BOOSTING TELECOM COMPONENT MANUFACTURING IN INDIA

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MAIT

India's apex Industry body empowering IT, Telecom & Electronics Hardware

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Introduction
to the Report

Established in 1982, MAIT is the leading industry body representing India's electronic hardware sector. As a not-for-profit organization, MAIT collaborates closely with Central and State government policymakers to foster growth in the Electronic System Hardware Design and Manufacturing sector. Its membership includes a variety of large and MSME companies and industries, encompassing OEMs, ODMs, EMS, design houses, recyclers, PROs, testing laboratories, and sub-sectoral associations.

With the manufacturing of Telecom equipment gaining pace, it is time to focus on understanding the state of component ecosystem in the country. To address this, MAIT wanted to publish a report on "Boosting Telecom Component Manufacturing in India." MAIT appointed a feedback advisory to author the report.

This report aims to set out the roadmap for developing telecom equipment components in India.

The Terms of Reference for this report included the following

- Overview of Telecom equipment manufacturing in India
- Type of components used in telecom equipment and specific requirements of telecom segment for components.
- The current landscape of Telecom component manufacturing in India includes the types of components produced, existing production capacity, and significant players.
- The current and likely future market for Telecom Components in India.
- Analysis of factors hindering the growth of domestic Telecom component manufacturing (e.g., lack of skilled workforce, infrastructure limitations, import dependence).
- Identification of potential growth drivers (e.g., government initiatives, technological advancements, talent development programs).
- Development of a roadmap with actionable strategies and recommendations for boosting domestic telecom component production in India

Executive Summary

Current status of Telecom Equipment manufacturing in India

To boost domestic manufacturing, investments, and exports in telecom and networking products, the PLI scheme, with a financial outlay of INR 12,195 crores (USD 1.47 bilion)[1] over a five-year period, has been initiated. So far, 42 PLI beneficiary companies have collectively invested INR 3,925 crores (~USD 470 million)[2] and achieved sales of INR 65,320 crores (USD 7.8 billion)[3], including exports of INR 12,384 crores (~USD 1.5 billion)[4] and direct employment of 24,980[5].

The PLI scheme has helped India increase local manufacturing of telecom equipment, reaching around INR 46,100 crores (USD 5.5 billion) in FY 2024. The PLI has encouraged players to invest in R&D and local capacity for manufacturing telecom equipment.

With the base-level Telecom Equipment having taken off now, it is now time for the Government and the Industry to focus on the next level of Components and Sub-assemblies localization in India.

[1] DOT Notification dated 24th February, 2021
[2] PLI Dashboard as on 30.09.2024
[3] PLI Dashboard as on 30.09.2024
[4] PLI Dashboard as on 30.09.2024
[5] PLI Dashboard as on 30.09.2024

Current Market Size and Growth for Components and Sub-assemblies

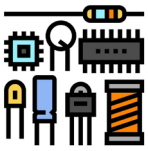
The significant growth in domestic telecom equipment manufacturing, fueled by geopolitical factors and the COVID-19 pandemic, has led to a growing market for Telecom Components.

Rapid Growth

Between FY 2019-20 and FY 2023-24, domestic telecom equipment manufacturing experienced a remarkable 370% compound annual growth rate (CAGR). This surge while on a very small base reflects a trend away from near-total reliance on imports.

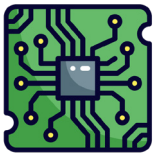
Market Sizing Methodology

The report estimates the market size for telecom components by applying a 60% material cost-to-revenue ratio to the total manufacturing estimate of telecom equipment in FY 2023-24. This figure is further broken down by equipment category (network service providers, enterprise, consumer premise equipment), resulting in an estimated **INR 30,000 crore (USD 3.6 billion)** market for components.



Component Market Segmentation

The component market is segmented by type (Electronics, Passives, PCBs, RF, Electromechanical/Mechanical). Electronics are the largest segment, at 45%, followed by Electromechanical/Mechanical (20%), Passives (18%) and the rest being PCBs and RF Devices. A similar breakdown is also presented for sub-assemblies.



Sub-assembly Market Segmentation

The sub-assembly market is estimated at **INR 3,150 crore (USD 380 million)**. Power supplies constitute the largest share (38%), followed by optical transceivers (24%) and RF filter units (24%).

The provided charts in Chapter 3 of this report, visually represent this market segmentation data, clarifying the relative contribution of each category to the overall market size.

Components and Sub-Assemblies used in Telecom Equipment

The Indian telecom equipment industry relies heavily on various components and sub-assemblies, categorized as follows

Electronics

This category encompasses semiconductors (including optics) and memory modules, forming a significant portion (40-60%) of the Bill of Materials (BOM). Currently, India is heavily reliant on imports for these items, with domestic production virtually nonexistent. Government initiatives aim to change this but significant progress is not expected for 2-3 years.

Passives

Resistors, capacitors, inductors, and magnetics are crucial passive components (9-15% of BOM). While some domestic manufacturing exists, a significant portion (95%) is still imported **due to its low cost & superior quality.** The industry predominantly utilizes Surface Mounted Devices (SMDs) for these components, but domestic production is largely limited to Through-Hole Technology (THT) components, creating a supply gap.

Printed Circuit Boards (PCBs)

Bare PCBs contribute 5-8% of the BOM. India has a relatively mature PCB manufacturing industry, but the capabilities for high-layer count (e.g., 16L, 24L, 48L) and high-quality PCBs needed for telecom applications are limited **to only very low volumes coupled with price competitiveness challenge.** Most domestically produced PCBs are for simpler designs.

Radio Frequency (RF) Components

RF devices (5-6% of BOM) are almost entirely imported. India lacks a robust domestic RF component manufacturing sector.

Electromechanical and Mechanical Components

Connectors, switches, plastics, and sheet metals (15-25% of BOM) Electro mechanicals have some domestic production but significant imports (70-80%) still exist due to competitiveness issues, **whereas Mechanical components eco system exists can be localized with joint efforts from Government & Telecom Equipment Manufacturers.**

Key Sub-assemblies

Optical Transceivers, Power Supplies, RF Filter Units, and Embedded Antennas constitute a substantial portion (~10%) of the BOM and are predominantly imported. Some limited domestic assembly of optical transceivers has started recently.

While most of the above components may seem as common to all other electronic manufacturing segments, it is important to note that Telecom Equipment require very specific Electronic components with specific features to cater to the stringent requirement of the Telecom Segment. The stringent requirements for telecom components due to the harsh operating environments (outdoor conditions, temperature fluctuations, humidity) includes the following:

Printed Circuit Boards

Telecom PCBs require high reliability (15-20 year lifespan), anti-CAF (Conductive Anodic Filament) protection, and specialized manufacturing processes for multi-layer boards (up to 48 layers) and high-speed digital signals.

RF Antennas

Factors like frequency range, polarization, gain, radiation pattern, impedance matching, size, bandwidth, and environmental resilience are critical for telecom antenna design and performance. Materials like copper, aluminum, and silver are commonly used due to their high conductivity.

RF Filters

These are crucial for managing interference and require specialized manufacturing processes and skilled labor.

