying, Crossing & Connecting & Maintaining FOC for International Internet Gateway Bandwidth
- **Minimize Blockade/Disturbance** to Train or Road Traffic during Adverse Weather Conditions, Planned Work & or Maintenance & Accident or Breakdown on other side of Border.
- **ICT Services** along Transport Sector & adjacent Rural Hinterland & Predictive Maintenance based Sensors, which warn of Developing Faults
- **Customer Information Displays**, Interactive Voice Response Systems (IVRS) & Internet Kiosks for Travellers moving across. Bank ATMs & Internet Kiosks on way at Stoppages for using Rest Room, Refreshments.
- Speed Sensing & **Policing** on Roads using Closed Circuit Television (CCTV) & Video Analytics including quick Disaster Recovery. **Access/Passport Control**, Security Screening & Customs Information Network.

Consolidated Conclusions & Inferences

Roads & Highways

Railways

Cross Border

FOC Co-deployment - Roads

Conclusions & Inferences

- Co-deployment of FOC along RoW of Roads is ***Feasible & Beneficial*** for All Entities & is Existing in Many Countries (**77% - Survey Feedback**)
- ***Narrowing Digital Divide*** - Important to Install High Speed FOC Network between Nations to achieve our Common Goals in Conformity with SDGs
- ***Pacific Region Vital*** for Global Economy and for Developing Regional Communities having Relatively Poor Economy & Social Infrastructure. ICT has Potential for Economic & Social Development in the Information Era
- ***Policy & Plan***, Legal & Regulatory Framework related to Co-deployment of FOC issued by Authorities Available. Ambiguities on Issues can be Resolved by Consultations.
- ***Data pertaining to FOC*** deployment is not mapped on GIS ported on Website & Optimum & Efficient Network Solution does not Evolve

FOC Co-deployment - Roads

Conclusions & Inferences (Continued)

- **Penetration of Telecom**, WiFi & ICT Services in Rural hinterland in Country is Low due to Inadequate Long Haul FOC backbone, unorganised Access Network to end user, inadequate Laptop Computers/Smart Phones & absence of Content in Local Language
- **Low per Capita Income** requires Affordable Services in Rural sector. Private Service Providers have not ventured into such areas
- Highway entities have allowed **Use of RoW** by PSUs, Telecom/FOC Network Operators & Service Providers with specific permissions to lay along or cross transport infrastructure with one time charge based on local land rates. Universal Services without any charge.
- Each entity has set its **Own FOC Network** Infrastructure laid on different routes & paths by repeatedly digging along RoW without any sharing of Space or Pipe or Duct.

FOC Co-deployment - Railways

Conclusions & Inferences

- Co-deployment of FOC along RoW of Railways is **Feasible & Beneficial** for All Entities & is Existing in Many Countries (**75% - Survey Feedback**)
- Railways have their **Own FOC Network Infrastructure** laid on Many Routes along RoW, Without Significant Sharing. **RoW Use Allowed** to Railway PSUs (RailTel in India) & not to TSPs. TSPs Given Permission to **Cross Railway Track** with one time charge based & for Universal Services with No Charge.
- **Affordable Internet Services in Rural Areas Not Available**. Private Service Providers have Limited Access on Tracks. FOC Network can be effectively used for **Rural Broadband** using Low Cost Technologies.
- For provision of **Utility Ducts or Conduits** close to extreme edge of Right of Way (RoW) presently Policy exists in some Countries.
- **Penetration of Telecom & ICT Services in Rural Areas is Substantially Low** due to inadequate Long Haul FOC backbone.

FOC Co-deployment - Cross Border

Conclusions & Inferences

- **Digital Divide amongst LDCs & Developed Countries Exists** - Important to install a High Speed Information Network to achieve Goals in Conformity with SDGs. Fibre Optic Cable Network along Transport Infrastructure is **Feasible & Mutually Beneficial for Nations**.
- Highway and Railway entities in **Countries have allowed use of RoW** by PSUs, Telecom Operators with specific Permissions along Transport Infrastructure for Cross Border Applications like ITS, Border Check, Passenger Information , Disaster Management & Recovery
- Each Country has an FOC Network Infrastructure laid on different routes and paths for **Resilience forming Joint Ventures or Consortiums** for Common Objective including Cross Border as required based on Multilateral Agreements
- For provision of FOC Infrastructure along RoW, Policy Exists in few Countries. Consultations & Interactive Sessions required to chalk out **Agreements**.

Consolidated Recommendations

Roads & Highways

Railways

Cross Border

FOC Co-deployment - Roads

Recommendations

- **Installation of FOC Network** with Minimum 2 X 48 Fibres in Concrete Ducts or Bundle of HDPE Ducts along identified Roads/Highways within Country & Across Border under Bilateral Agreement; May be Specified.
- **Department of Telecom - Central Authority** to enforce Directives through Authorised Entities, which could be TSPs &/or Highway PSUs for national & international long distance FOC links.
- Mechanism for **Single-Window** Approvals/Permits in **Defined Time Limit** administered ON Line be established
- **Procedure** for Permission for FOC/Conduit Laying, Leasing of Space in Conduits, **Costs** for Way Leave, Installation, Repair & Maintenance, Typical Location & Layout **Designs** be stipulated by a notified **Central Authority** comprising of Members from all units & stakeholders.

