Quantum Communication Technologies

GLIMPSES OF INTER-MINISTERIAL COMMITTEE REPORT

Department of Telecommunications

..A MASSIVE COLLABORATION EFFORT

Industry

O/o PSA

ISRO

Academia

CDAC

PRL

RRI

NSCS

C-DoT

DST

DRDO

DoT

"The IMC Report is an outcome of a <u>broad-based</u> consultation and <u>in-depth analysis</u>, and covers:

1. Existing Indigenous Competencies (Academia, RI, Industry),
2. Products,
3. Research Activities,
4. R&D Infrastructure,
5. List of Experts,
6. Standardization Opportunity,
7. Macrolevel Roadmap and
8. Policy Recommendations "

QUANTUM OPPORTUNITY

Many technology giants and start-ups internationally have already invested significantly in quantum technologies, with confirmed and announced deals for 2021 alone totaling about $2.1 billion.

By 2030, Quantum Communication & Sensing alone could generate $13 billion in revenues, and that amount could grow substantially in later years. Quantum Communication could account for an estimated $8 billion in revenue by 2030.

Inter-Ministerial Committee

Member (T), DCC, DoT, CHAIRMAN		
Dr. Ekta Kapoor	Head (FFT) & Scientist 'G', DST	Member
Dr. Manjunath	Principal Consultant, WIPRO	Member
Dr. Nagendra Nagaraja	CEO, QPIAI	Member
Shri Narendra Nath	Joint Secretary, NSCS	Member
Shri Nixon Patel	CEO, QuLabs	Member
Smt Pamela Kumar	DG, TSDSI	Member
Dr. Preeti Banzal	Adviser/Scientist'G', O/O PSA	Member
Shri Raghu N	Deputy Director, ISRO	Member
Dr. Subrata Rakshit	Director, CAIR DRDO	Member
Dr. R. P. Singh	Professor, Physical Research Laboratory	Member
Dr. S D Sudarsan	Executive Director, CDAC	Member
Shri Sunil Gupta	CEO, QuNu Labs	Member
Dr. R K Upadhyay	Executive Director, CDOT	Member
Dr. Urbasi Sinha	Professor, Raman Research Institute	Member
Shri Vidyut Navelkar	Head, Quantum Computing Incubation, TCS	Member
Shri Kishore Babu	DDG (SRI), DOT	Member Secretary

TASK FORCES

| S.No	Task Force	Champion(s)	Supporting Leads	Limited view (to be developed)
1	Build synergies across institutions	Prof. Urbasi Sinha (RRI); Dr Pankaj Dalela (CDOT); Dr. R. P. Singh (PRL);	Dr. Sudarshan (CDAC); Prof. Bhaskar Kanseri (IIT Delhi) ;	a) List of institutions (Indian & Intl) and their activity b) List of Indian companies and their activities c) Bucketing institutions with common work d) Engagement with global institutions & Countries e) List of global experts and engagement
2	Identify Use cases & applications and enable pilot trials	Dr. Nagendra (QpiAI); Dr Purnima Sethi (SuperQ); Dr Balaji Sompalle (SuperQ); Dr Amlan Mukherjee (QpiAI); Prof. Nixon Patel (QuLabs); Devendra Mishra (Qulabs); Rahil Patel (Qunu labs)	Dr Anindita Banerjee (CDAC); Vinayak Godse (DSCI); Prof. Bhaskar Kanseri (IIT Delhi) ; Dr. R. P. Singh (PRL); Dr. Goutam K Samanta (PRL); D. K. Singh (SAC); Adarsh Jain (SAC)	a) Usecases & Applications b) Proposals for pilots – size, institutions, application c) Avoiding duplication of pilots d) Quantum testbed for R&D and community use
3	Facilitate IPR creation in India	Dr. Nixon Patel (Qulabs), Sunil Gupta (QuNu labs), Dr. Nagendra (QpiAI), Dr. Anindita Banerjee (CDAC)	Dilip Singh (CTO, QuNu Labs);	a) Global achievements in Quantum R&D and deployment – Indian proposals b) Potential areas for IPRs c) Next generation R&D in Quantum Comm activities
4	Standards development & Coordinate India's position in global standards bodies	Pamela Kumar (TSDSI); Dr. Nixon Patel; Dr Manjunath (Wipro), Dilip Singh (CTO, QuNu Labs); Col. Nath (ED Pune and Corp R&D, C-DAC)	Prof. Urbasi Sinha (RRI); Dr. R. P. Singh (PRL)	a) Standards across intl entities b) Standardization gaps c) Current TSDSI / TEC actions on QC d) Roadmap for contribution e) Testing and benchmarking f) Certification
5	Policy measures to promote QC products, production and deployment	Sudarsan (CDAC); Dilip Singh (CTO, QuNu Labs)	Dr. R. P. Singh (PRL); Dr. Goutam K Samanta (PRL); D. K. Singh (SAC); Adarsh Jain (SAC)	a) National initiatives to promote adoption b) QC CoE / QC THUB / QC Testbed – What, where, governing mechanism c) Data protection & Encryption policy
6	Action plan for the development of Quantum Communication Technologies	Prof. Urbasi Sinha; Atul Gupta (CDoT), Sunil Gupta (QuNu labs); Dr. Anindita Banerjee (C-DAC R&D) Dr. R. P. Singh (PRL)	Dr. Goutam K Samanta (PRL) Shri R. K. Bahl (SAC)	a) QC Directory on technology companies, institutions, Usecases, Demonstrations (done) b) Institutional Mechanisms to build synergies in QC across entities c) Action plan covering other TF items

