TATA COMMUNICATIONS

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Mobile core value proposition
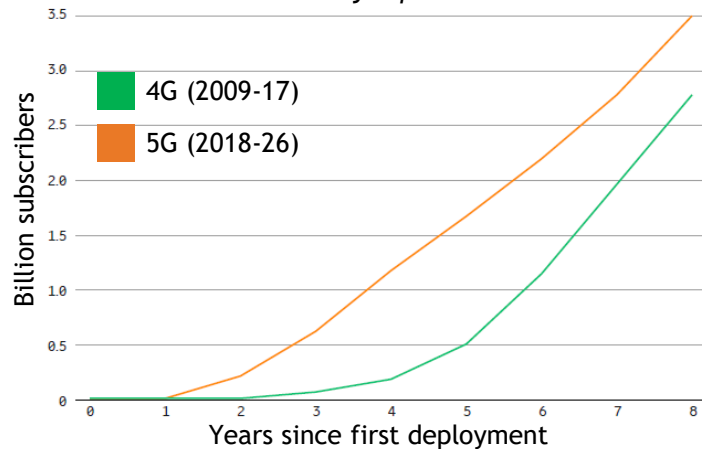
December'21

AGENDA

- Recent trends and technological advancements

- Potential benefits of exploring partnership expansion

- Tata Communications – Usage Based Services

- Mobility core value proposition

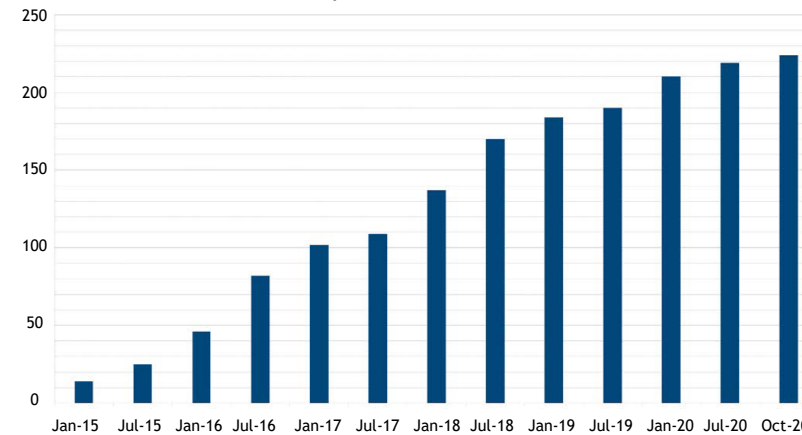- Our strengths, accelerators and differentiators

- Appendix

RECENT TRENDS IN TELECOM MOBILITY

HIGHLIGHTING THE SPEED OF INNOVATION AND SHIFT FROM TRADITIONAL BUSINESS MODELS

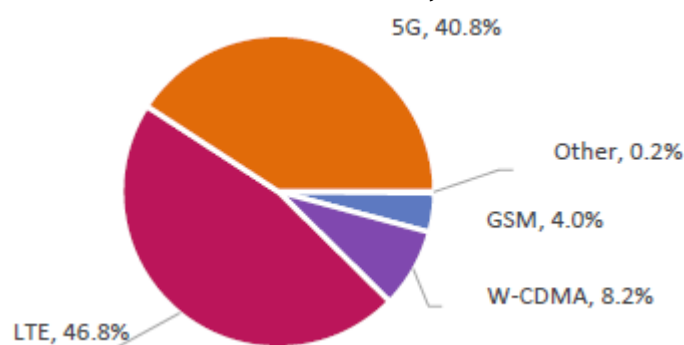Comparison of 5G and 4G subscription uptake
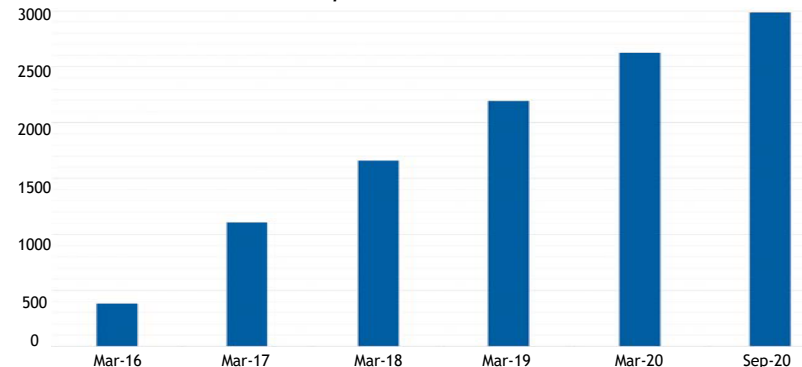*Source: Ericsson mobility report*

- 4G (2009-17)
- 5G (2018-26)

Mobile subscriptions by technology, end 2026
Source: GSA LTE and 5G market forecasts

5G, 40.8%
Other, 0.2%
GSM, 4.0%
W-CDMA, 8.2%
LTE, 46.8%

Growth in number of commercial VOLTE network worldwide
Source: GSA VOLTE report

Growth in VOLTE devices
Source: GSA VOLTE report

Changing customer preferences

- Demand excellent experience, privacy and speed
- Reduced movement
- Mobile broadband driven in the digital age

Increasing complexity

- Pace of transformation
- Multiple standards
- Disappearing industry boundaries

Squeezing margins

- Regulations clamping down on rates
- Market forces
- Increasing competition
- Fragmentation of supply

Increased Opex and Capex

- New technologies
- New partner connections
- Security and fraud
- AI and Analytics

DRIVING AHEAD OF THE RACE ON TECHNOLOGICAL EVOLUTION

CHANGES BEING EXPERIENCED ACROSS THE LANDSCAPE OF MOBILE CORE

Internal landscape

Agility and flexibility of development and execution

Security of networks and data

AI and automation driving efficiency of operations and analytics

Profitability and returns from increasing investments

External landscape

Customer preferences driven by new technologies – for example, XR/ VR implementation through 5G, IoT, VoLTE roaming, Containerisation, etc.

