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TRAI/FY23-24/67
Dated: 15.01.2024

To,
Shri Anand Kumar Singh,
Advisor (CA&IT)
Telecom Regulatory Authority of India,
Mahanagar Door Sanchar Bhawan,
JawaharLal Nehru Marg,
New Delhi – 110 002.

Subject: Response to Consultation Paper on "Encouraging R&D in Telecom, Broadcasting, and IT (ICT) Sectors"

Dear Sir,

This is in reference to TRAI's Consultation Paper on "Encouraging R&D in Telecom, Broadcasting, and IT (ICT) Sectors dated 22.09.2023 (19/2023)

In this regard, please find enclosed our response for your kind consideration.

Thanking You,

Yours' Sincerely,
For **Bharti Airtel Limited**

Rahul Vatts
Chief Regulatory Officer

Encl: a.a

C-12/(1)/2024-TD

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Response to CP on Encouraging R&D in Telecom, Broadcasting, and IT (ICT) Sectors

Airtel thanks the Telecom Regulatory Authority of India (TRAI) for giving it the opportunity to share its perspective on "*Encouraging R&D in Telecom, Broadcasting and IT (ICT) Sectors*."

Research and development (R&D) play a vital role in driving economic growth, developing sustainable solutions, improving efficiency and increasing the competitiveness of businesses. For any country to grow and sustain its growth, it is important that the country completely transform its science, innovation and R&D ecosystem. R&D does not just improve lives by making products and services more accessible and affordable, it also bolsters a nation's self-reliance and security.

The world of Telecom, Broadcasting and IT, meanwhile, is undergoing rapid technological advancements and convergence as emerging trends like 5G, 6G, Open-RAN, (IoT), AI /ML, Distributed Ledger Technology (DLT), AR, VR, Metaverse, Quantum Computing, Cloud, Edge Computing, NFV, SDN and Over-The-Top (OTT) services transform the industry; and 'Made in India' mobile phone shipments cross the 2-billion cumulative units mark over the 2014-20221 period, registering a 23% CAGR, according to the latest research from Counterpoint's Made in India service. In fact, in 2022, more than 98% of shipments in the overall Indian market were 'Made in India', compared to just 19% in 2014.

The overall ICT sector contributes over 13 percent to India's GDP and is a major economic driver. India aims to grow the ICT sector to $1 trillion by 2025, or 20% of GDP. According to NASSCOM, India's technology industry recorded its highest-ever growth by reaching $227 bn in revenue in 2021, from $200bn in 2020. Additionally, all subsectors of the technology industry, including IT and business process management, IT-enabled services, engineering research and development, hardware, software products, and e-commerce recorded double digit growth in 2021.

To assess the effectiveness of the R&D ecosystem of a country, it is important to first understand the critical statistics and parameters which define the R&D ecosystems. The Gross Expenditure on R&D (GERD) of any country is one such important statistic. According to NITI Aayog's India Innovation Index Report 2021, India's GERD is one of the lowest in the world, with just $43 per capita. The table that follows provides the GERD of a few select countries to show India's relative position. It shows that India needs to boost this expenditure and at least be on par with its BRICS or ASEAN counterparts like Russia (285), Brazil (173) and Malaysia (293).

Country	GERD per capita (2018)
Belgium	1438.17
Brazil	173.37
China	325.82
Germany	1701.47
India	43.41
Indonesia	26.34
Israel	2108.20
Italy	593.90
Malaysia	293.39

Country	GERD per capita (2018)
Mexico	63.82
Russian Federation	284.80
South Africa*	105.69
United Kingdom of Great Britain and Northern Ireland	791.43
United States of America	1777.93

Note: - *Data for South Africa is for 2017.
Source: UNESCO Institute for Statistics.