FOC Co-deployment - Roads

Recommendations

- **RoW Policies** are Required to be Strengthened to ensure more **Transparency, Faster Deployment & Ease of Doing Business**. Uniform RoW Policy across all Units by Central Authority & Implemented at Local Levels.
- Open **Transparent Lease** of Space in Utility Duct/Pipe/Cable to Network Operator/Service Provider - Defined Charges per Km per Year based on Location. Standardized **Rates for Sharing** & Uniform Procedures May be put into Practice
- **“Dig or Duct Only Once,”** “Integrate Planning of Utilities” & “Collaborate to Share Infrastructure” be guiding principles for Transport Infrastructure & ICT Entities. Lay multiple HDPE Pipelines & share to avoid repeated digging subsequently. Infrastructure Construction Design Policy to make provision for Utility Ducts in their Project Costs.
- **Encourage Utility Corridors:** Provide **Utility Ducts or Conduits** at time of New Construction or Upgradation/Expansion of Roads. Standards be laid down by a **Central Authority** for adoption by All Entities & Enforced with Penalties

FOC Co-deployment - Roads

Recommendations (Continued)

- All Utilities & Ducts along with FOC POPs/POIs of all Entities be **GIS Mapped** & shared on Website for Stakeholders for Optimised Network Installation, Reliable Operations & Maintenance. Information on Spare Space, Pipe & Fibre Availability & Hardware for Bandwidth May be Shown. RoW Granting Authorities May **Mark Area for Laying of Utilities/Cables**
- May Specify Administrative & Legal Provisions (Contractual) for **Compensation for Cable Cut/Damage** by any Agency executing Maintenance/Works.
- Substantial **Increase in Funding** of FOC Infrastructure & to use USOF Optimally for **Affordable Broadband** May be Necessary.
- **Investment in FOC Co-deployment in Ducts/Concrete Conduits** along Roads/Highways may be **Considered** for Backbone Link to ICT & ITS Applications in addition to ITS. Standards/Specifications; Methods/Procedures; Agreements/Protocols; Costing/Financing Allocation & Options & Technologies for Meeting Requirements May be Laid Down

FOC Co-deployment - Roads

Recommendations (Continued)

- **Central Repository** may created after deep review & based on Details of Experiences, Policies, Regulations & Processes followed, Standards, Techniques & Technologies used. Access to this data be linked on a Website.
-
- A **Comprehensive Long-term Master Plan** for FOC network & its utilisation including requirements of all Roads/Highways (ITS, PIS, Toll). **Public Sector** may initially be in charge of Co-deployment & Subsequently Considerations may be given to Private Sector Participation (PPP) to share roles & responsibilities for efficient broadband market growth.
- Different level of Technologies & Standards may be Evaluated & Considered for meeting region-wide Requirements. It may be necessary to establish **National Standard**.

FOC Co-deployment - Railways

Recommendations

- **RoW Policies** - Transparency, Faster Deployment & Ease of Doing Business for Seamless & Time-bound FOC Build Out. **Uniform RoW Policy** across all departments based on Rationalised License Fee/Lease Charges/Rental by Central Government/Authority & implemented at Local levels without any arbitrary interpretation.
- Mechanism for **Single Window** Approvals/Permits in **defined time limit** for by an Authority be put in place. Permission for FOC/Conduit Laying, Leasing of Space in Conduits, Costs for Way Leave, Installation, Repair & Maintenance, Location & Layout Designs be stipulated by **Central Authority** comprising Members from all units.
- **Transparent Lease** of Spares in Utility Duct/Pipe/Cable with Standard Defined **Charges per Km per Year** based on Location with Uniform Procedures. Charges may be levied towards **Restoration** to Original State

FOC Co-deployment - Railways

Recommendations (Continued)

- **“Dig or Duct Only Once,”** “Integrate Planning of Utilities” & “Collaborate to Share Infrastructure” be Guiding Principles. Railways may include Provision for Utility Ducts/HDPE Pipes in Construction Design Policy & Drawings.
- **Encourage Utility Corridors:** Railway Units may be asked to provide ducting along all new or upgradation Projects. Provision of **Utility Ducts or Conduits** close to extreme edge of RoW may be Considered.
- **Standards by a Central Authority** for adoption by Entities/Railways. Penalties for Non-compliance. Administrative & Legal provisions for **Compensation in Case of Cable Cut/Damage.**
- All Utilities & Ducts along with FOC POPs/POIs may be **GIS mapped** on **Web Site** & shared for optimised Installation & Reliable O&M. Railway may **mark area for laying of underground cables** at significant distance from Track considering expansion plans.

FOC Co-deployment - Cross Border

Recommendations

- Member Nations Agreement on **Cross Border Transportation Infrastructure** for FOC Co-deployment with Lawful Interception based on Principles of Mutual Trust, Equality & Mutual Benefits.
- **Bilateral Agreement for FOC:** Comprehensive Agreement be Signed by Countries for Provision of FOC Connectivity specifying Technology & Configuration for Compatibility & the Bandwidth Need over Defined Period.
- Entity of Transport Infrastructure (**Asian Highway or Trans Asian Railway**) or Power Transmission Lines or Gas/Oil Pipe Lines along which the FOC has to be Co-deployed be Indicated. TSPs may be Identified & Indicated in the Agreement.
- **Specifications** of Conduits/Pipes & Number, FOC & Number of Cores, Man/Hand-Holes or Joint Enclosures, Terminations, Instruments & Infrastructure for Lawful Interception (LI) be Standardised for Small/Medium & Large Interchange Points.
- **Access to Internet** through International Gateways through the Submarine FOC Cable Landing Stations be stipulated as per need.

FOC Co-deployment - Cross Border

Recommendations (Continued)

- **Monitoring from the Security Angle** – On-Line and Off-Line Monitoring of all Classes of Cross Border Telecom Traffic (Internet, Video, Audio) as per Attributes Destination, Recipient, Sender, Key Words. is required to be provided under the Lawful Interception (LI). Teams to Include Personnel of concerned departments of both Countries
- **Intelligent Transport System Centers** of the neighboring countries on an international FOC corridor may provide links for information exchange regarding the road and traffic conditions of their responsibility areas to inform road users.
- Cross Border Utilities and Ducts along with FOC POPs/POIs of all Entities May be **Mapped on GIS** on a **Web Site** for Sharing with Stakeholders
- Administrative and Legal Provisions be put in place for **Payment of Compensation in case of Cable Cut/Damage or Interruption** by any Agency Executing Maintenance or Digging.