New use cases arising out of existing assets, for example, existing Core connectivity (mobile core, wifi core, etc.) may be utilized for carrying IoT traffic

Cyber risk and fraud – for example, open sourced standards, unsecured networks and increasing change in technologies may lead to increased threat of fraud and spam

Expanding partner ecosystems, for example, interdependencies between OEMs, SaaS, Connectivity service providers, carriers, operators and Enterprises

GIVING YOU REASONS TO EXPAND YOUR PARTNERSHIPS

WITH TECHNOLOGY ADVANCEMENTS, CHANGING CUSTOMER BEHAVIOUR AND SHRINKING TRADITIONAL BUSINESS, THERE ARISES A NEED FOR AGILITY AND GROWTH OPPORTUNITIES

Reason for change	Description
New business models and revenue streams	Seek and partner with disruptors that are pioneering new business models and diversifying revenue generating opportunities by focusing on adjacent industries, in turn maximizing revenue monetisation from existing assets
New distribution channels and extended reach	Expand coverage and increase redundancy while incrementally reducing marginal costs, thereby, improving margins
Rationalization and control over your customers' usage	High amount of customizations through programmable APIs that help you drive changes to your service based on your customers' usage patterns in a fast paced environment
Increase your marginal benefits from Partners	Instead of a service based partnership, focus on a portfolio based partnership (Revenue/ cost) across the communications services, viz. Signalling, Voice, Messaging, et al. Thereby, increasing your marginal benefits from every partnership and driving down potential opportunity cost
Organization flexibility	Speeding up processes and resolutions that provide flexibility, scalability and data based insights for further driving up your margins

Introducing Tata Communications

TATA COMMUNICATIONS

WE ARE THE POWERHOUSE OF THE WORLD'S FASTEST ECONOMIES

We enable over **5 billion** transactions per year

Over **12,000** petabits of internet traffic is carried on our internet backbone every month

We're **#1** in colocation in India. A leading player in managed hosting and cloud services globally

We handle **1** in **12** of all international voice calls

We connect businesses to providers who account for almost **50%** of cloud computing

20 terabits of international bandwidth lit capacity

85 million voice transactions handled every day

TATA COMMUNICATIONS
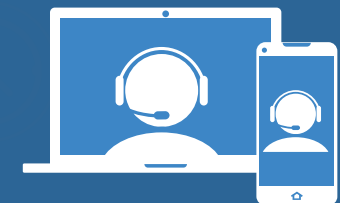
CARRIER SERVICES | PRODUCT PORTFOLIO

VOICE

TRANSPORT & TERMINATION

- ❖ VTS Prime
- ❖ VTS Corporate
- ❖ HD Voice

VALUE ADDED SERVICES

- ❖ Int'l Toll Free
- ❖ LNS
- ❖ Mobile LNS
- ❖ Fraud Mitigation
- ❖ ACNS
- ❖ Domestic Voice
- ❖ PSTN replacement
- ❖ CLI masking

- • 13 Voice POP's Globally
- • >240,000 km subsea fiber infrastructure &
- • >50,000 km terrestrial fibre

SIGNALLING (SCCP/DSX)

- ❖ World's largest Signalling network
- ❖ One-stop solution for **800+** dest.
- ❖ Symmetrical traffic over a single-hop with over **290** on-net dest. and major ANSI dest.
- ❖ Mobile roaming services supporting 2/3/4/5G(WIP) roaming within a single solution framework

A2P

- ❖ Carrier-grade platform
- ❖ Global aggregation
- ❖ Hosted SMS Firewall
- ❖ Long code
- ❖ Short code
- ❖ 2 way messaging
- ❖ Campaign management

Guaranteed **quality of service** and **experience**

We **own, manage and support** our network on an end-to-end basis

24x7 **NOC** support

85% of issues resolved within 4 hours of its reporting

Why Tata
Communications

POTENTIAL BENEFITS THAT TATA COMMUNICATIONS CAN OFFER

IN ADDITION TO THE TRUST WE BRING TO THE TABLE, WE WILL HELP YOU REALISE BENEFITS ACROSS OPERATION, FINANCIAL AND CUSTOMER ASPECTS OF YOUR BUSINESS

Operational benefits

- Reliable and Robust network
- Wide roaming coverage
- High availability of 99.999%
- E2E infra allows 1 SPOC
- Excellent 24x7 support

Benefits across the Business sphere

Financial benefits

- Roaming Revenue from subscribers
- Single marketplace for all mobility needs
- Reciprocal revenue (from voice/A2P/MOVE)
- Service credits in case of failure
- Cost optimization by choosing best roaming partners in visited domain

Customer benefits

- Better customer experience in border area
- Dedicated BW instead of best effort BW
- Fraud mitigation

WHY TATA COMMUNICATIONS FOR SIGNALLING?

| Robustness | Reachability | A2Z roaming | Future ready | Support | E2E solutions |