Technology Roadmap

Sunil Gupta
Prof. Urbasi Sinha
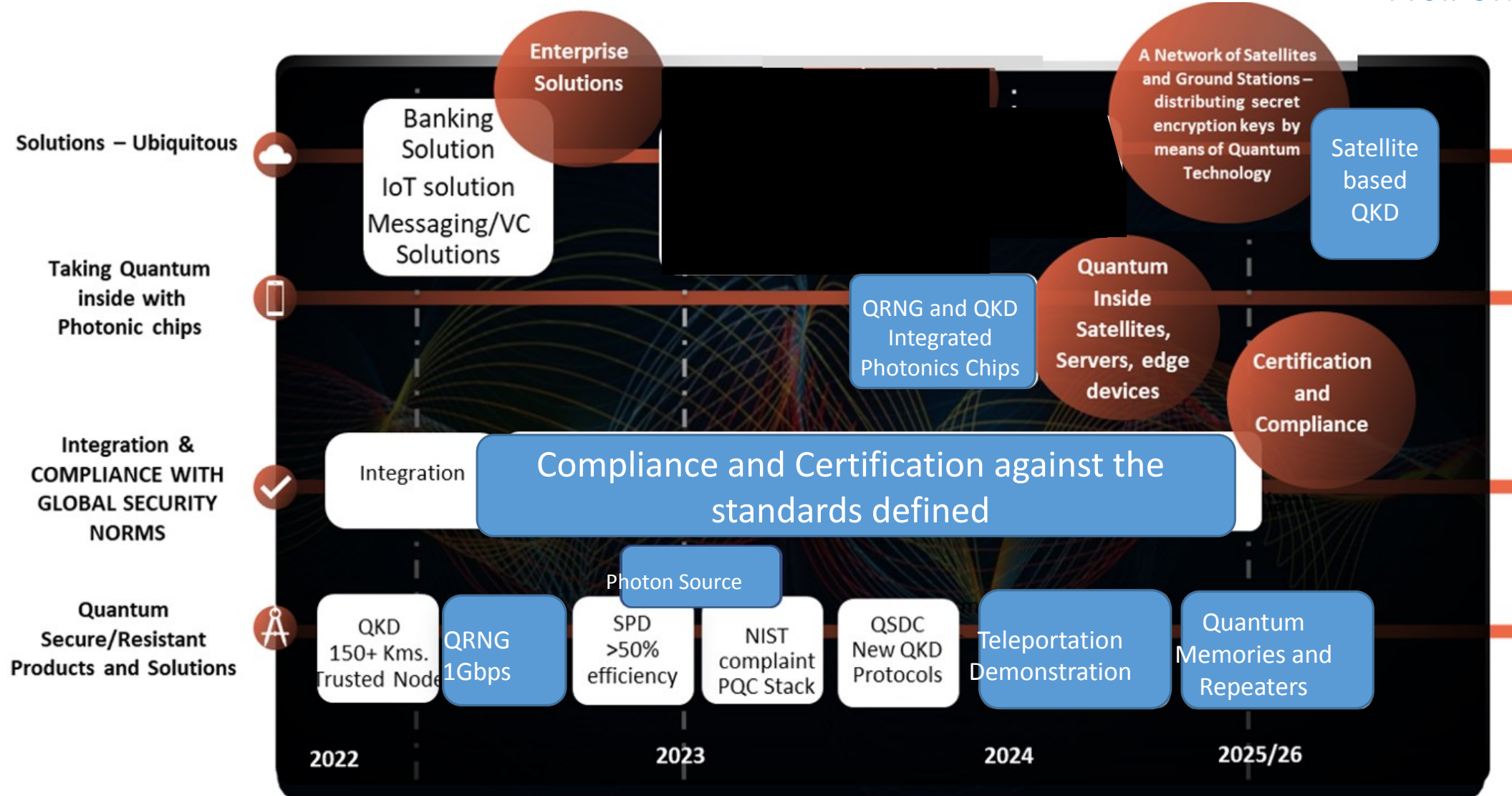
Standardization Gaps