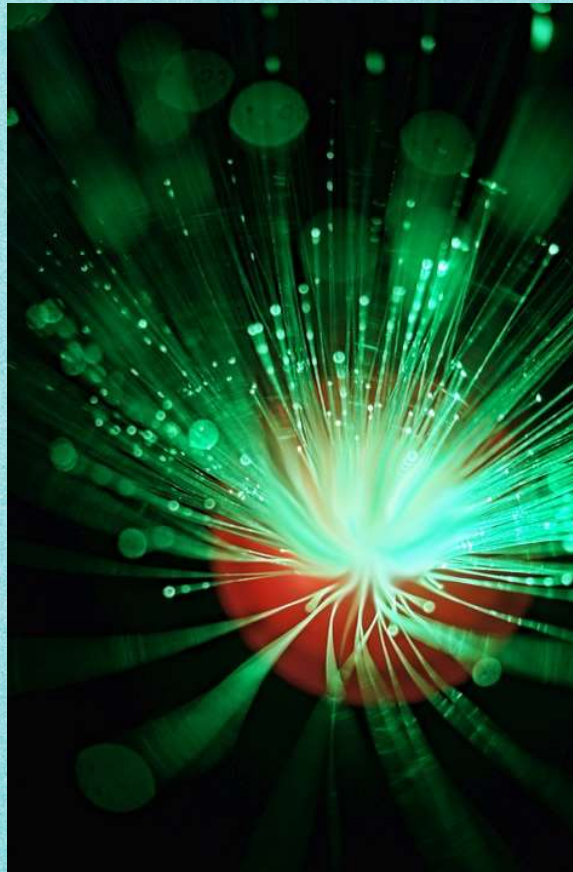
FOC Co-deployment - Path Forward

- Typical **Formats of Inter Governmental Agreements** indicating Specific Requirements may be Prepared & Circulated as Reference Document for Projects (Individual Countries May Modify as per Local Needs)
- **Joint Venture & Consortium Agreement** Templates be Drafted & Shared with Member Nations
- **Specifications & Standards** be Laid Down for Minimum Equipment & Features to be Incorporated in FOC Link along Roads, Railways & at Cross Border Interchange Point
- **Working Groups** with Members Drawn from Entities be Nominated to prepare these Reference Documents
- **Website** to host Data on Fibre Optic Cable Infrastructure be Extremely Useful

Thank You

**Action to
Move Ahead!**

**Clarifications
??**



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Study on Co-deployment of Fibre Optic Cables Bridge Digital Divide to meet **SDGs**

CONTENTS

- Broad Band & Internet - World Scenario - Inadequate Internet & Broad Band Penetration - DIGITAL DIVIDE
- Background of Study Initiated by UN-ESCAP - Achieving Sustainable Development Goals (2030)
- Terms of Reference of Study
- Components of Broadband & Internet Access
- Presentations by National Consultants of China, Korea, Russia, Thailand & Turkey
- Indian Perspective, Cross Border Cases & Consolidated Conclusions & Recommendations

Distinguish National Professionals & Experts

Prof Xiaojing Wang, China; Dr Sang Yeon Hong & Mr. Oh-Joung Kwon, Korea;
Mr Vladimir Kryuchkov, Russia; Maj Dr Tongkarn Kaewchalermtong, Thailand;
Mr Marut Barut, Turkey

UN-ESCAP Study

(Secretariat)

- International Telecom Union Data & ESCAP Studies Reveal Widening **Digital Divide** in Regions Leading to Disparities in Socio-Economic Indicators (SDG)
- **Investments in FOC** based ICT Infrastructure is Costly & Time Consuming, More So for Cross-Border Networks, which depend on Border Barriers & Political Inclinations.
- **Co-deployment of FOCs** during Construction along Transport Corridors is **Practiced in Countries**, with Extensive & Effective Coordination amongst Public & Private Entities to Overcome Challenges while Implementing across Borders Including Political, Legal, Institutional & Financial Issues.
- A **Study & Analysis of Co-deployment Practices** & Experiences would be Useful for Policy Maker & Authorities

UN-ESCAP Study (Continued)

- UN-ESCAP Committees on Transport & on Information & Communications Technology in 4th Session (October 2014) observed that for a Cost Effective & Resilient Terrestrial FOC Network, Synergies with Infrastructure Sectors be Leveraged.
- Good Practices exist in ESCAP region with Positive Results, including Additional Revenues for Entities as well as Cost Effective, Timely & Extensive Deployment
- Synergies between ICT, Energy (Gas Pipelines & Power Transmission) & Transport (Roads & Railways) Infrastructures Feasible - Consideration be given while Modifying/Preparing Governmental Agreements

UN-ESCAP Study (Continued)

- Activities for FOC Co-deployment Involves Public & Private Sector Units, Authorities & Governments - **Requires Extensive Consultations** due to Importance of ICT, Technical & Legal Issues
- UN-ESCAP Secretariat to **Undertake a Study** in Collaboration with all Public & Private Units & Authorities in Member States.
- Joint Session of AP-IS Steering Group Meeting suggested to ***Undertake Further Study*** & Consider it again in a Year.
- After completion of Study, a **Joint Meeting of Working Groups** on Asian Highway Network, Trans-Asian Railway Network & Asia-Pacific Information Superhighway Steering Group to be Organised.

UN-ESCAP Study-ToR

- **National Professionals/Experts** from China, India, Korea, Russia, Thailand & Turkey were Appointed as Consultants to Conduct **Study/Research**
- **Areas** proposed to be Covered:
 - A. National Co-deployment** Information - Consultant's Country.
 - i) Experiences on Co-deployment, Sectors Involved in Highway & Railway Sectors, How many Kms, which Routes, Benefits & Challenges Encountered.
 - ii) Governance & Institutional Aspects (Which Agency does What) – Include Private Sector Participation Information
 - iii) Legal Issues
 - iv) Financial Basis, Cost-Sharing among Agencies/Public & Private Units
 - v) Operation & Maintenance models for Country Highway & Railway Sectors to be Considered Separately.
 - C. Cross-Border** Fiber Optic Co-deployment Information on Country on connectivity with Neighbouring Countries, covering above items with Case Studies for each Sector.