Telecom Enclosures

These need to protect equipment from harsh conditions and require robust materials (stainless steel, aluminum, fiberglass, ABS plastic). Advanced manufacturing techniques like high-pressure die casting and laser welding are needed.

Interconnects and Chipsets

The technical requirements for interconnects and chipsets used in telecom equipment are crucial for ensuring optimal performance, reliability, and compatibility in communication networks. These include specific electrical performance (must maintain characteristic impedance (commonly 50 ohms for RF applications, 75 ohms for video) to minimize signal reflection and loss etc.); Heat dissipation (Chipsets must be designed to handle heat generation without thermal throttlin

Memory Components

The choice of memory (flash memory cards, eMMC, DRAM) is crucial and depends on reliability and performance requirements. Environmental tolerances are paramount.

Import Dependence and Localization Efforts

Based on inputs from various industry members, this report has noted India's heavy dependence on imports for most telecom components and sub-assemblies.

Semiconductors and Optics

100% imported due to the absence of major semiconductor fabs and OSATs (wafer testing and assembly companies). Government initiatives are underway to build domestic semiconductor capacity, but the local supply to India's Telecom sector isn't expected for the next 2-3 years.

Passives

While some domestic production of passive components exists, imports still dominate (95%). The lack of large-scale SMD manufacturing is a significant constraint.

Printed Circuit Boards

Though India has many PCB manufacturers, their capabilities in terms of Multiple Layers (>16 Layers) and High-Quality requirements for the Telecom sector are nonexistent. However, some local supply of double-sided PCBs for the Telecom sector has started.

RF Components

Almost entirely imported due to a lack of large domestic manufacturers with necessary expertise.

Electromechanical/Mechanical Components

Domestic manufacturing exists, but significant imports persist (70-80%) due to competitiveness challenges, particularly when compared to China.

Sub-assemblies

Mostly imported; only limited assembly of optical transceivers has begun domestically. India has some Power supply manufacturers, but the manufacturing capacity is limited. Some large PSU companies have factories in India, but focused on non-telecom products

The table summarizing the contribution of domestic versus imported components underscores this reality

Table 1

Category	Specific Components	% of BOM	Domestic Contribution %	Imports Contribution %
Electronics	Semiconductors + Optics	40% to 60%	0%	100%
	Memory Modules	5% to 8%	0%	100%
Passives	Resistors, Capacitors, Inductors & Magnetics	9% to 15%	5%	95%
Printed Circuit Boards	Bare PCBs	5% to 8%	1-2% (Only 2-4L)	>98%
RF	RF Devices	5% to 6%	0%	100%
Electromechanical	Connectors, Switches & Plastics, Sheet Metals etc.	15% to 25%	20-30%	70-80%
5 key Sub-assemblies	Optical Transcievers, Power Supplies, RF Filter Units, RF Embedded Antennas & RF Power Antennas	~10%	0%	100%

Future Market Projections and Export Opportunities for Components and Sub-assemblies

The future market for Telecom Components is based on the manufacturing growth of Telecom Equipment in India and also the fact that India could potentially pivot in an 'export-led' growth by addressing global opportunities for these Components and Sub-assemblies. These aspects are summarized below

Drivers of Future Growth

The deployment of 5G technology, the rise of IoT and digital solutions, and increased investment in telecom infrastructure are expected to significantly drive future demand for telecom components. Specific mentions are made of BSNL's 4G investment, JIO and Airtel's 5G expansion, and the general adoption of industry 4.0 and digital transformation initiatives.

Future Market Projections

Based on anticipated growth in telecom equipment manufacturing (9% CAGR), the overall market size is projected to reach approximately INR 125,000 crore (USD 15 billion) by 2030. This aligns with estimates from NITI Aayog's report, "Electronics: Powering India's Participation in Global Value Chains," which also anticipates USD 15 billion in telecom equipment manufacturing by 2030.

Export-Oriented Strategy

The report argues that focusing on export markets is crucial for establishing a sustainable and scalable component ecosystem. The global telecom equipment market is estimated to reach USD 1 trillion by 2030, presenting significant opportunities.

Global Market Penetration Targets

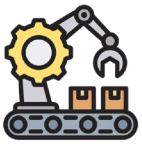
The report proposes ambitious yet realistic goals for India's share of the global telecom component market by 2030. Electromechanical/mechanical components could potentially achieve a 10% share, while electronics might realistically aim for 0.5%. Achieving a minimum of 2% of the global market within the next six years is a key goal. This would place the market size in India around INR 165,000 crore (USD 19.5 billion) by 2030.

Sub-assembly Focus

The report specifically highlights the potential for sub-assemblies, particularly SFP optical transceivers, power supplies, RF filter units, embedded antennas, and RF power amplifiers. The report projects a USD 0.85 billion for domestic market requirement by 2030, and if India aims for a 5% market share by 2030, it can even target a USD 8.75 billion market by 2030

Localization Challenges and Opportunities

There are several significant obstacles hindering the development of a robust components and sub-assembly ecosystem in India, impacting the competitiveness of Original Equipment Manufacturers (OEMs). The key challenges in localizing telecom component production in India are summarized below:



Lack of Advanced Manufacturing Technology

India's limited access to cutting-edge manufacturing technologies prevents domestic firms from producing high-quality components meeting international standards. This necessitates reliance on imports, leading to increased costs and longer lead times.

Lack of Economies of Scale

The absence of large-scale manufacturing facilities in India prevents cost reductions through economies of scale. Indian manufacturers struggle to compete with global counterparts who benefit from larger production volumes and lower unit costs.

Lack of Technical Know-How

Qualified technical resources with the knowledge of manufacturing know-how is lacking due to absence of related manufacturing industries

Raw Material Dependence

Many key raw materials required for component production are unavailable or must be imported, adding to costs and supply chain complexities. This import dependence makes the sector vulnerable to global market fluctuations.

Incomplete Ecosystem

A well-functioning ecosystem requires a network of suppliers, manufacturers, and service providers that can collaborate and drive innovation. India's fragmented component sector lacks this cohesive network, hindering technological advancements and manufacturing efficiency.

Cost Competitiveness Issues

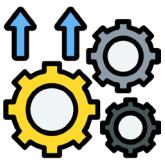
High Cost of Capital: The cost of borrowing and financing in India is substantially higher than in other major exporting countries. This limits access to the favorable financing terms that support manufacturing in other regions.

High Infrastructure Costs: Land, construction, utilities (electricity and water), and logistics expenses are higher in India than in many competing nations. This adds to overall manufacturing costs.

Regulatory and Compliance Costs: Compliance requirements, including obtaining permits, enforcing contracts, taxes, and regulations, are more burdensome in India, creating an additional cost burden for manufacturers.

Testing and Certification Costs: Multiple standardization agencies and delays in obtaining testing and certification add to the costs and time associated with product development.

Foreign Incentives: Other countries often provide manufacturing incentives, making them more competitive than India.