[1] https://www.counterpointresearch.com/insights/india-mobile-phone-production/

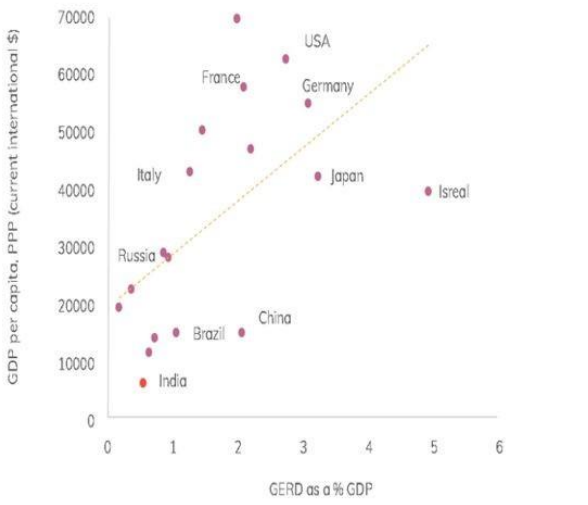
India's GERD as a percentage of GDP has been consistent and hovered around 0.7% for about a decade and it needs considerable improvement. Improvement in GERD will play a critical role in India's ambitious target of achieving the goal of a $5 trillion economy and making India lead and influence its innovation footprint across the globe.

GERD as a percentage (%) of GDP (2018)

Country	R&D as a % GDP	GDP per capita, PPP (current international $)
Argentina	0.49	20771
Brazil	1.16	14835
Canada	1.56	46611
China	2.14	17211
Egypt	0.72	12607
France	2.19	46983
Germany	3.13	54792
India	0.65	6504
Israel	4.94	39482
Italy	1.39	41829
Japan	3.28	42390
Malaysia	1.04	27924
Mexico	0.31	18444
Netherlands	2.16	59268
Norway	2.07	62645
Russian Federation	0.98	29812
South Africa	0.83	13361
United States of America	2.83	65593

Note: - *Data for South Africa is for 2017.
Source: UNESCO Institute for Statistics.

Correlation between GDP per capita and GERD as a per cent of GDP (2018)

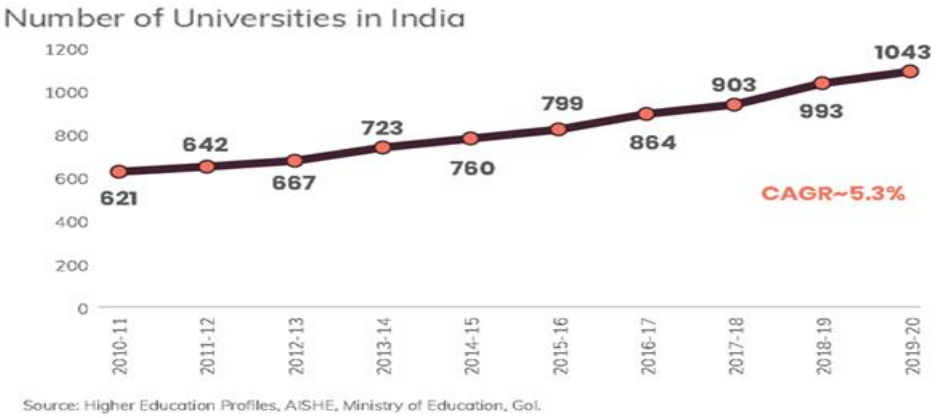


Source: UNESCO Institute for Statistics and World Bank.

However, it is also a matter of fact that India has improved its position in R&D and innovation, recently securing its place as the top-ranked economy in the "Central and Southern Asia" region and ranking 40th in the Global Innovation Index 2022. The country has seen a substantial increase in the generation of Intellectual Property Rights (IPRs). This surge in innovation is attributed to the government's initiatives such as "National Education Policy 2020," "National Policy on Electronics 2019," "National Digital Communications Policy 2018," and programmes like "Make in India," "Digital India," "Startup India" and "Telecom Product-Linked Incentives (PLI) scheme".

The Government of India is also earmarking funds for R&D / Ministry of Science & Technology for new innovations.