UN-ESCAP Co-Deployment Study

Typical Methodology Adopted

Activities to Cover the Subject Extensively for Robust Methodology

Interaction with AITD Experts and Professionals & Assessment of ToR.

Study of Available Data & Reports

Preparation of a Survey Format/Questionnaire & Circulating to Member Countries for Feedback

Planning of Interaction Meetings with Public & Private Sector Units associated with FOC Deployment

Submission of the Research Plan to Secretariat UN-ESCAP

Interaction with FOC Network Planning Group & Utility Teams of Entities by National Professional Experts

Studying, Analysing & Summarising Details/Data collected during Interaction with Entities

Site and Field Visits for Feedback, Observing Systems and Work Processes

UN-ESCAP Co-Deployment Study

Methodology

Activities to Cover the Subject

Interaction with Government Officials of Railway, Road Transport, Telecom Department, Private Companies, Regulatory & Other Statutory Units

Preparation & Submission of First Draft Report on National Co-Deployment for Comments

Collecting Details of Cross Border Connectivity Cases & Interaction with Entities

Study Issues Associated with Interface for Cross Border Network

Preparation and Submission of Second Draft Report on Cross-border FOC Co-deployment for Comments to UN-ESCAP

Reports & Feedback from Consultants from Countries (China, Russian Federation, Korea, Thailand, Turkey), AITD, UN-ESCAP Secretariat & Stake Holders

Preparation & Submission of Draft Final Report to Secretariat

Feedback from AITD, UN-ESCAP Secretariat, Consultants & Stake Holders

Incorporation of Comments, Preparation & Submission of Final Report

Presentations by National Consultants Follow

[Russia](#)

[China](#)

[Korea](#)

[Turkey](#)

[Thailand](#)

[India](#)

Co-deployment of Fibre Optic Infrastructure

RoW of Roads, Railways & Cross Border

Part 2

Indian Perspective

Cross Border Examples

Conclusions & Recommendations

Plans & Policy on Roads - India

Year	Policy	Description
1994	1st National Telecom Policy (NTP) India	Mobile Licenses to TSPs
1999	2nd NTP	National Long Distance Segment Allowed to Private Sector with favourable License Conditions with Revenue Sharing
2012	National (Indian) Telecom Policy	Provides for High Speed & High Quality Broadband Access to Village Panchayats through a combination of Technologies Progressively by 2020
2016	Ministry of Road Transport & Highways (MoRTH)	Issued guidelines for provision of Utility Ducts , preferably at Extreme Edge of Right of Way (RoW) in Construction of National Highways
2018	Draft National Digital Communications Policy	Draft document under finalisation, includes a Fibre First Initiative & a National Digital Grid with Provision for Common Service Ducts & Utility Corridors along Highways & Formation of an Authority for Common Utility Ducts

Legal & Regulatory Framework Roads & Highways

1. Control of **National Highway (Land & Traffic) Act 2002 (India)**
Chapter VI & Relevant Rules 2004 - *Regulation of Construction of Public Utilities on RoW of Road Land.*
2. Indian Telegraph Act 1885 with Amendments Jan 2004 - Para 4.
Exclusive privilege in respect of telegraphs, & power to grant licenses.
3. Indian Easement Act 1882 with Amendments - *Stipulates legal provisions for allowing access to Public Utility & Right of Way to Entities based on license fee or lease rental.*

Operations & Maintenance (O&M) Model Roads - India

1. O&M of FOC & Power Cable Required for ITS Transport Infrastructure, which includes Indicators & Displays, CCTVs & Street Lights by **Road/Highway Entity**.
2. **TSP Entities bear Cost** of O&M of FOC Network including any License Fee/Lease/Rental for use of Duct or RoW.
3. **Co-deployment is in Nascent Stage** along National Highways, State Roads, District Roadways, Rural Roads but is significant in Urban Roads with Co-build in Cities.
4. While **CAPEX** issue can be largely addressed by agreed Cost-Sharing among TSPs, there needs to be a clear understanding on O&M & OPEX towards O&M.
5. O&M Expenditure Sharing Not Simple as sharing as CAPEX due to issues - Capacity, Reliability & Availability, Network Model & Responsibility Matrix, to be considered for **Robust O&M Mechanism**. OPEX Calculations, Slice Costs among Co-deployment Entities.

Legal & Regulatory Framework on Railways - India

- ▶ **Indian Railway Act 1989** - Para 11. Power of Railway Administration to Execute & Authorize all Necessary Works
- ▶ **Indian Telegraph Act 1885 with Amendments Jan 2004, 2016 & 2017**
 - ▶ Exclusive Authority in respect of Telegraph & Power to Grant Licenses
 - ▶ Power of Telegraph Authority to Place & Maintain Telegraph Lines & Posts
 - ▶ **Indian Telegraph Right of Way Rules, 2016**

Operations & Maintenance (O&M) Models - Railways

O&M of Railway's National Long Distance FOC Network is assigned to **RailTel, Public Sector Unit.**

Cost of Services given to Indian Railways Recovered as per directives of Telecom Directorate of Railway Board.

- Fibre (2 Pairs) Maintenance Charges per Km per Month for each Pair of Fibre (**INR 132 for 2016-17**)
- STM4 Bandwidth at rate of Rs 7219 per Km per Annum.

RailTel bears Cost of Operations & Maintenance of FOC Network including any License Fee/Lease Rental for use of Duct or RoW.

Cross Border Co-Deployment - Russian Federation

Case 1

World's Largest Country by Land Area, Russian Federation

Pivotal Role in Creating Terrestrial FOC Connectivity

**Co-deployment Practice for National network as well as
Cross-Border Connections**

FOC Routes

E119 Highway (AH8 Segment of Asian Highway Network)

Azerbaijan-Russian Federation Rail line.