Network robustness	Reachability	One stop shop	Future proof	Excellent support	Minimal dependencies
Tata Communications ensures network robustness by providing geographic, node, link and port level redundancies in all its services. Tata Communications ensure that network nodes are provided by leading OEMs like Oracle, Cisco etc.	Tata Communications ensures reachability to each destination by direct or by peering partner for all roaming services. Widely spread PoPs and peering with all leading carriers ensures it further	Tata Communications propose complete set of roaming services including – signaling 2G/3G and 4G, data, voice and IoT	Tata Communications make sure to use its infra to provide future proof solutions like - VoLTE roaming (RAVEL), 5G roaming, steering of IoT devices etc.	With 2 NOC centres, 24/7/365 support and local sales/presales teams, we ensure excellent support for our customers	With the help of its rich infra - telecom nodes, connectivity via cables and MPLS network, Tata Communications ensure no/minimal dependencies on any 3rd party

TATA COMM IS BEST POSITIONED TO HELP YOU REALISE THE POTENTIAL IMPACT

OUR INNOVATIVE ENGAGEMENT MODELS WILL DELIVER CONVENIENCE OF SERVING YOUR CUSTOMERS WITH HIGH QUALITY AT LUCRATIVE COSTS

Categories of engagement models

Tier Based model	Threshold based model	Fixed unit rate with min commit	Unlimited traffic model	Bundled model	Hybrid model
• Volume or destinations can be billed on basis of tiers	• Volumed or destinations can be billed on threshold basis	• Min commitment with a fixed/variable volume or destinations	• Fixed billing for unlimited traffic	• Bundling other roaming services like SCCP, DSX, IPX • Cross sell A2P or voice • Upsell VAS	• Mixing transactions & bundled model • Unlimited model with BW capping

We have made commercial arrangements and other thresholds, across our engagement models, modular in nature by breaking down various variables of Mobile Core

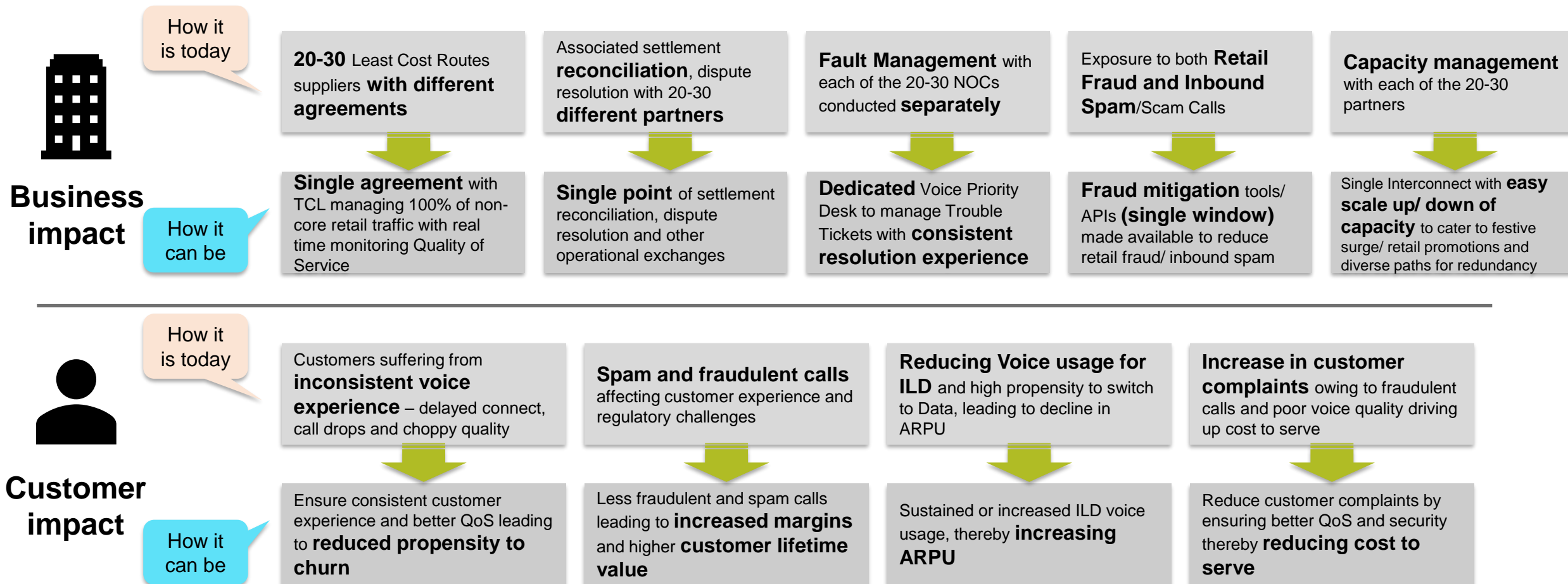Flexibility to choose various thresholds and blends across these variables

| Volume | VAS | Registration attempts | Connectivity type |
| Destinations | Service bundling | Bandwidth | Cross Sell |