Scale, Raw Materials, and Capital Expenditure Challenges

Lack of Scale: The sector is highly fragmented, dominated by many small and medium-sized enterprises (SMEs) with limited annual turnovers. This prevents economies of scale and the associated benefits of larger-scale investments in technology, R&D, and infrastructure. A specific example is provided showing how the largest Indian PCB manufacturers have significantly less manufacturing capacity than top global competitors.

Raw Material Shortages: The need for various raw materials, including advanced films, copper laminates, and multiple chemicals, highlights a challenge stemming from the lack of a domestic supply chain capable of supporting large-scale manufacturing. This makes the sector dependent on imports, causing vulnerabilities & **High cost of imports**

Low Capital-Output Ratio: The component and sub-assembly sector has a lower capital-output ratio compared to the finished goods manufacturing sector. This means that generating a comparable value requires more investment in components and sub-assemblies than in finished products. This is compounded by the higher cost of capital in India.

Geopolitical Considerations (Interactions with Chinese Firms): Geopolitical tensions and difficulties in engaging with Chinese firms (visa issues, travel restrictions) negatively impact localization efforts. China's dominance in the global production of electronic components creates dependencies that India seeks to lessen, but those dependencies also create vulnerabilities.

Recommendations for boosting Components and Sub-assemblies ecosystem for Telcom Segment

This report, prepared by MAIT (Manufacturers' Association of Information Technology), proposes a strategic roadmap to enhance the production of telecom components and sub-assemblies within India. The initiative is framed within the context of the Indian government's anticipated "Components Policy" and aims to create a sustainable manufacturing ecosystem by 2030. The potential market opportunity for export-led component manufacturing is estimated at a substantial **INR 165,000 crore (approximately USD 19.5 billion)** by 2030.

The framework based on several key recommendations is summarized below

Prioritize Localization

A phased approach to localization is proposed, prioritizing sub-assemblies (power supplies, SFP transceivers, RF filter units, RF power amplifiers, RF embedded antennas) in the immediate term due to their relatively higher potential for near-term success. This prioritization is based on the existence of some firms already engaged in their manufacture. Localization of components such as PCBs and passives is given as mid-term time horizon, with long-term focus on ASICs, xPUs, and memory/HDD components.

Develop a Telecom Components Manufacturing Vision

A comprehensive vision supported by consistent policies and dedicated funding is advocated. This vision would guide the sector's development, fostering innovation and attracting investment, both domestic and international. This initiative should align with existing "Make in India" initiatives and explore financial incentives (OPEX and CAPEX) to stimulate growth.

Engage Global OEMs and Tier-1 Suppliers

The report emphasizes the importance of attracting global Original Equipment Manufacturers (OEMs) and their key suppliers to invest in India. Incentivizing OEMs to source components locally and providing market access to global markets are key components of the proposed strategy. The challenge of existing restrictions on sourcing from China needs to be addressed through strategic and potentially phased liberalization, acknowledging the significant time investment needed to develop domestic capacity.

Improve the Ease of Doing Business (EODB) Metrics

Streamlining regulations, reducing bureaucratic hurdles, and improving transparency are essential for attracting investment and ensuring a favorable business environment. Reform export license (SCOMET) procedures and benchmark turnaround times with competing countries such as Thailand, Vietnam, Mexico, Malaysia etc.

This report offers detailed recommendations to achieve its objectives

Financial Incentives

Significant financial incentives (40-50% capital expenditure support) are proposed for pioneering companies establishing component/sub-assembly manufacturing units. This incentive would be capped at three to four units per domain, and these units would also be eligible for Product-Linked Incentive (PLI) schemes, boosting their competitiveness.

Investment Drive

A comprehensive investment drive should raise awareness about the policy, actively encourage investment from global and Indian firms, and highlight the opportunities in the sector.

Collaboration with MSMEs

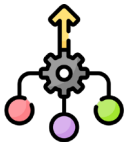
Engaging Micro, Small, and Medium Enterprises (MSMEs) through mentorship, knowledge-sharing programs, and financial incentives is vital for fostering innovation and creating a more inclusive ecosystem.

Focus on Skilling and R&D

A multi-pronged skilling strategy is needed, including establishing dedicated research labs in collaboration with premier institutions and launching skill development programs under initiatives like Skill India. These should emphasize areas such as PCB design, semiconductor fabrication, and RF engineering.

Identify and Support Domestic Champions

The report suggests identifying and supporting Indian domestic component firms that can partner with global firms to create a more robust domestic industry. A list of key global companies and their product areas are included to help guide this strategy.



Demand Consolidation

Government can consolidate all demands from Telecom manufacturers to make suppliers to invest in India with a long line of sight / demand visibility

In essence, the roadmap emphasizes the need for a comprehensive, coordinated effort by the Indian government and the private sector to build a strong, competitive, and export-oriented telecom component and sub-assembly industry. Success depends on attracting investment, fostering a supportive ecosystem, and building the necessary skills and expertise.

CHAPTER 01

Current landscape of Telecom Equipment supply in India

To boost domestic manufacturing, investments, and exports in telecom and networking products, the PLI scheme, with a financial outlay of INR 12,195 crores (USD 1.47 bilion)[6] over a five-year period, has been initiated. So far, 42 PLI beneficiary companies have collectively invested INR 3,925 crores (~USD 470 million)[7] and achieved sales of INR 65,320 crores (USD 7.8 billion)[8] , including exports of INR 12,384 crores (~USD 1.5 billion)[9] and direct employment of 24,980[10].

The products under the PLI program is given below Table 2

Table 2: Products under PLI Program

Category	Sub Category
4G/5G, Next Generation Radio Access Network And Wireless Equipment	4G/ Long Term Evolution (Lte)Radio Access Network (Ran) Base Station & Core Equipment
	5G Ran Base Station & Core Equipment
	Centralised Unit
	Distributed Unit
	Edge And Enterprise Equipment
	Open-Ran Equipment (Radio Unit Distributed Unit)
	Ran Intelligent Controller
	Telecom Antenna
	Wireless Telecommunication Equipment In Access And Backhaul

[6] DOT Notification dated 24th February, 2021

[7] PLI Dashboard as on 30.09.2024

[8] PLI Dashboard as on 30.09.2024

[9] PLI Dashboard as on 30.09.2024

[10] PLI Dashboard as on 30.09.2024

Category	Sub Category
Access & Customer Premises Equipment (Cpe), Internet Of Things (Iot) Access Devices And Other Wireless Equipment	5G Cpe
	Gpon Optical Network Terminal (Ont),
	Internet Setup Box
	Ip Multimedia System
	Lte Cpe
	Ng-Pon-Ont
	Satellite Cpe'S For Accessing Internet
	Short Range Devices And Associated Electronics In New Technologies Like 4G/5G/Fibre To The Home (Ftth)
	Soft Switch
	Telecom Module Of Iot/M2M Access Devices
	Unified Communication Platform
	Vsat Equipment
	Wireless Fidelity (Wi-Fi) Access Point And Controller
Core Transmission Equipment	Dense Wavelength Division Multiplexing (Dwdm)
	Digital Microwave Radio
	E/V Band Radios
	Free Space Optics Communication Equipment
	Gigabit Passive Optical Networks (Gpon)/ Next Generation- Passive Optical Network (Ng-Pon) Optical Line Terminal (Olt)
	Milimeter Radio
	Multi Service Provisioning Platform (Mspp)
	Optical Transport Network (Otn)
	Packet Transport Network (Ptn)/ Multi-Protocol Label Switching (Mpls)
	Satellite Gateway (Hub/Earth Station) Equipments
	Synchronous Digital Hierarchy (Sdh)
Enterprise Equipment: Switches, Routers	Internet Protocol (Ip) And Packet Switching And Routing Apparatus
	Routers
	Switches

The following table describes the product sales (domestic and export) from PLI firms for the FY 2023-24.