Cross Border Co-Deployment - Russian Federation

Case 1

Azerbaijan-Russian Federation (Rostelecom)	
Date	2003
Length	400 kms
International Connectivity	Azerbaijan to Russian Federation via border crossing at Samur, Azerbaijan
Main Nodes	Baku
Capacity	Initial Capacity of STM-1 (155.52 Mbps)
Technology	SDH
Developers/Owners/ Operators/Suppliers	Azertelecom/Delta Telecom Rostelecom Fiber supplied by Alcatel
Along Rail/Highway	Follows E119 (AH8) highway
Notes	Rostelecom's Investment in Network, of 200 kms on Russian Federation side between Makhachkala & Derbent RUB 137 million (USD\$4.5 million).

Cross Border Co-Deployment - Russian Federation

Case 2

**May 2009 - Azertelecom & Synterra (Russia) - Agreement
Construction of 10 Gbps Link between
Derbent (Russia) & Guba (Azerbaijan) along E119 (AH8) Highway
\$17 Million Joint Venture called C-Ring Telecom
for Caspian Region.**

**2009 - Iran Mobin Consortium had a 50/50 Joint Venture with C-Ring for
Connectivity
towards Islamic Republic of Iran**

**July 2010 - Russian Regulator Roskomnadzor gave License to Synterra for
Operation of Trans-border FOC Link**

**2011 - Azerbaijani Segments of Network Completed
C-Ring Awaiting Completion of Russian Segment**

**Dec 2010 - C-Ring Consortium Role Review - Synterra Purchased by Russian
Telecom Conglomerate MegaFon for International Network Development Strategy**

Cross Border Co-Deployment - Russian Federation

Case 2

Azerbaijan-Russian Federation (Synterra (MegaFon)/Azertelecom)	
Date	20/10/2011
Length	100 kms
International Connectivity	Quba Azerbaijan to Derbent Russian via border crossing at Samur, Azerbaijan
Main Nodes	Quba & Azarbaijan
Capacity	STM-64 (10 Gbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	Azertelecom/Delta Telecom Synterra (Taken Over by MegaFon in 2010)
Along Rail/Highway	Follows E119 (AH8) highway

Cross Border Co-Deployment - Russian Federation

Case 3

**2008 - Russian Federation's Trans Tele Kom (TTK) provided IP Bandwidth to
Delta Telecom
between Yalama, Azerbaijan & Samur, Russia**

**TTK is Subsidiary
of Russian National Railway & Major Operator of FOCs along Railway Route of
76,000 Kms**

**2009 - TTK provided 2.5 Gbps of IP Bandwidth to Delta Telecom
Upgraded to 10 Gbps**

**Cable Route follows Azerbaijan-Russian Rail Line
(Part of Trans Asian Railway Network)**

Cross Border Co-Deployment - Russian Federation

Case 3

Azerbaijan-Russian Federation (TransTeleKom)	
Date	2008
Length	20 kms
International Connectivity	Russian Federation via Yalama, Azerbaijan
Main Nodes	Yalama & Azarbaijan
Capacity	STM-64 (10 Gbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	Azertelecom/Delta Telecom TTK (Russia)
Along Rail/Highway	Follows Azerbaijan - Russia Railway Line (Part of TAR)

Cross Border Co-Deployment - Russian Federation

Case 4

Kazakhstan - Russian Federation (Northern Kazakhstan)	
Date	1999
Length	340 kms
International Connectivity	Petropavlovsk - Kazakhstan to Kormilovka, Russia via Omsk, Kazakhstan
Main Nodes	Petropavlovsk
Capacity	STM-4 (622 Mbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	Kazakhtelecom & Rosetelecom & TTK (Russia)
Along Rail/Highway	Follows M51, E30 - <u>AH6</u>

Cross Border Co-Deployment - Russian Federation

Case 5

Kazakhstan - Russian Federation (North Western Kazakhstan)	
Date	2001
Length	340 kms
International Connectivity	Atyrau, Kazakhstan to Volgograd, Russia via Saykhin, Kazhakstan
Main Nodes	Atyrau
Capacity	STM-4 (622 Mbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	Kazakhtelecom & Rosetelecom, VimpelCom & MegaFon (Russia) Equipment by Siemens
Along Rail/Highway	Main Road between Artyrau & Volzhsky (North Volgograd)
Notes	2013 - MegaFon & Kazakhtelecom Activated Diverse Route for European & Asian Markets (DREAM) between Germany & Kazakhstan's border with China

Cross Border Co-Deployment - Russian Federation

Case 6

Kazakhstan - Russian Federation (Western Kazakhstan)

Date	2006
Length	200 kms
International Connectivity	Atyrau, Kazakhstan to Astrakhan, Russia via Ganyushkino, Kazakhstan
Main Nodes	Atyrau
Capacity	STM-4 (622 Mbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	Kazakhtelecom & Rosetelecom,
Along Rail/Highway	Via A27 Highway (Kazakhstan) & A340 Highway (Russia) <u>Part of AH70</u>

Cross Border Co-Deployment - Russian Federation

Case 7

2002 - Co-deployment by TTK (Russia) & Railtelia (Finland)

Interconnection of FOC Networks along Railways

on Russia-Finland Border of Buslovskaya– Vainikkala

Saint-Petersburg - Buslovskaya is a part of Trans Asian Railway Network.

2004 - TTK in collaboration with Mongolian Carrier “Ulan-Bator Railway” & Chinese National Telecom Company, China United Telecommunications Corp. (China Unicom) Provided Shortest FOC Link between Europe & Asia

ERMC (Europe – Russia – Mongolia – China) stretches from London to Stockholm, Moscow, Ulan-Bator, Peking & ends in Hong Kong

Follows Mongolia - Russian Railway Line (Part of TAR)

Provides an alternative, shorter path to Submarine Communications Cables, over 11500 kms

Cross Border Co-Deployment - Russian Federation

Case 7

Europe - Russia - Mongolia - China (ERMC)	
Date	2004
Length	11500 kms
International Connectivity	Russia to China via Mongolia & to Europe & UK
Main Nodes	London, Stockholm, Moscow, Ulan-Bator, Pekin, HongKong
Capacity	Initially 40 Gbps (Scalable to 400 Gbps)
Technology	SDH
Developers/Owners/Operators/Suppliers	TTK (Russia), Ulan-Bator Railway (Mongolia), China Unicom (China)
Along Rail/Highway	Folllows Mongolia - Russia Railway Route (TAR)