Service bundling: ANSI | SCCP | IPX | DSX

Cross Sell: A2P | Voice | GT | IoT
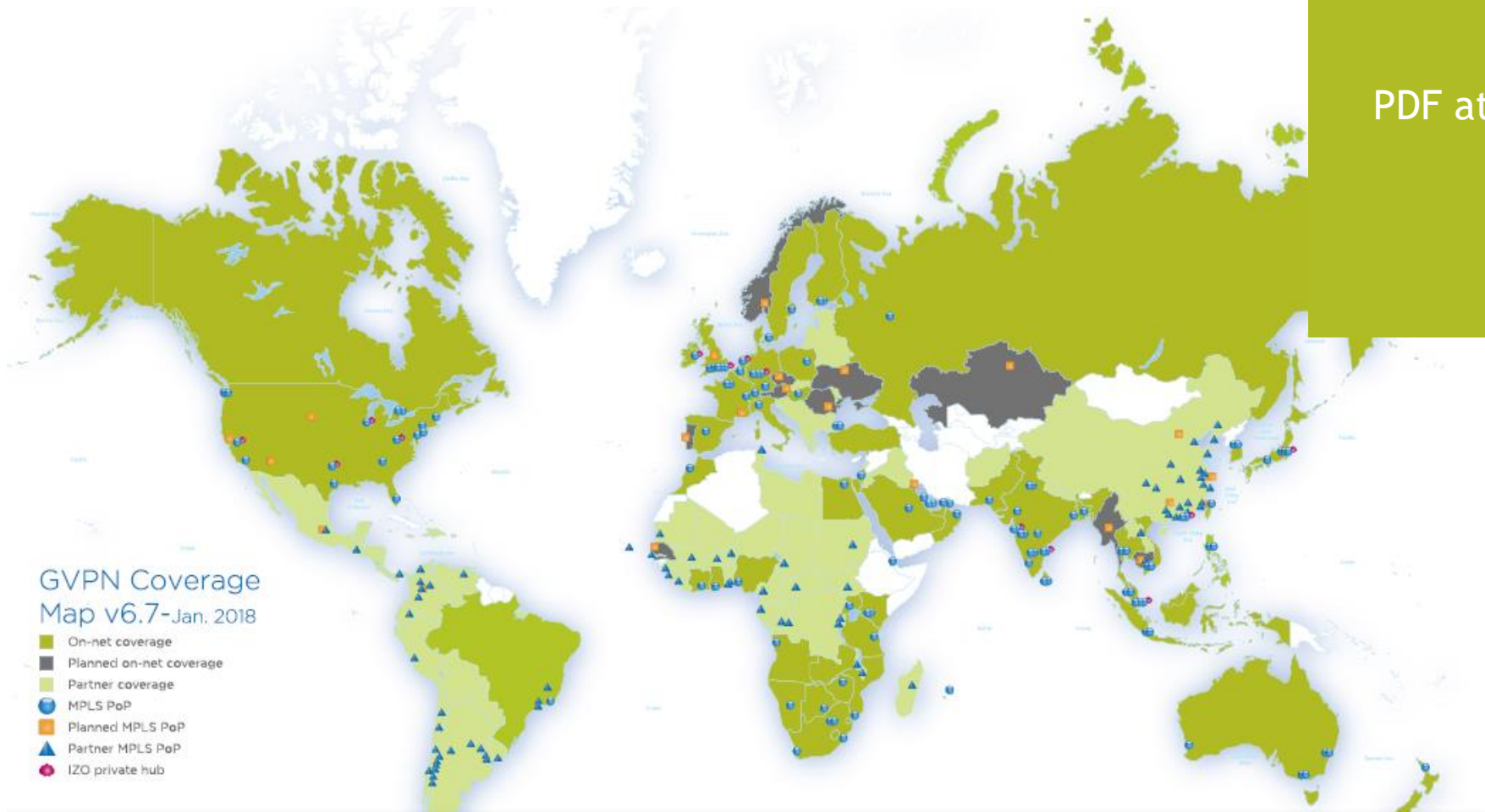
POINTS OF PRESENCE

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PDF attached for better resolution

PoP Coverage

GVPN Coverage
Map v6.7- Jan. 2018

- On-net coverage
- Planned on-net coverage
- Partner coverage
- MPLS PoP
- Planned MPLS PoP
- Partner MPLS PoP
- IZO private hub

Americas
Atlanta	Mexico City
Ashburn	New York
Beijing	Newark
Boston	Phoenix
Chicago	Santa Clara
Dallas	Seattle
Denver	Sau Paulo
Houston	Silicon Valley
Los Angeles	Toronto
Miami	Wall

Europe
Astana	Highbridge	Munich
Amsterdam	Istanbul	Oslo
Brussels	Kiev	Paris
Bucharest	Lisbon	Prague
Budapest	London	Vienna
Copenhagen	Madrid	Guangzhou
Dublin	Marseille	Slough
Frankfurt	Manchester	Warsaw
Geneva	Milan	Zurich
Helsinki	Moscow	

Africa & Middle East
Abidjan	Dubai	Maputo
Accra	Durban	Muscat
Al Fujairah	Gaborone	Nairobi
Casablanca	Harare	Port Louis
CapeTown	Johannesburg	Riyadh
Cairo	Kampala	Tel Aviv
Dakar	Kuwait	Windhoek
Dar-es-Salaam	Lagos	
Djibouti	Luanda	
Doha	Manama	

India
Ahmedabad
Bangalore
Chennai
Ernakulam
Hyderabad
Kolkata
Mumbai
New Delhi
Pune

Asia Pacific
Auckland	Kuala Lumpur	Sydney
Bangkok	Manila	Taipei
Beijing	Melbourne	Tokyo
Colombo	Naypyidaw	
Dhaka	Osaka	
Guangzhou	Perth	
Ho Chi Minh	Phnom Penh	
Hong Kong	Seoul	
Jakarta	Shanghai	
Karachi	Singapore	

SIGNALLING VALUE PROPOSITION

TATA COMMUNICATIONS SIGNALLING PORTFOLIO

Manage your roaming traffic efficiently, while providing a seamless user experience.