Table 3: Category wise product sales under PLI scheme – domestic and export in INR Crores (FY 2023-24)[11]

Table 3

S. No	Specified Product	Category	Domestic Sales	Exports Sales	Total Sales	%age Contribution in sales
1	GPON/NGPON OLT	I	289	452	741	2.0%
2	DWDM	I	641	79	720	2.0%
3	PTN/MPLS	I	528	39	567	1.2%
4	SDH	I	387	97	484	1.1%
5	OTN	I	9	66	75	0.2%
6	Digital Microwave Radio	I	0.2	0.1	0.3	0.0%
7	Multi Service Provisioning Platform (MSPP)	I	-	-	-	0.0%
8	Millimeter Radio.	I	-	-	-	0.0%
9	E/V-band Radios.	I	-	-	-	0.0%
10	Satellite Gateway (Hub /Earth station) Equipment.	I	-	-	-	0.0%
11	Free Space Optics Communication Equipment.	I	-	-	-	0.0%
12	4G/LTE RAN Base Station & Core Equipment	II	11131	4054	15186	33.0%
13	5G RAN Base Station & Core Equipment	II	13184	607	13791	30.0%
14	Wireless Telecommunication Equipment in Access and Backhaul	II	1999	103	2102	5.0%
15	Telecom Antenna	II	305	1	306	0.7%
16	Open-RAN Equipment (Radio Unit, Distributed Unit, Centralised Unit, and RAN Intelligent Controller)	II	34	8	42	0.1%
17	Edge and Enterprise Equipment.	II	-	-	-	0.0%
18	Internet Set Top Box	III	2783	0	2783	6.0%
19	GPON ONT	III	2724	8	2732	6.0%
20	Wi-Fi Access Point and Controller	III	717	160	878	2.0%
21	Short Range Devices and Associated Electronics in new technologies like 4G/5G/FTTH etc.	III	208	366	574	1.2%

[11] Source: DOT

S. No	Specified Product	Category	Domestic Sales	Exports Sales	Total Sales	%age Contribution in sales
22	5G CPE	III	464	0	464	1.0%
23	IP Multimedia Subsystem	III	61	235	296	0.6%
24	Unified Communications Platforms	III	151	30	181	0.4%
25	Soft Switch	III	28	0	28	0.1%
26	Satellite CPEs for accessing Internet.	III	-	-	-	0.0%
27	VSAT Equipment.	III	-	-	-	0.0%
28	NG-PON-ONT	III	-	-	-	0.0%
29	Switches	IV	451	2744	3196	7.0%
30	Telecom modules of IOT/M2M Access Devices	IV	431	427	858	2.0%
31	Routers	IV	18	0	18	0.0%
32	IP and Packet Switching and Routing Apparatus	IV	4	0	4	0.0%
33	LTE CPE	IV	0.5	0	0.5	0.0%

The main equipment is 4G/5G base station and core equipment having 63% value share in FY 2023-24.

The sales from PLI firms in 2023-24 captured by the key category of Networking & Telecom Equipment are summarized below in Table 4

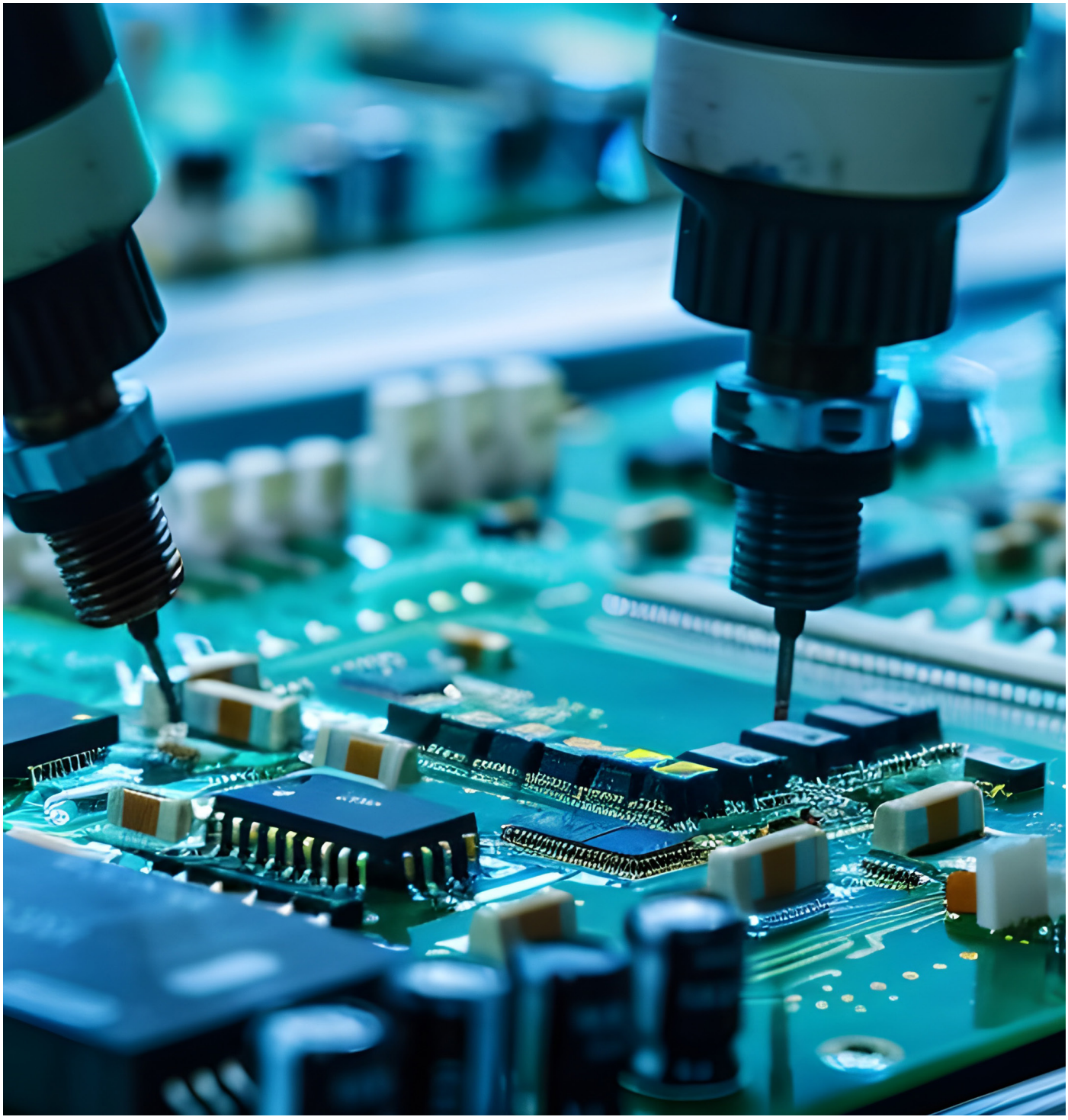
Table 4

S. No	Category	Domestic Sales INR Cr	Export Sales INR Cr	Total Sales INR Cr	%age Contribution in sales
1	Core transmission Equipment	1,854	733	2,587	6%
2	4G/5G, Next Generation RAN and Wireless Equipment	26,653	4,773	31,426	68%
3	Access & CPE, IoT Access Devices and Other Wireless Equipment	7,136	799	7,935	17%
4	Enterprise Equipment: Switch and Router	904.5	3,131	4,075	9%
	Total	**36,548**	**9,476**	**46,024**	