Cross Border Co-Deployment - Russian Federation

Case 8 (EPEG)

March 2011 - MoU Signed by Four Investors to Create 10,000 Kms
Europe Persia Express Gateway (EPEG) Network
between Oman & Frankfurt (Germany)

June 2011- Construction & Maintenance Agreement Signed by Four Investors
in Tehran, Islamic Republic of Iran

2012 - Network Tested
2013 - Network Brought in Service

EPEG Project Came Up due to Delay in Trans-Egyptian Segment of Europe-
India Gateway (EIG) Undersea Cable Project on account of Arab Spring &
Widespread Changes in Political Leadership, Difficulties in Obtaining Permits
for Implementation of Two Terrestrial Links on Routes between Red Sea &
Mediterranean

Cross Border Co-Deployment - Russian Federation

Case 8 (EPEG)

О проекте

8 июня 2011 года консорциум из четырех ведущих операторов связи из четырех стран подписал Соглашение о строительстве и техническом обслуживании новой кабельной системы - «Европа-Персидский экспресс-шлюз» (EPEG). Новая система с начальной мощностью 540 (54 × 10) Gbps была введена в эксплуатацию в декабре 2012 года.



Cross Border Co-Deployment - Russian Federation

Case 8 (EPEG)

Europe - Persia Express Gateway (EPEG)	
Date	2013
Length	10000 kms (600 kms in Azerbaijan)
International Connectivity	Via Trans Asia Europe connecting Iranian Border at Astara to Baku via Russian Infrastructure at Yalama
Main Nodes	Baku
Capacity	500 Gbps (Designed for 3.2 Tbps)
Technology	SDH
Developers/Owners/Operators	Delta Telecom (Transit Operator of Azerbaijan Sector); Rostelecom; Omnatel (Iran) & Vodaphone
Along Rail/Highway	Follows M3 Highway at Iran Border & Azerbaijan - Russia Railroad RoW
Notes	Cost of Azerbaijan Sector - 3 million Euros using TAE Infrastructure

Cross Border Co-Deployment - TAE

Case Studies

Important Chinese Role in International FOC Network

Oct 1998 - Trans Asia-Europe (TAE) Link (27,000 kms) Activated - Cost of \$560 Million

Connects Frankfurt, Germany to Shanghai, China

Countries Associated - China, Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, Turkmenistan, Islamic Republic of Iran, Turkey, Ukraine, Belarus, Poland, Romania, Hungary, Austria, Germany, Georgia, Azerbaijan, Armenia, Pakistan, & Afghanistan

Initial Capacity of STM-4 (622 Mbps)

Upgraded to STM-16 (2.488 Gbps) in Kazakhstani Segment

1,500 kms Long - in Cost \$25 Million

Crosses Kazakhstan's Southern Border with Uzbekistan via Main Road

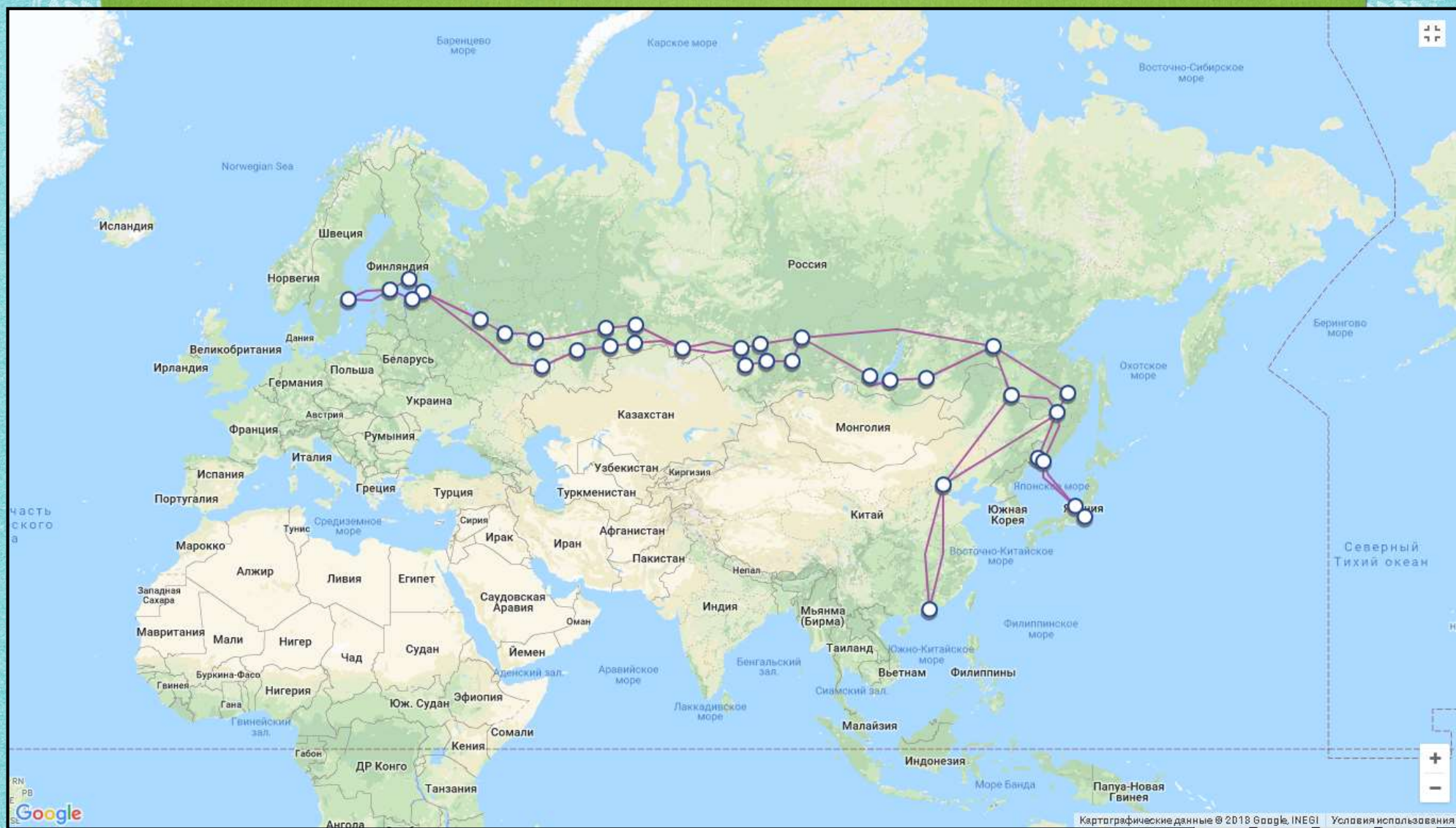
Uzbekistan's Capital of Tashkent & Shymkent in Kazakhstan (AH5)