Domain	Standard
SDN	ETSI GS QKD 018 V1.1.1 (2022-04): orchestration interface
	ETSI GS QKD 015 V2.1.1 (2022-04): control interface
	IEEE P1913 SDN for QC
QKD APIs	ETSI GS QKD 004 V2.1.1 (2020-08): Application Interface
Channel	ETSI GS QKD 012 V1.1.1 (2019-02): device & communication channel parameters
Network	ITU FG QIT4N.D1.2 : Network aspects
Protocols	ETSI GS QKD 014 V1.1.1 (2019-02): Protocol& data format
	ITU FG QIT4N.D2.3 : QKDN protocol Quantum layer
	IETF [3] connection setup
Terminologies	ETSI GR QKD 007 V1.1.1 (2018-12):vocabulary
	IEEE P7130 Quantum Technologies Definitions
	ITU FG QIT4N.D1.1 : Terminologies of QIT
Interfaces	ETSI GR QKD 003 V2.1.1 (2018-03): components & internal interfaces
Characterization	ETSI GS QKD 011 V1.1.1 (2016-05): component characterization
Use cases	ETSI GS QKD 002 V1.1.1 (2010-06):QKD use cases
	ITU FG QIT4N.D2.2 : Use cases of QKDN
Test & evaluation	ISO/IEC CD 23837-1.2: test and evaluation methods for QKD
Benchmarking.	IEEE P7131: Standard for Performance Metrics & e Benchmarking
QoS	ITU Y.QKDN-Qos-Ml-Reg machine learning based QoS

Standardization bodies

IEEE   ISO   IETF

ITU Standard   ETSI

ITU FG QIT4N Report
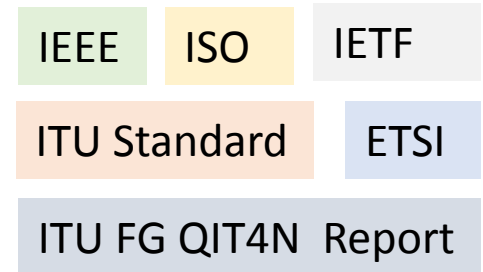
Technical gaps

- vastness of the documents
- multiple standards
- contradicting recommendations
- Implementation issues

Logistic gaps

- Support from experts across academia, startup, Industries, R & D
- Holistic ecosystem spanning simulation, implementation, testing, benchmarking and standardization

KEY RECOMMENDATIONS

1. Draw a **National Level Program for Quantum Communication (QC) Pilots and Trials with indigenous products** –DoT PSUs, ITI, TCIL may take lead in deploying these pilots across strategic verticals

2. **Fund Public access QC testbeds** (3 to begin with) in research labs or institutions or section 8 companies and ENSURE industry facilitation; Access to integrated testbeds at a nominal cost;

3. **Quantum security** an **integral part of National Security Strategy** with specific actions

Quantum Secured Network in Strategic Verticals

1. M/o Power for secured grid operation,
2. M/o Railways for secured control & Operations,
3. M/o H&FW,
4. Secured transactions in Banking, NPCI/UPI, Stock market infrastructure,
5. Data centres where government data is stored / managed,
6. Network of TSPs,
7. Airports networks,
8. GSTN,
9. GeM,
10. NIC etc.

4. **Test & Certification**

   Testing and Certification facility at Delhi and Bengaluru and C-DAC, Pune by TEC

   for interoperability, and testing of equipment from multiple vendors

5. Make available **QC public R&D infrastructure** created with government funding **for collaborative and federated use**

6. A subgroup of Inter-Ministerial Committee to coordinate **central funding of R&D projects** in Quantum Communications to enable synergies - Focused funding for higher R&D goals with and minimizing duplication

7. Quantum Communications facilitation centre by TEC to galvanize government, industry and academia in taking actions on Quantum Communications

8. **QC and Application Use case l**abs / Experience Centres in key economic verticals driven and hosted by Industry with funding support; They shall also act as **QC experience centers**.

Thank you