[12] Source: ELCINA, DOT

The PLI scheme has helped India increase local manufacturing of telecom equipment, reaching around INR 46,100 crores (USD 5.5 billion) in FY 2024. The PLI has encouraged players to invest in R&D and local capacity for manufacturing telecom equipment.

In summary, though India has made strides in reducing its dependence on imported telecom equipment through government initiatives and increased domestic production, addressing the existing technology deficit remains a priority. Now the focus should be to increase domestic production to cater to the global market through robust exports by 2030.



CHAPTER 02

Components & Sub-assemblies used in Telecom Equipment

A. Key Components and Sub-assemblies for the Telecom sector

Telecom Equipment, across the value chain of Network Service Providers, Enterprises, and Consumer Premises, are made up of a variety of Components and Sub-assemblies. These are mostly Electronic components and some Electro-mechanical & Mechanical Components. There are a few Sub-assemblies as well, which use the above-mentioned types of components.

These are summarized below in Table 5

Table 5: Key Components and Sub-assemblies used in Telecom Equipment

Category	Specific Components
Electronics	*Semiconductors + Optics*
	Memory Modules
Passives	*Resistors, Capacitors, Inductors & Magnetics*
Printed Circuit Boards	*Bare PCBs*
RF	*RF Devices*
Electromechanical	*Connectors, Switches & Plastics, Sheet Metals etc.*
5 key Sub-assemblies	*Optical Transceivers, Power Supplies, RF Filter Units, RF Embedded Antennas & RF Power Antennas*

B. Specific requirements of Components for the Telecom sector

1. Printed Circuit Boards

Telecom Equipment (TE) PCB needs to comply to work in a harsh environment (outdoor, humidity, hot, cold, snow and seasons temperature change etc.) unlike the Datacom / server / supercomputer / computing / AI industry products PCB, where it is installed for indoor & temp controlled environments. Therefore, the TE PCB specifications and manufacturing process needs to be little bit different than other industry use PCB's. The TE PCB's must have the following specific requirements

- The PCB manufacturing process shall meet the high reliability and long-life cycle of TE PCB (min. 15 years, avg. 20 years) and anti-CAF (Conductive Anodic Filament which is normal failure point in PCB and especially for TE PCB's requires Anti-CAF process).
- PCB and PCB laminates requests both radio frequency and high-speed digital technical know-how.
- PCB usage varies from 2 Layers to 48 layers in many cases.
- High tech manufacturing equipment & process required for producing Multi-layers PCB hybrid stack up and combined with copper coins for thermal dissipation. (e,g mfg proces POFV- plating over filled vias, back-drill and special immersion technology).
- Sub-6G mMIMO TRX (32, 64, 128) and antenna PCBs are large format size(>28" length) which requests customize PCB manufacturing processes and equipment.
- mmWave antenna PCB requests high-layers (>20 layers) high-speed/frequency stack up with HDI(micro-via) technologies which need professional engineers and processes.
- PCB Manufacturing requires purified deionized water. Also it is important to have a robust wastewater treatment capability.
- The consistent process control and quality control is very critical on telecom PCBs. Otherwise poor manufacturing process / technology can cause high field return or Epidemic failure.

Some materials that are used to make PCBs for communication devices include

- FR-4 glass reinforced epoxy
- High frequency/low loss laminates
- PTFE based composites
- Aluminum, which is lightweight, durable, and good at heat transfer

2. RF Antenna

RF antennas are used in a variety of telecom applications, including mobile communication, broadcasting, satellite communication, radar, and wireless networking. Multiple inputs and multiple outputs (MIMO) RF antennas are commonly used in radio communication due to their highly effective antenna directivity. RF antenna for telecom applications must take into account following factors in consideration

- **Frequency range:** The antenna's ability to function within a specific range of frequencies
- **Polarization:** The orientation of the radio wave's electric field component
- **Gain:** The antenna's ability to amplify signals
- **Radiation pattern:** The antenna's pattern of signal distribution
- **Impedance matching:** The antenna's ability to match its impedance with other components
- **Size:** The antenna's physical dimensions
- **Bandwidth:** The range of frequencies within which the antenna can function optimally
- **Environment:** The conditions in which the antenna will be used
- **Cost:** The cost of the antenna
- **Regulatory compliance:** Whether the antenna complies with regulatory requirements
- **Coverage area:** The desired area of coverage for the antenna
- **Signal strength:** The strength of the signal the antenna will produce
- **Interference mitigation:** The antenna's ability to reduce interference

Metals like copper, aluminum, and silver are commonly used for telecom antennas because of their high conductivity and low electrical resistance.

3. RF Filters

RF Filters requires eco system of above technologies plus investments on Auto tuning, plating and high skilled man power for final Tuning in the manufacturing line.

4. Telecom Enclosures & the need for Aluminium High Pressure Die Casting facilities

Telecommunications enclosures, which are also referred to as telecommunications cabinets, are fully enclosed cabinets that help protect electrical cabling and other equipment from potentially damaging environments, including those that contain dust, rain, ice, and external heat.

The ANSI/TIA-942 Standard specifies requirements for telecommunications infrastructure, including infrastructure, site location, architectural, electrical, mechanical, safety, and security. TE products like Remote Rado, massive MIMO products typically require high tonnage machineries to cast Chassis required for those equipment **and requirement for high thermal conductivity requires special raw material & casting process** which calls for high & significant investments. Moreover, TE Castings are required additional technologies like Laser welding, Friction stir welding, thin Fins (for heat transfers), Form In Place (FIP) and so on.

Depending on the application, a telecom enclosure has features such as

- Hinged doors for easy access
- Keyed lock systems for security
- Molded mounting flanges or feet for quick and easy mounting

- Transparent covers for easy readability
- Built-in mounting bosses for printed circuit board installation
- Bonding studs for electrical grounding
- Cooling systems
- Power distribution units
- Cable management
- Ventilation systems
- Monitoring and control systems

The material used for a telecom enclosure depends on the application, but common materials include

- **Stainless steel:** Strong and corrosion resistant, making it ideal for harsh environments
- **Aluminum:** Lightweight and strong, with good heat dissipation, making it suitable for both indoor and outdoor use
- **Fiberglass:** Provides excellent protection in harsh environments and is resistant to ultraviolet light and chemical corrosion
- **ABS plastic:** Cost-effective, lightweight, and durable, making it suitable for less demanding environments

5. Memory Components

In the design and operation of telecommunications infrastructure, the choice of memory components is critical. Whether in switches, routers, satellites, or base stations, embedded memory components help to ensure that these systems perform reliably and efficiently. When designing communications hardware, engineers and designers must carefully consider the type of memory they use, as well as how it integrates into the overall system to meet the demanding requirements of modern telecom networks.