Continues to Almaty before crossing Kazakhstan's Southeastern Border with China via Main Road between Khorgos, Kazakhstan & Korgas, China

Southern Ring - Kazakhstan to Kyrgyzstani Capital of Bishkek Crossing Border at Chaldybar, & Kamyschanovka, Kyrgyzstan & Third Redundant Link between Kazakhstan & Kyrgyzstan

Cross Border Co-Deployment - China/Russia

TAE Case



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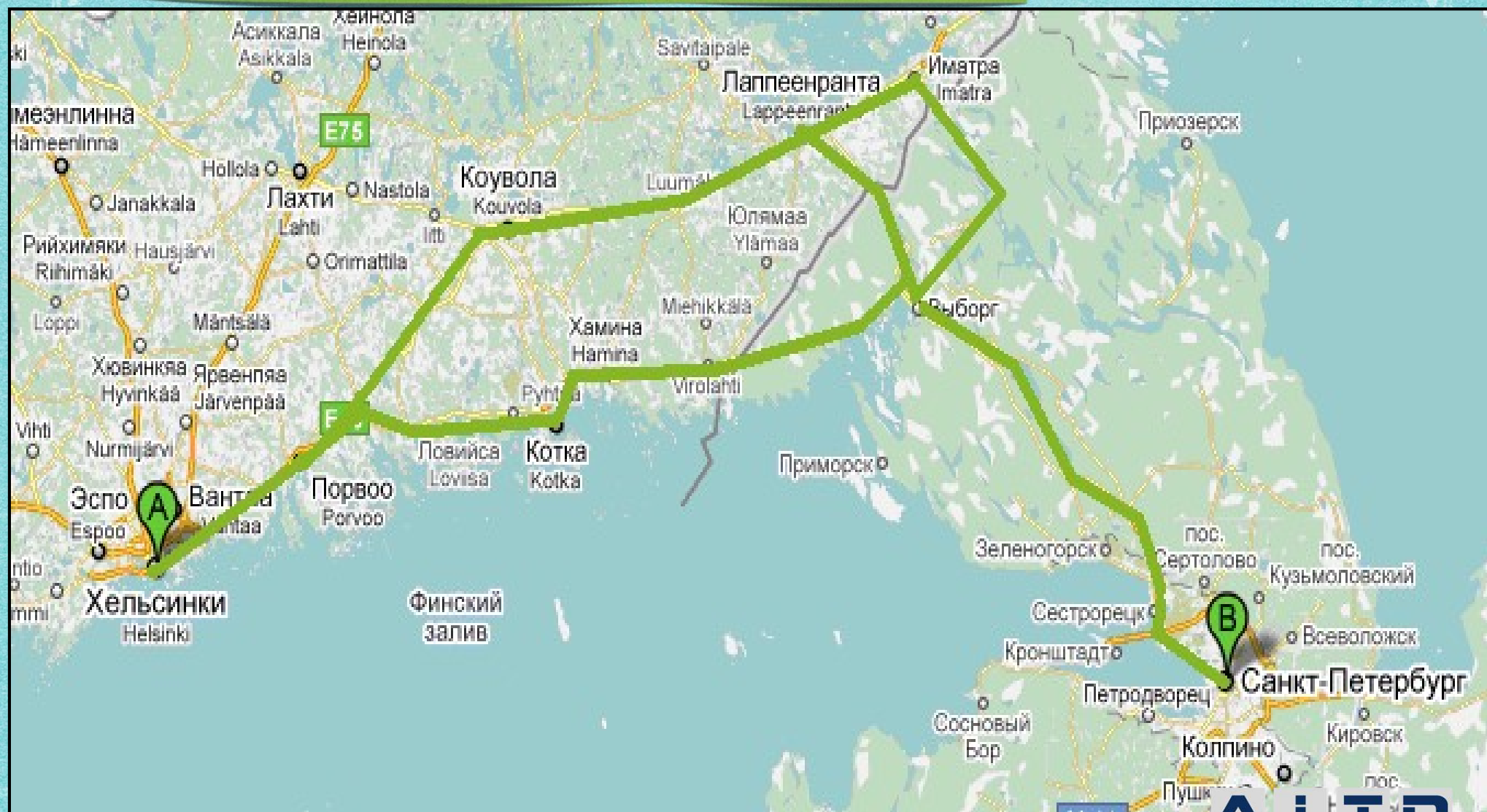
Cross Border Co-Deployment - TAE

Case 9

Trans Asia - Europe Line (TAE - 27000 kms)	
Date	1998
Length	1500 kms in Kazakhstan
International Connectivity	Shymkent, Kazakhstan to Tashkent, Uzbekistan via Border at Chernayevka, Kazakhstan & Gisht Kuprik, Uzbekistan; Almaty, Kazakhstan to Urumqi, China via Border crossing at Khorgos/Korgas; Saribulak, Kazakhstan to Bishkek, Kyrgyzstan via Kamyshanovka, Kyrgyzstan; Merke, Kazakhstan to Bishkek, Kyrgyzstan via Chaldovar, Kazakhstan & Chaldybar, Kyrgyzstan; Kazakhstan-Kyrgyzstan via Korday, Kazakhstan
Main Nodes	Almaty, Sogety, Merke, Simhent Sarybulak
Capacity	STM 4 (622 Mbps)
Technology	SDH
Developers	TAE Consortium of 20 Countries; Kazakhtelecom
Along Rail/Highway	All <u>AH5</u> - Kazakhstan & Uzbekistan - M39 & A2 Kazakhstan & China - A353 Kazakhstan-Kyrgyzstan - M39 (Western) Kazakhstan-Kyrgyzstan - A2 (Northern)