Mobile roaming services for LTE roaming migration, supporting 2G, 3G, 4G and 5G roaming within a single solution framework.
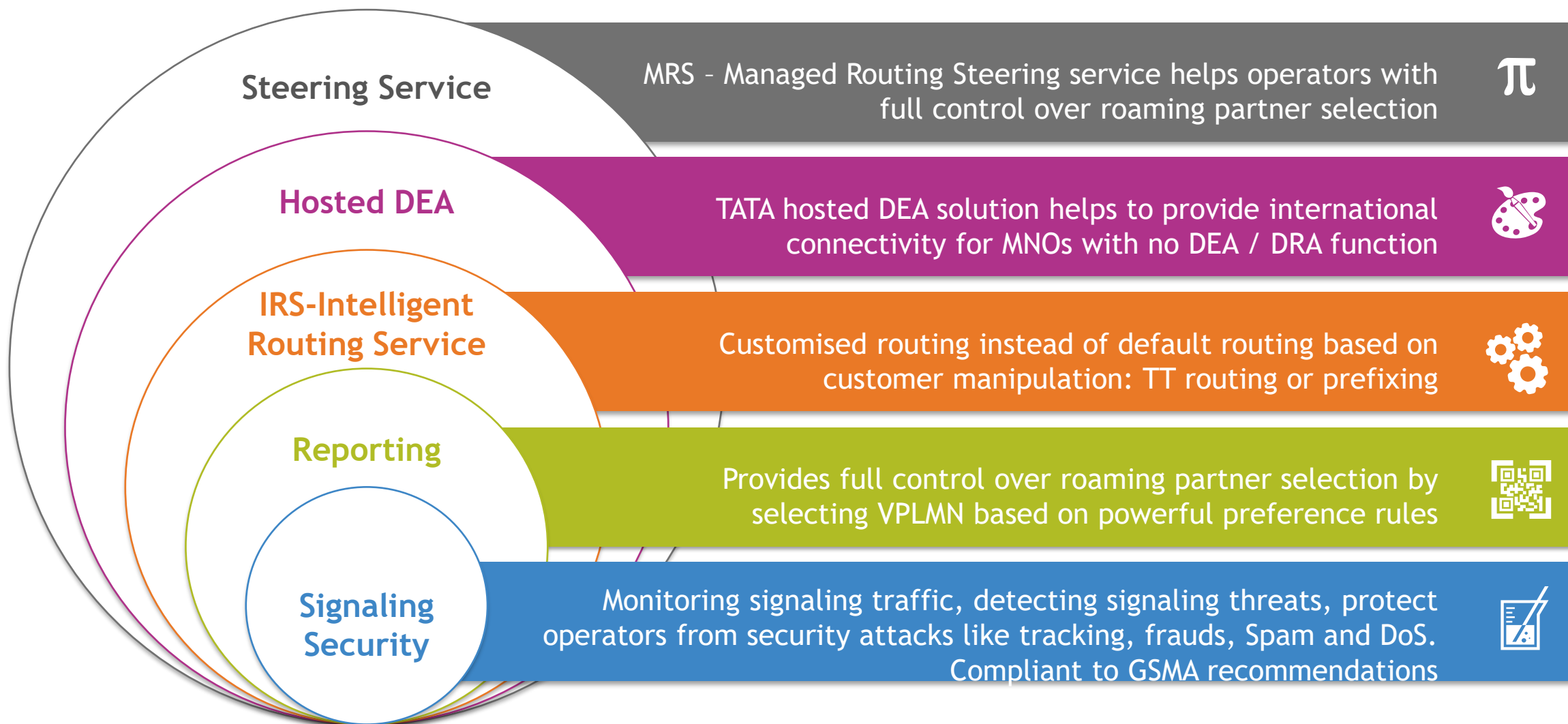
SS7
2G / 3G roaming core signaling