Environmental Tolerance, Data Integrity, Endurance and Longevity, Power Efficiency are to be considered while using memory components in telecom applications.

- **Flash Memory Cards:** Flash memory cards, like SD Cards and microSD Cards, are used in telecom infrastructure due to their versatility, durability, and non-volatile nature. They can be found in network switches, base stations, and other equipment when reliable and removable data storage is essential.
- **eMMC:** eMMC is commonly used in routers, modems, and satellite communications equipment. Its compact size makes it ideal for mobile and embedded systems, such as those found in satellite transceivers and small base stations.
- **DRAM:** DRAM is the workhorse of telecom infrastructure when it comes to high-speed data processing. DRAM is used in network switches, routers, and servers, where it serves as the primary memory for buffering data, running complex algorithms, and managing large volumes of traffic. In satellite communications, DRAM is essential for processing data in real time, ensuring that signals are transmitted and received without delays.

6. Passive components:

Passive components are electronic components that receive energy, but do not need an external source to operate. Some examples of passive components include resistors, capacitors, and coils.

Passive components for telecom applications need to meet specific requirements, such as

- **Function-specific parameters:** These include frequency bandwidth, insertion/return losses, input/output impedance levels, group/phase delays, and isolation and transient response.
- **Temperature stability:** This is a secondary parameter, but it can directly affect circuit design depending on the application.
- **Vibration resistance:** This is a secondary parameter, but it can directly affect circuit design depending on the application.

7. Connectors

Connectors technology is one of the critical for RF, Board to Board and Power connections. Manufacturing of these connectors requires high capital investments on Special purpose machines and secondary process of plating. The manufacturing process requires world class process and quality control technologies to meet Telecom standards

C. Setting out the BOM Requirement for key equipment categories

There are a diverse range products considered in the Networking & Telecom Equipment as shown in Table 1 above. Therefore, the Bill of Materials (BOM) or the composition of components in each of these products vary as per the requirement and the construction of the said Product.

A summary of the Components usage in Networking & Telecom Products is given below in Table 5 below

Table 6: Summary of BOM composition in Networking & Telecom Equipment[13]

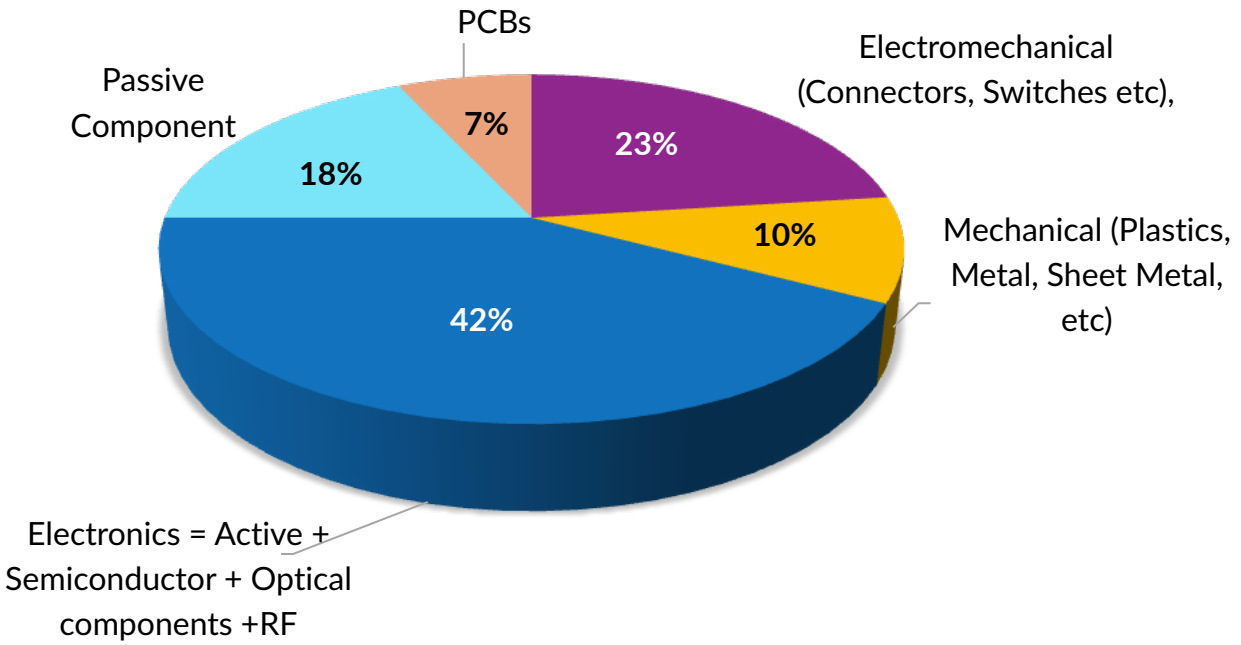
Category	Specific Components	% of BOM
Electronics	Semiconductors + Optics	**40% to 60%**
	Memory Modules	**5% to 8%**
Passives	Reisstors, Capacitors, Inductors & Magnetics	**9% to 15%**
Printed Circuit Boards	Bare PCBs	**5% to 8%**
RF	RF Devices	**5% to 6%**
Electromechanical	Connectors, Switches & Plastics, Sheet Metals etc.	**15% to 25%**
5 key Sub-assemblies	Optical Traansceivers, Power Supplies, RF Filter Units, RF Embedded Antennas & RF Power Antennas	**~10%**

[13] Feedback Analysis based on interviews with Telecom Equipment manufacturers

Some examples[14] of the BOM composition at a Product level is given below for reference.