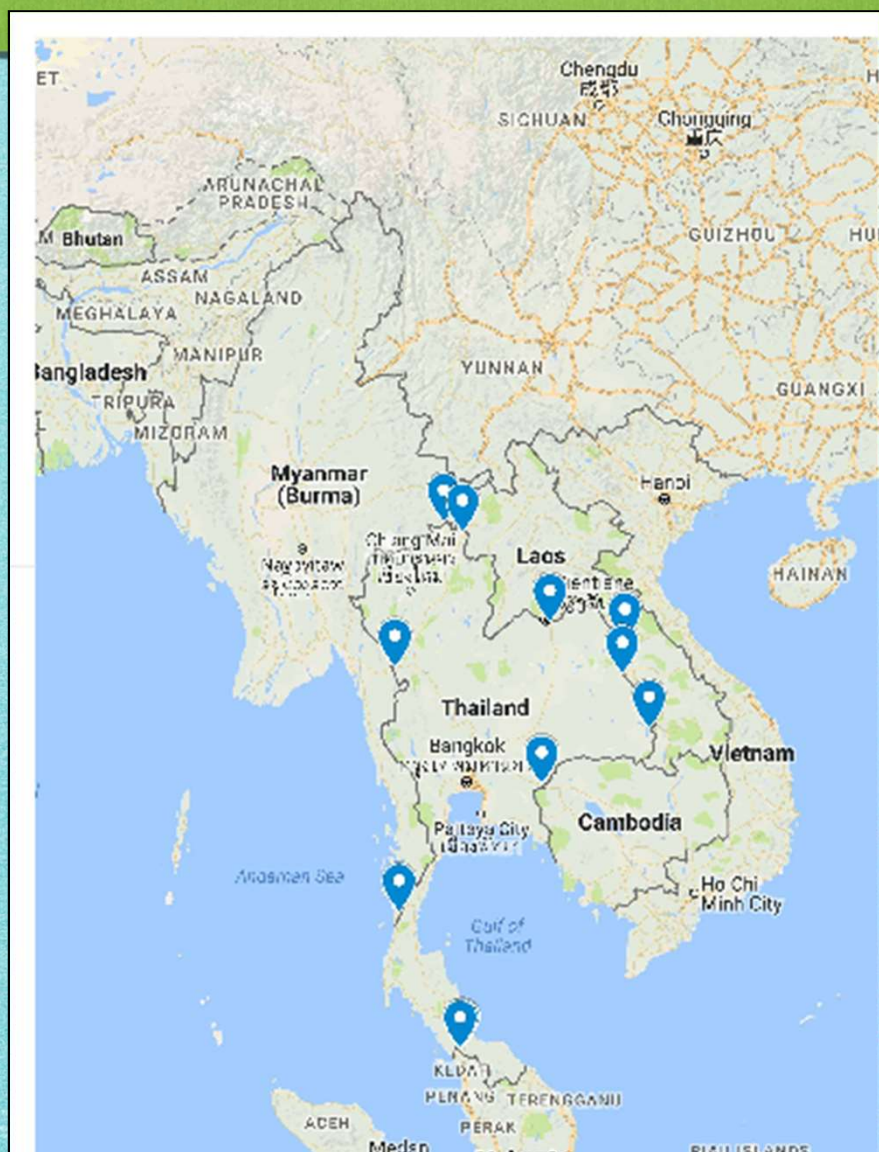
Cross Border Co-Deployment - Russia/Finland

CARAVAN/CAVLANE



Cross Border Co-Deployment - Thailand

Map



Cross Border Co-Deployment - China

Case Studies

**Extensive Co-deployment of FOC in Chinese National Network
Co-deployment an Important Feature of Belt & Road Initiative.**

**Increased Cost Effectiveness in Remote Areas for Deployment
of FOC Infrastructure**

**Beginning at bilateral level, China has implemented many
cross border terrestrial fibre projects. Linking China with
Neighbouring Countries**

**Vital Redundancy For Resilience & Opportunities for
Economic Development.**

Cross Border Co-Deployment - China

Cases

Region	Border Crossing	Border Station	Operators
Russia & Mongolia	China-Russia	Fuyuan, Manzhouli, Heihe, Suifenhe	China Telecom, China Unicom, China Mobile
Russia & Mongolia	China-Mongolia	Erenhot	Same
ASEAN	China-Vietnam	Pingxiang, Dongxing	Same
ASEAN	China-Myanmar	Ruili	China Telecom, China Unicom
ASEAN	China-Laos	Mengla	Same
Central Asia	China-Kazakhstan	Khorgas, Alashankou	China Telecom, China Unicom, China Mobile
Central Asia	China-Kyrgyzstan	Artux	China Telecom, China Unicom
Central Asia	China-Tajikistan	Tashikuergantajike	China Telecom
Southern-East Asia	China-Pakistan	Tashikuergantajike	Same
Southern-East Asia	China-India	Yadong	China Telecom, China Unicom, China Mobile
Southern-East Asia	China-Nepal	Zhangmu	China Telecom, China Unicom
Northeast Asia	China-DPRK	Dandong	China Unicom

Plans & Policy Cross Border Co-deployment

Policy Framework Documents & Inter Country Agreements on FOC Co-deployment Crossing Borders are prepared on Communication Requirements, Political & Commercial/Trade Relationships

Case to case Agreements between Entities on either side for Cross Border FOC Links have been done. Most countries, which are not landlocked depend on their Network Voice & Data Requirements from Submarine Cables.