WGR
2ITU-ANSI conversion

DSX
4G roaming signalling

SoR
Steering of roaming

VAS
Value added service like IRS, Signalling security
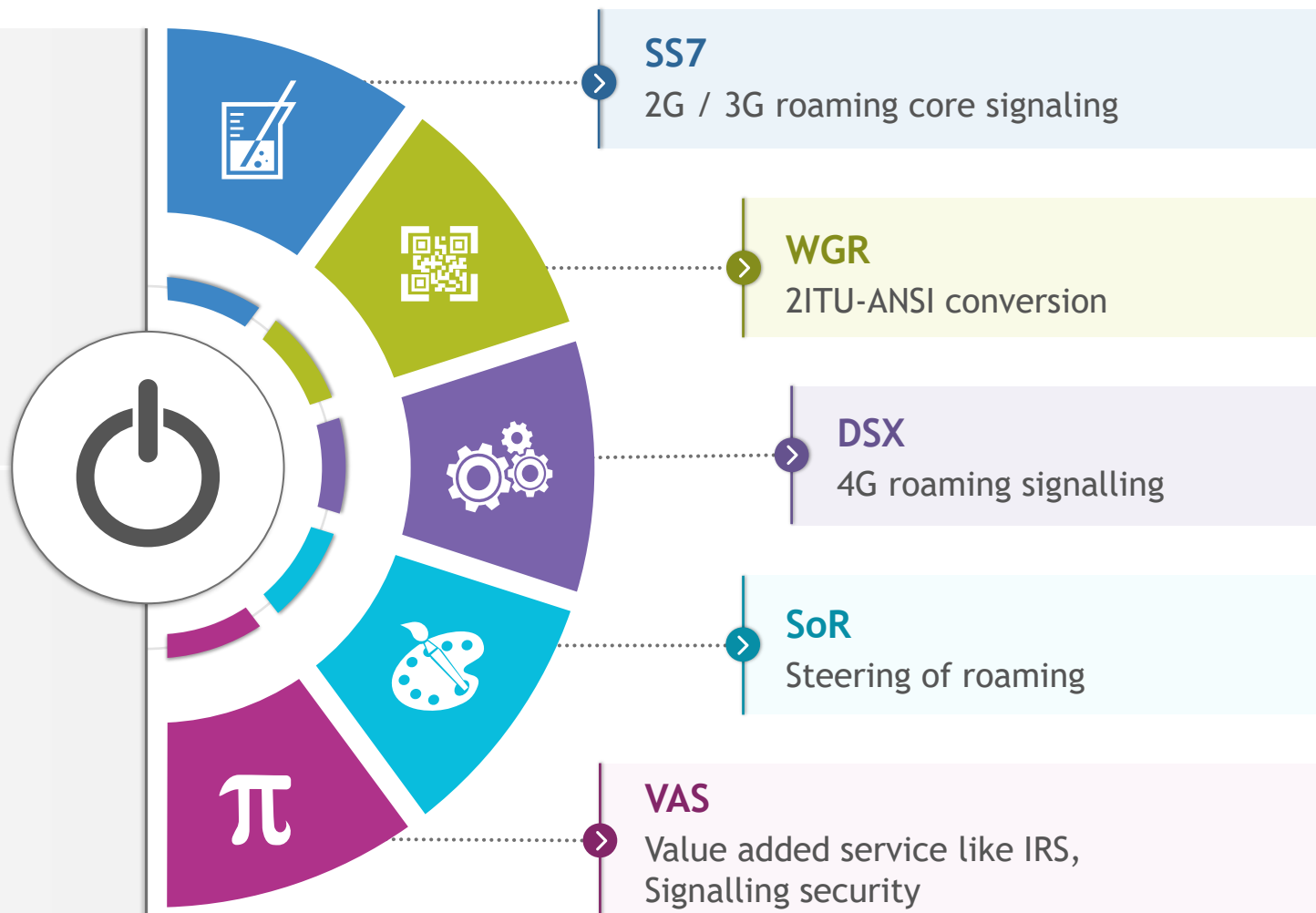
ROADMAP OF INCREMENTAL INNOVATION

WE ENDEAVOUR TO CONTINUOUSLY KEEP ADDING FEATURES THAT ARE IN LINE WITH THE TECHNOLOGICAL INNOVATION AND EVOLUTION IN ORDER TO SERVE ARE CLIENTS IN THE BEST POSSIBLE WAY

Feature	Service	Expected availability	Remarks
Border Roaming	SCCP & DIAMETER Signalling	31-Jan-2022	Intelligent border roaming function avoid unnecessary handovers or location updates near national border
Signalling Security	DIAMETER	31-Mar-2022	Signalling security for DIAMETER interface to detect and protect SPAM or frauds
Reporting & Monitoring	SCCP & DIAMETER Signalling	30-Apr-2022	Provide access to customer to generate and see reports of their signalling traffic for business intelligence and monitoring purpose
Burstable Billing	IPX/GRX	31-May-2022	Charge customer's data roaming traffic automatically on usage basis
Reporting	IPX/GRX	31-Jul-2022	Provide access to customer to generate and see reports of their data traffic for business intelligence & monitoring purpose
Roaming Hub	5G roaming	Dec-2022	Provide MNOs access to 5G enabled roaming partners with no efforts on signing roaming agreements
VoLTE Roaming	VoLTE services	Dec-2022	Carry VoLTE traffic with no hassle for MNOs to sign VoLTE agreements with RPs
LTEm & NBIoT roaming	LWPA Roaming	Mar-2023	Provide hub service for LTEm and NB-IoT devices
5GS Roaming	5Gs signalling & Data	Dec-2022	Carry 5G signalling and data traffic between roaming partners

ROAMING VALUE ADDED SERVICES

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Steering Service — MRS – Managed Routing Steering service helps operators with full control over roaming partner selection

Hosted DEA — TATA hosted DEA solution helps to provide international connectivity for MNOs with no DEA / DRA function

IRS-Intelligent Routing Service — Customised routing instead of default routing based on customer manipulation: TT routing or prefixing

Reporting — Provides full control over roaming partner selection by selecting VPLMN based on powerful preference rules

Signaling Security — Monitoring signaling traffic, detecting signaling threats, protect operators from security attacks like tracking, frauds, Spam and DoS. Compliant to GSMA recommendations

MOBILITY VALUE PROPOSITION ON A PAGE

SCCP

Unique Multi-STP Configuration
- Superior redundancy and reach - 6 global STPs
- Fully redundant, scalable hi-speed inter-STP backbone

One stop shop roaming solution
DIAMETER signalling, data (GRX/IPX), voice, messaging and IoT services, Tata Communications provides single window for all roaming services

Minimal 3rd party dependencies
With owned infra network and number of roaming solutions, Tata Communications minimizes dependencies on 3rd parties

Excellent reach
- 200+ direct customers
- Reach to 900+ destinations in ANSI and ITU plane
- 230+ PoP locations

E2E Infra network
- Network Equipment like STPs, SMS Aggregators, conversion platform, Lawful interception nodes
- Global connectivity Network
- Globe covered cables

Follow the Sun support
- 2 NOC centres in different time zones
- Regional presales and sales teams provide all-time available experience

DSX

Reliable Transport
- Global coverage - 74 On-Net PoPs in 40 countries
- Flexible IP transport configuration options
- S6a, S6d, S8 and S9, Relay Agent, Proxy Agent
- SCTP multi-homing, Load balancing. Congestion control, IR.77 compliant (inter-operator IP BB security)
- IR88 conforming