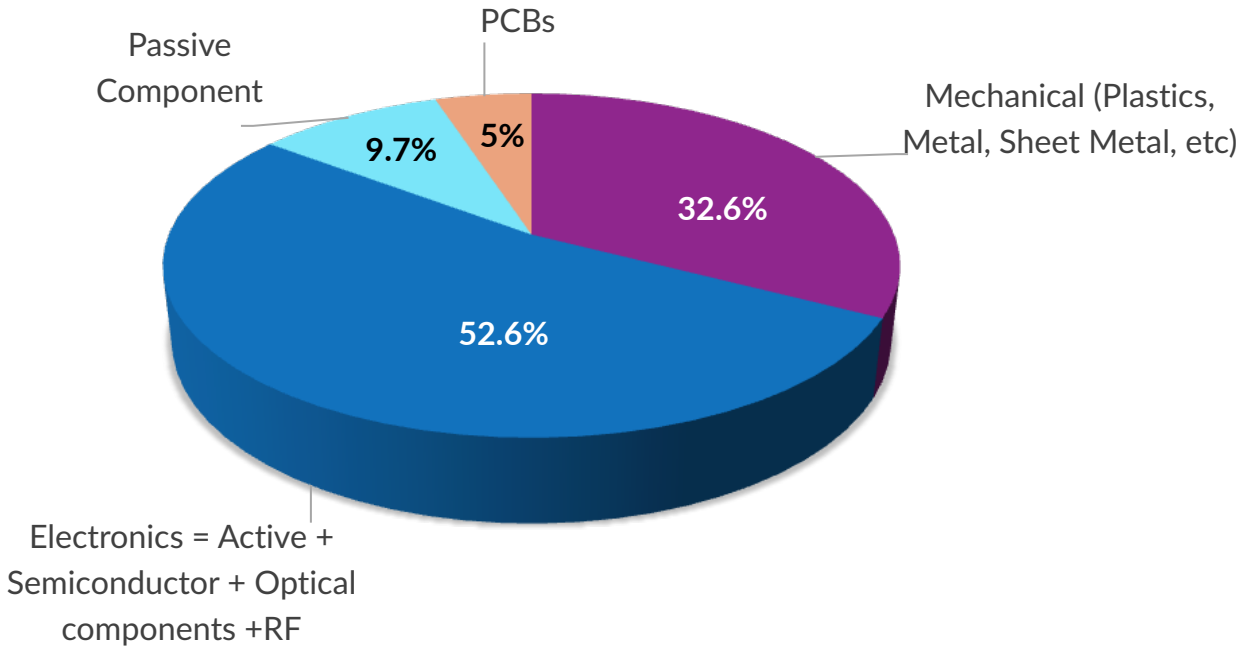
a. Communication Gateway

Figure 1: Communication Gateway BOM split



b. ONT GPON

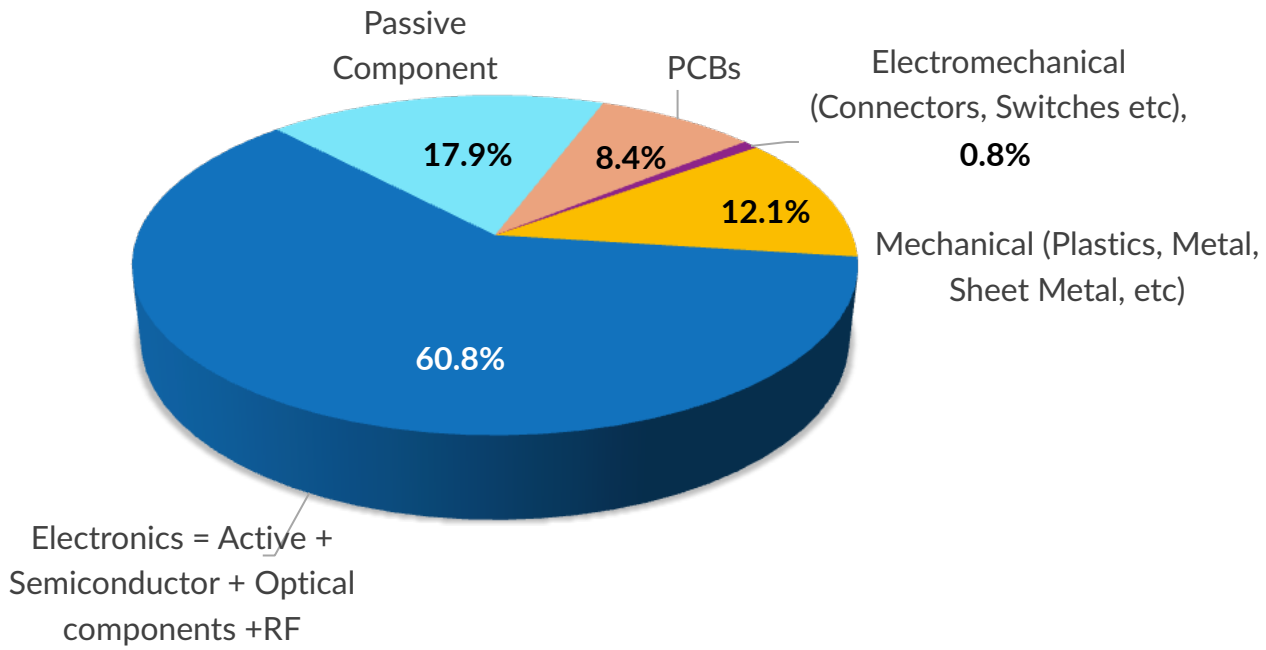
Figure 2: ONT GPON BOM split



[14] Primary interviews with Telecom Equipment Manufacturers in India

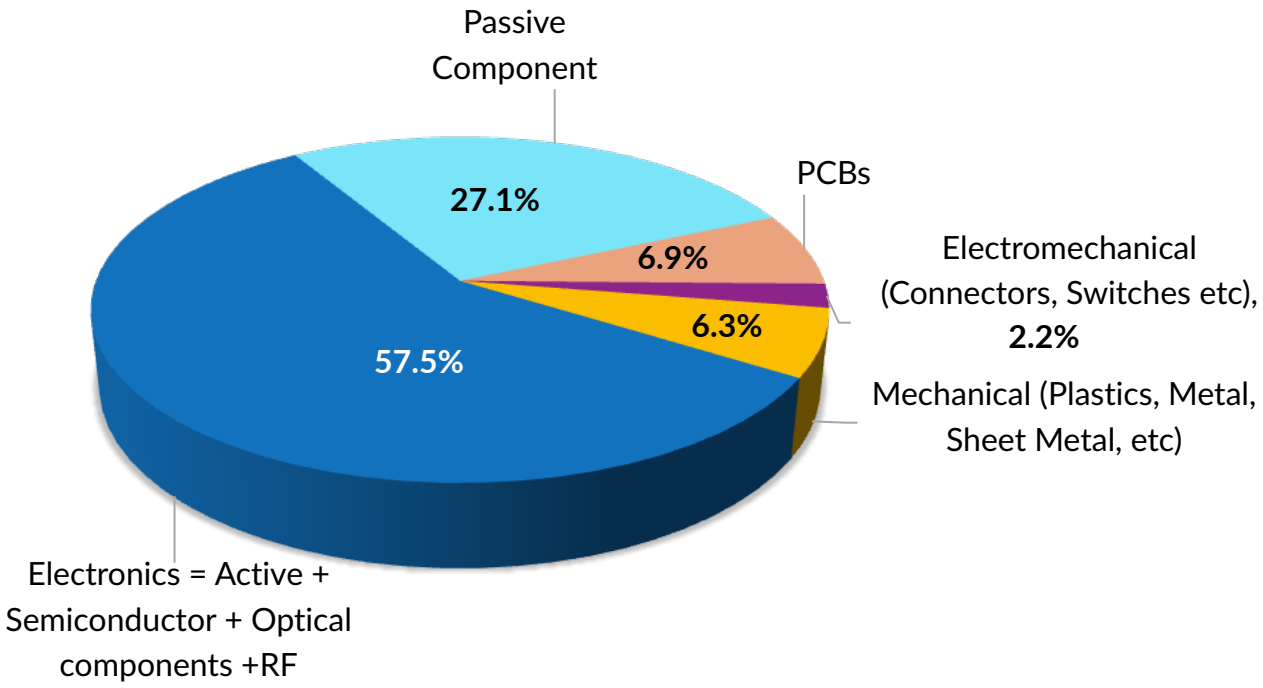
c. Switches

Figure 3: Switches BOM split



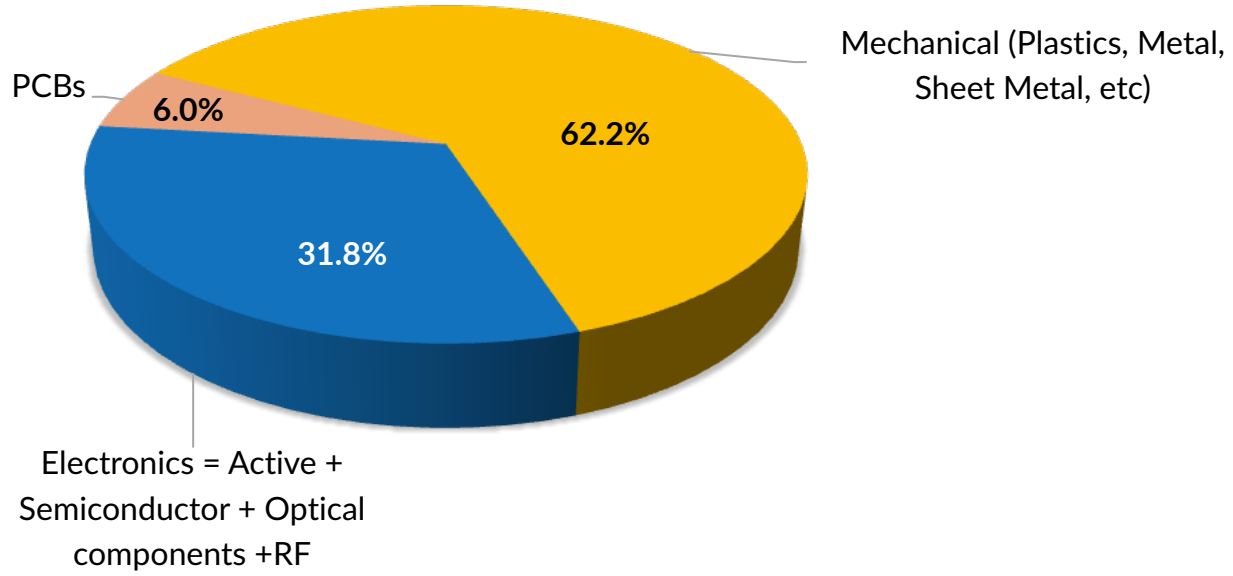
d. Access Points

Figure 4: Access Points BOM split