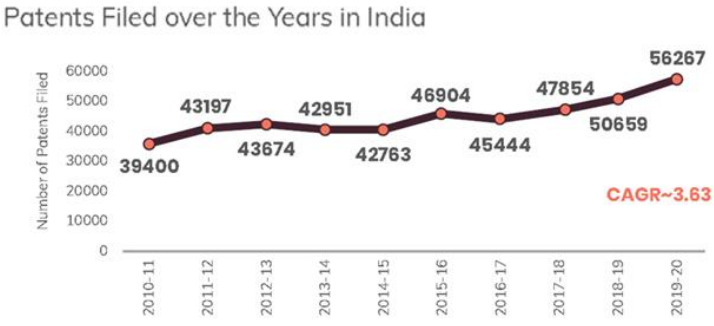
The R&D ecosystem of a country can also be measured by its research acumen, the number of universities, IoEs (institute of Eminence), researchers (Ph.D.) and number of publications/citations by them. Currently, India has ~122 centrally funded institutions of technical and science education. These include: IIITs (25), IIITs (23), IIMs (20), IISc BLR, IISERs (7), NITs (31), NITTTRs (4), and 9 others (SPA, ISMU, NERIST, SLIET, IIEST, NITIE & NIFFT, CIT). As per the government of India data, there are ~1050 universities active in the country and India, on an annual basis, is adding several new universities to this list (CAGR, ~ 5.3%). This gives a solid platform from which to grow and disseminate a culture of research all across India, thereby creating a strong R&D ecosystem in the country.



Source: Higher Education Profiles, AISHE, Ministry of Education, GoI.

India is actively working towards becoming the global leader in renewable batteries, green hydrogen, solar energy. Additionally, as part of its effort to become a Digital nation, India has established several Artificial Intelligence and IoT incubation centres, resource centres and automation and IoT-based advanced analytics test beds to improve the competitiveness of the business, particularly the R&D and Manufacturing. Tech Startups have also started investing in these pathbreaking technologies.

On the patent and publication front as well, India's contribution is rising. The table that follows highlights that almost fifty-six thousand patents were filed during 2019-20. This demonstrates the intellectual capacity of India and proves that given the opportunity in R&D, India can grow its R&D landscape significantly.



Source: United Nations, Department of Economic and Social Affairs. Population Division (2019). International Migrant Stock 2019 (United Nations database, POP/DB/MIG/Stock/Rev.2019).

Thus it is evident that the R&D ecosystem plays a critical role in driving innovation and progress across a range of industries, from technology and healthcare to energy and agriculture. To be more effective and efficient, the R&D ecosystem requires collaboration and coordination among its various stakeholders such as partnerships between industry and academia, funding mechanisms to support early-stage R&D and policies that encourage knowledge-sharing and the commercialisation of modern technologies. This can be achieved through four elements:

1. Education and Training System

While the Indian Education system has several strengths including the IT workforce, quality higher education, strong emphasis on Science, Tech, Engineering & Math (STEM), it also faces challenges in promoting a scientific temper, critical thinking and practical skills among students, particularly in the ICT sector. Reforms are needed to align the education system more closely with the demands of the modern R&D-driven ICT industry, including an increased focus on practical, project-based learning and easily available research opportunities. Some of the key strategies to further bolster the R&D ecosystem could include:

- Increased Funding for R&D
- Promotion of Industry Academia Collaboration
- A simplified regulatory framework
- Greater IPR protection
- Investment in emerging technology.

2. Science System

The term "Science System" refers to an interdisciplinary field that studies the complexity of systems in nature, social or any other scientific field. While it has made considerable progress in India, there is scope for improvement when it comes to fostering R&D and innovation, particularly in the ICT sector.

Participation of Public Sector Enterprises (PSEs) involved in R&D in the Indian ICT sector can help synergise national effort in this sphere and have significant impact. Some strategies to achieve this may include making more funding & resources available, establish Tech Transfer Offices, etc.