VAS
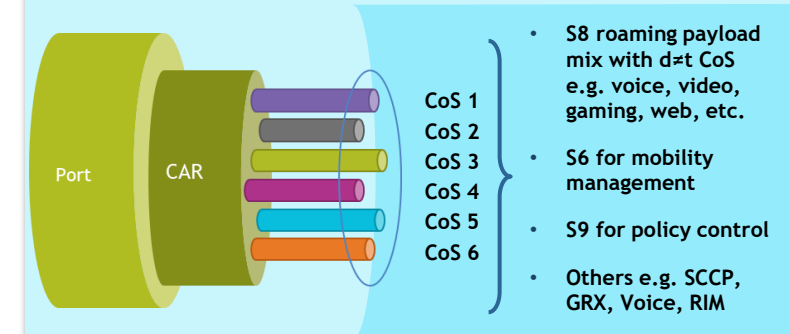- Enables MNOs to leverage LTE Steering over the cloud
- Hosted DEA support

Superior QoS
- Comprehensive SLAs,
- 2 pairs of DRAs with geo-redundant network architecture
- IR34 conforming
- Pro-active monitoring, 24/7/365 dedicated support desk with up to 99.999% availability
- Fast re-route (FRR) in the network core
- Support different CoS levels (1 to 6)

Worldwide Peering
Tata Communications ensures reachability to destination because of its worldwide peering relations with all the major roaming service providers

IPX

Port | CAR

CoS 1
CoS 2
CoS 3
CoS 4
CoS 5
CoS 6

- S8 roaming payload mix with d≠t CoS e.g. voice, video, gaming, web, etc.
- S6 for mobility management
- S9 for policy control
- Others e.g. SCCP, GRX, Voice, RIM

10 GE ready backbone

200+ PoPs deployed in all continents

5 types of access management

Customer self-provisioning and **100G backbone** on the roadmap

QoS offering supporting a mix of up to **6 classes of service** at any one time

Scalable bandwidth with quick TAT to add capacity when the need arises

Flexible B/W pricing catered to evolving CoS and application type usage patterns

One **simple monthly fee** for any mix of class of service with up to 50% usage on CoS1 and 2
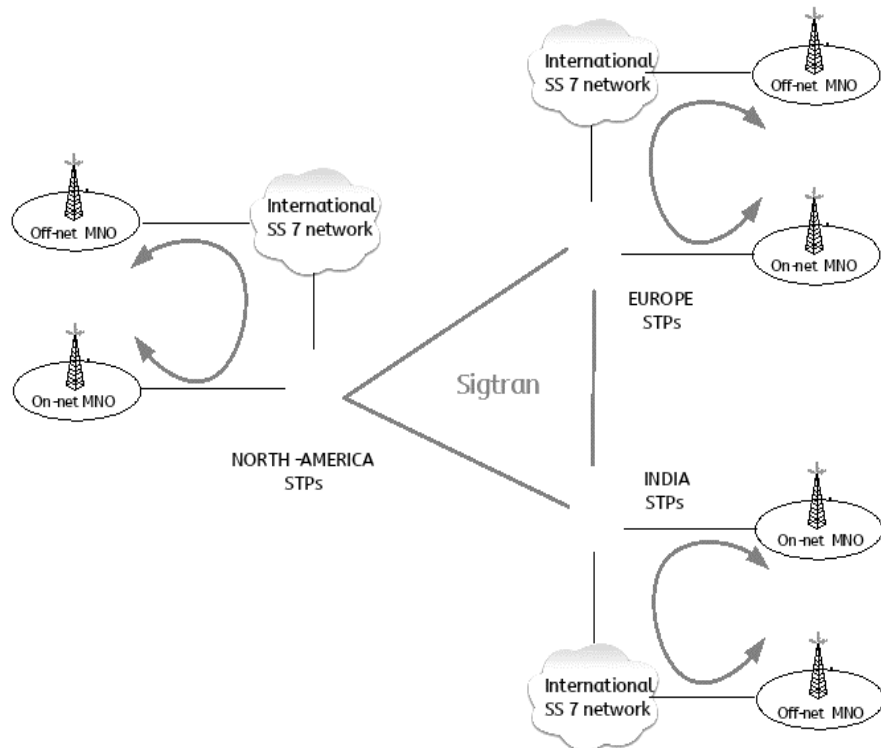
Appendix