The development of effective next-generation technology testbeds in India could also help in fostering further innovation, research and development in emerging technologies - these require efforts like a facilitative regulatory framework, collaborative ecosystem, functioning data management & security, etc.

3. Policies and programmes

Establishing a transparent mechanism for the adequate and timely disbursement of funds for R&D programmes in India is crucial to ensure that resources are utilised effectively and that outcomes are achieved. Steps for transparent fund disbursement may include establishing a clearly defined objective, competitive granting process, budget allocation, application evaluation process, some of which have been discussed in the regulatory sandbox approach of TRAI consultation earlier.

Encouraging the participation of the Indian private sector in R&D is crucial for fostering innovation, economic growth and technological advancement. Several incentivisation models or a combination of these models can be employed to do so. Tax incentives, R&D grant and subsidies, PPPs, etc. will all help towards promoting this.

Promoting research, development, and innovation at the state level in India is essential for balanced and sustainable economic growth and technological advancement. While India has several national-level initiatives to support R&D and innovation, a mechanism at the state level can provide a more localised and customised approach to meet the specific needs & strengths of each state.

4. IPR Framework

Increasing awareness about Intellectual Property Rights (IPR) among researchers and the industry in the Indian ICT sector, is crucial for fostering innovation and protecting intellectual property. Incorporating IPR into the academic curriculum can be a proactive step to achieve this. Improving the speed and efficiency of the patent approval process for ICT in India is crucial to support innovation and technological advancements in the sector.

Lowering the cost of filing patents can make the process more accessible and affordable for a broader range of inventors and organisations which may include fee structure reforms, fee waiver for MSMEs, fee reduction for green tech, online filing, and payments, etc.

Introducing an Intellectual Property (IP)-backed financing system in India for the Information and Communication Technology (ICT) sector will also be beneficial for promoting innovation and facilitating access to capital for technology companies. IP-backed financing will allow companies to leverage their intellectual property assets, such as patents, copyrights and trademarks as collateral for loans or other forms of financing.

Accordingly, in summary, the following may be considered to promote R&D:

- *Align the education system more closely with the demands of the modern R&D-driven ICT industry, including focusing on practical, project-based learning and research opportunities.*
- *The Government should take the lead role in funding industry-academia collaboration on technology, and also partly fund the products.*
- *Establish the steps needed for transparent fund disbursement with a clearly defined objective, competitive granting process, budget allocation and application evaluation process.*
- *The next-generation technology test beds can foster innovation, research and development in emerging technologies.*
- *Put emphasis on R&D and collaboration in the field of hardware/equipment where stakes are high and investment requirements huge. More focused schemes like PLIs (linked with certain interim milestones) will help de-risk the investments and encourage more R&D.*

- *Provide tax benefits for industry-academia collaboration since these require heavy investments but the returns cannot be assured due to the extremely low success rate of such collaborations in terms of products envisaged, multiple iterations, scale economies.*

- *Increase awareness about IPR among researchers and the industry in the ICT sector to foster innovation and protecting intellectual property. Incorporating IPR into the academic curriculum can be another proactive step in achieving this.*

- *Introduce an Intellectual Property (IP)-backed financing system in India for the ICT sector. This will allow companies to leverage their intellectual property assets such as patents, copyrights and trademarks, as collateral for loans or other forms of financing.*

- *Assess the need for new Telecom CoEs based on the evolving landscape and the benefits that have accrued from the appointment of such CoEs.*

- *Look at the ways to improve Technology Readiness Levels (TRLs) as different product R&Ds may have different life cycles. The partnership between public sector enterprises (PSEs) and academia should have a common ground to work, clear vision and objective about the outcome. The participation should be totally voluntary.*

In view of the above, wherein we have elaborated on the important points that needed elucidating in our summary above, our response is limited to three of the questions posed in the Consultation Paper.

Q7. What role do you envisage for the service providers and industry in facilitating indigenous R&D in the ICT sector respectively? How can industry participation in R&D in the ICT sector be further improved? Please support your answer with justification and best practices in India and abroad in this regard.

Q8. How Telecom Centres of Excellence (TCOEs) can be made hubs of innovative product delivery to telecom industry? What can be done to further strengthen the TCOEs in order to provide an impetus to innovations in the telecom sector? Please support your answer with justification and best practices in India and abroad in this regard.

Q9. Is there a need to establish new Centres of Excellence for the broadcasting sector? What can be done to synergize telecom and broadcasting sectors for the objective of convergence? Please support your answer with justification and best practices in India and abroad in this regard.

Airtel Response:

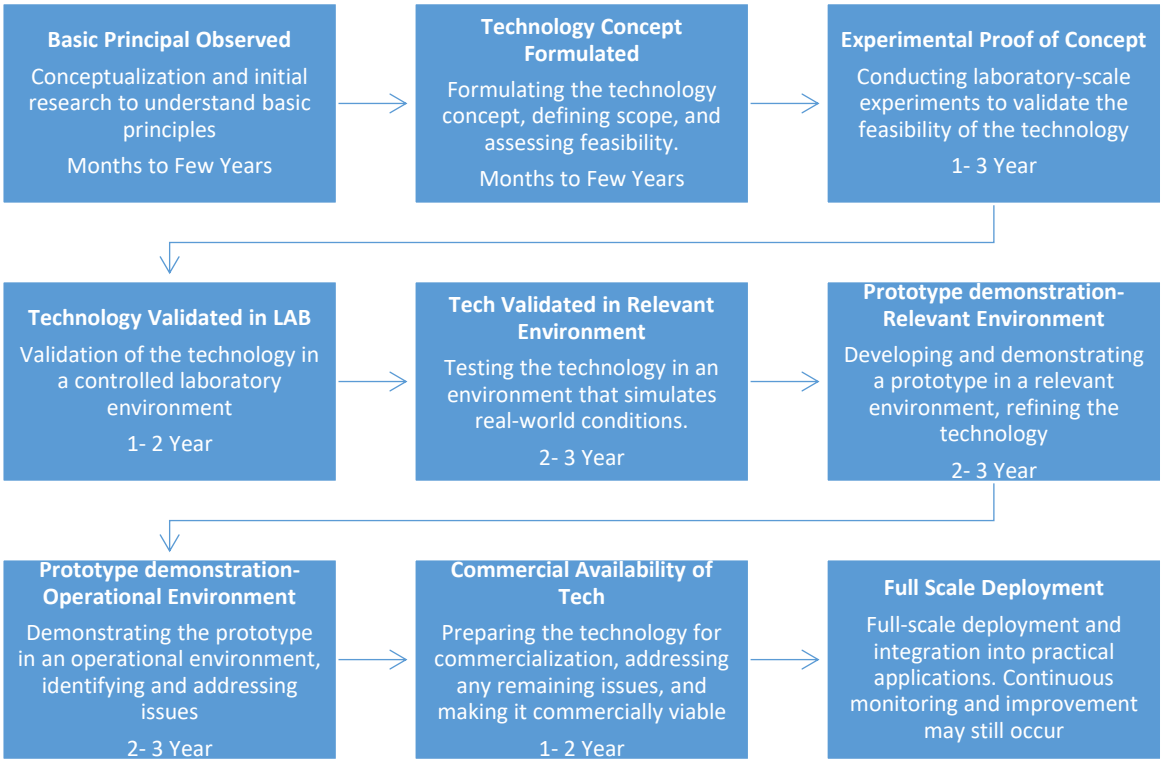
The Telecom Centres for Excellence (CoEs) are established to foster innovation, R&D in the telecommunications sector. Their effectiveness can be assessed based on several factors:

- **R&D**: The effectiveness of the centre can be measured by the quality and relevance of the research projects undertaken, as well as by any resulting innovations.
- **Industry Collaboration:** The extent to which the CoE collaborates with industry stakeholders, including telecom companies, technology vendors and government bodies is what will determine its effectiveness. Strong partnerships can lead to practical solutions and the implementation of new technologies.
- **Skill Development**: Telecom CoEs often contribute to skill development by offering training programmes, workshops and courses. The effectiveness can be evaluated by the impact on the skill sets of individuals involved and the industry as a whole.
- **Technology Transfer:** Successful CoEs facilitate the transfer of technology (ToT) from research labs to the industry. If the centre can effectively bridge the gap between academia and industry, it is likely to be considered effective.
- **Innovative Ecosystem:** The establishment of an innovation ecosystem is crucial. This includes support for startups, incubation programmes and a conducive environment for entrepreneurs to develop and commercialise telecom-related technologies.
- **Policy Advocacy**: CoEs can also contribute to the formulation of telecom policies by providing valuable insights based on their research and analysis. Their effectiveness can be measured by the impact of their recommendations on policy decisions.
- **Global Recognition**: A successful CoE may gain recognition on the global stage, attracting collaborations and partnerships with international organisations and research institutions.

It is important to note that the specific goals, objectives and performance indicators of a Telecom CoE can vary, and its effectiveness may be subjective based on the criteria mentioned previously. However, while industry academia collaboration plays an important role in the development of technology, and the objectives of the stakeholders may be the same, it should be kept in mind that the horizon of such associations may differ from stakeholder to stakeholder. While academia's focus could be on developing technology via continued research without any specific or stretched timelines, the telecom sector will be largely interested in the deployment of such technology and in ascertaining its effectiveness and usability in a live environment and then further building it up from there.

This brings us to an especially important metric used to assess the maturity of a technology which is known as the *"Technology Readiness level (TRL)"* which ranges from the level of 1 to 9 and provides a collective understanding of the development stage of a technology.

The timelines of the TRL life cycle can vary significantly based on the nature of the technology, the complexity of the project, available resources and the specific goals of the development effort. Different technologies may progress through the TRL stages at different rates. However, here is a general guideline depiction for the timelines associated with each TRL stage:



From the above indicative timelines, it can be inferred that typically a technology takes at least eight years to get deployed in markets which are too stretched and may not yield the desired results in the timeframe envisaged by the PSEs.

It is therefore important that the partnership between PSEs and academia should have a common ground from which to work off, with a clear vision and objective about the outcome to be achieved.

An additional aspect to consider is difference between Industry research and academic research, both of which are distinct fields of research that have different goals, methods, and outcomes. We list down the differences in the following table:

Differentiating Aspect	Industry research	Academic research
Focus	creating new products, improving existing ones, increasing customer choices	expanding knowledge & understanding in a particular field
Funding	typically, company/industry players	government grants, private foundations, or endowments
Funding driven motivation	the goal is often to create a product or service that can be sold for financial sustainability	the goal is often to expand knowledge & understanding in a particular field
Level of Autonomy and oversight	often projects are closely aligned with the company's goals and objectives	relatively more autonomy and freedom, and able to pursue their own research interests, and work is typically subject to less oversight
Use of methods	often more applied, with a focus on solving specific problems or creating new products	sometimes more theoretical, with focus on understanding principles and concepts
Outcomes	often leads to new products or services that creating more options for customers and new avenues for industry. Outcomes may also be kept confidential	often leads to new knowledge & understanding that is shared with the scientific community through publications. Typically made available to the public

The above table and chart (about TRLs) indicate that the industry and academia participation in the R&D projects have their own motivations, outcomes, and lifecycles, timelines that have their own variables. Hence, participation in this should not be mandated. Through a TRL life cycle lense, the government should fund the R&D phase being investment heavy, and, in the deployment/prototype phase, industry can also pitch-in to support once the outcome of the research shows the potential to culminate it into a product which can be deployed in the market.

India has now the opportunity to elevate the industry-academia relationship as a central driver of economic capabilities by transforming conflicts of interest into a convergence of interests.

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