SIGNALLING NETWORK CAPABILITIES | MULTI – STP CONFIGURATION

NETWORK OVERVIEW
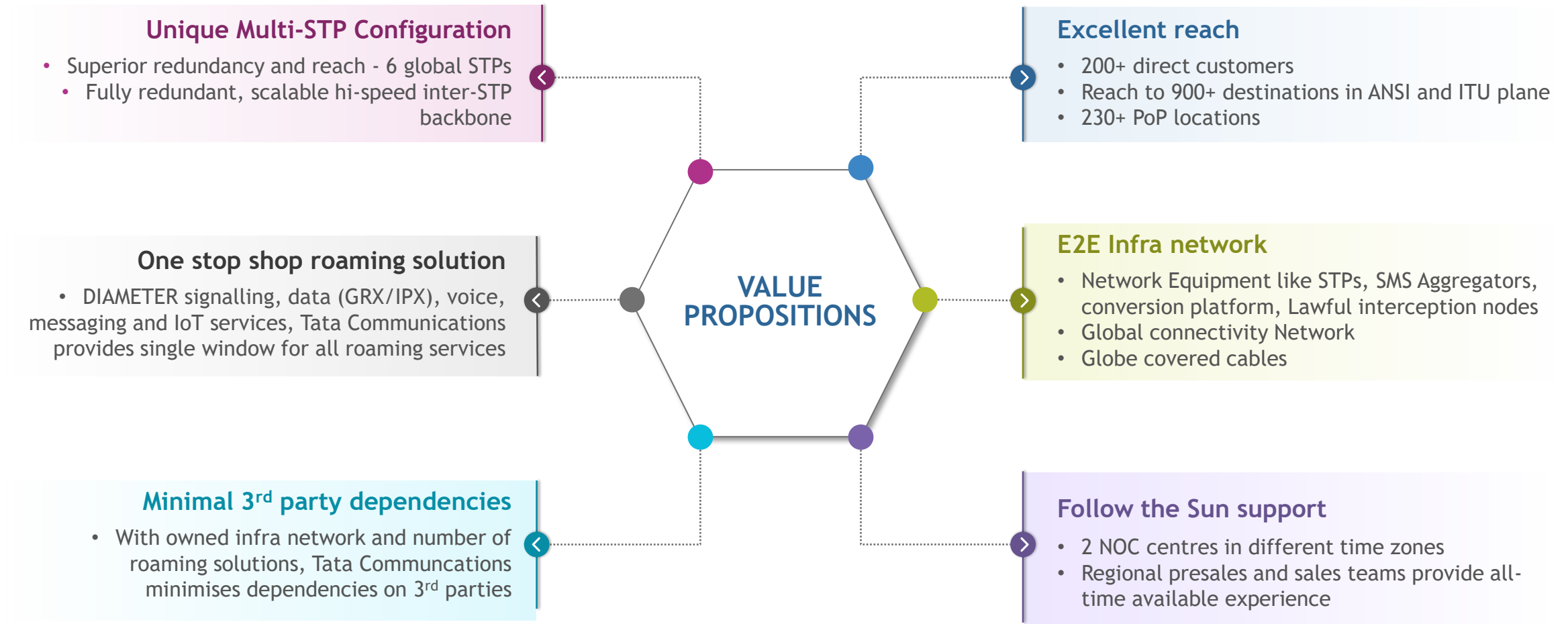
UNIQUE MULTIPLE-STP APPROACH

UNRIVALLED NETWORK REDUNDANCY

- **6 STPs on 3 different continents:**
  - STPs from Oracle - most advanced and reliable SS7 vendor
  - Rapidly scalable - designed to handle sharp peaks

- **Regional Traffic Localisation:**
  - Traffic between regional MNOs stays within same STP-pair
  - Better resiliency and low round-trip delays
  - Better impact isolation during major events

- **Redundancy Between STP-Pairs**
  - During major cable system failure, traffic can be rerouted through alternate inter-STP link-sets.

- **Sigtran capabilities:**
  - Sigtran ring between STPs – additional redundancy thanks to multi-homing

The redundancy of a multi-IGP configuration with traffic symmetry and operational benefits of a single service provider

SCCP VALUE PROPOSITION

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VALUE PROPOSITIONS

DSX VALUE PROPOSITION

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DSX Values

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IPX VALUE PROPOSITION

Tata Communications LTE Roaming Solution offers a robust and scalable upgrade path to 4G, along with the ability to support a mix of rich media roaming services
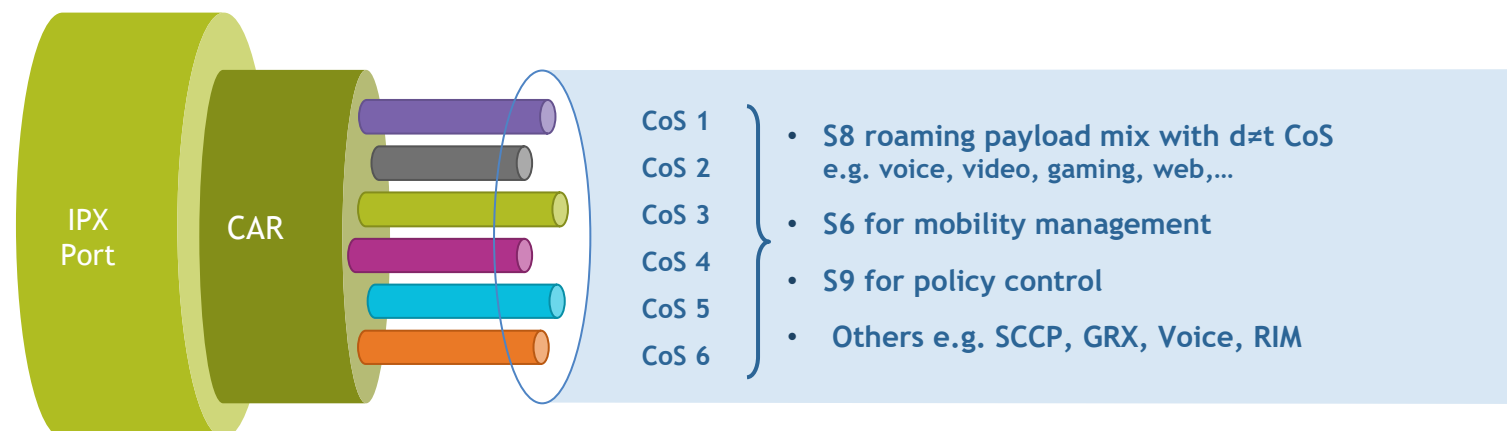
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CoS 2
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CoS 5
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TATA

THANK YOU

tatacommunications.com