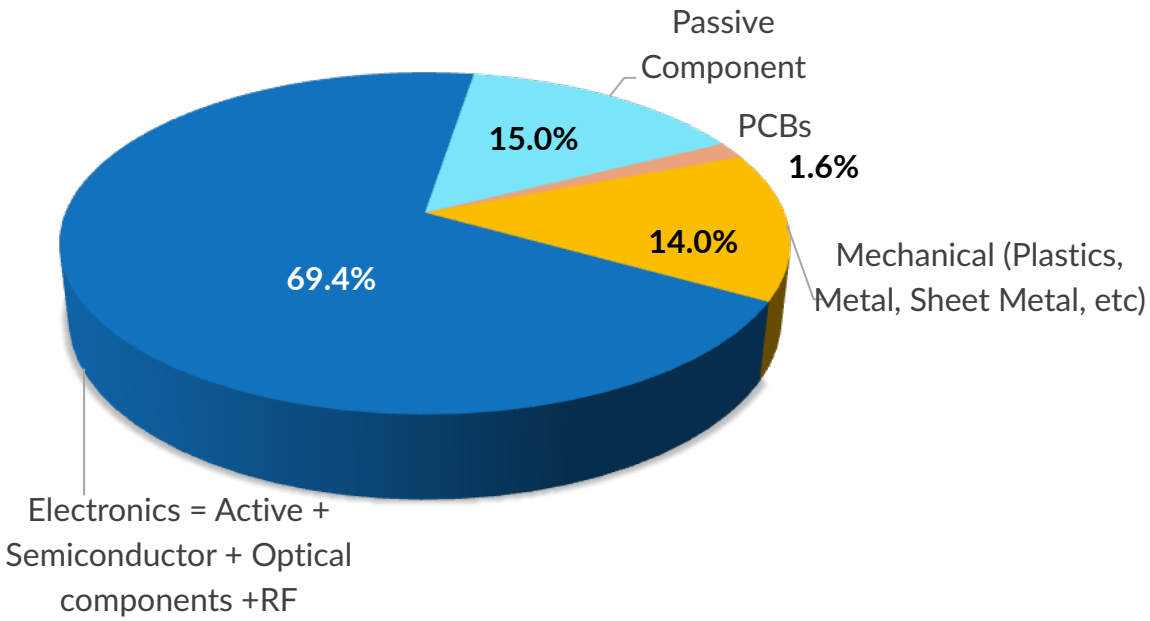
e. Antennas

Figure 5: Antennas BOM split



f. Zigbee Bluetooth Dongle

Figure 6: Zigbee Bluetooth Dongle BOM split

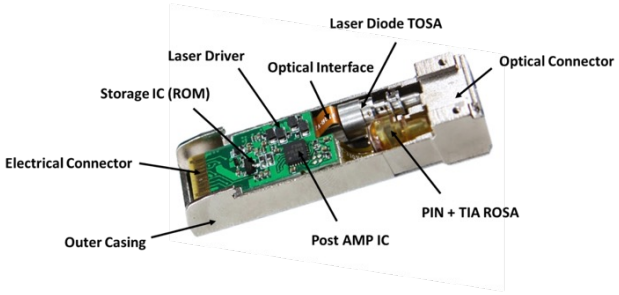


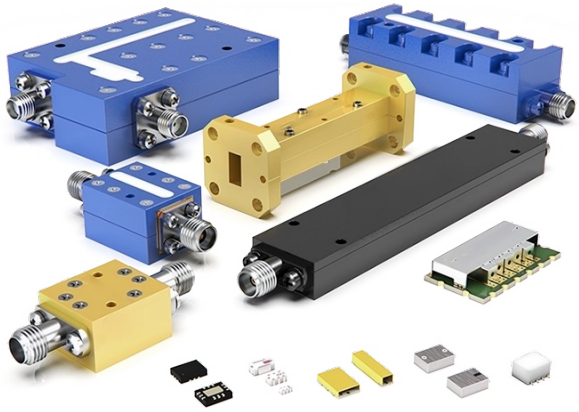
D. Key Sub-assemblies used in the Telecom sector

Apart from the components mentioned in the above sample examples, it is important to note that some specific sub-assemblies are used in Networking & Telecom equipment.

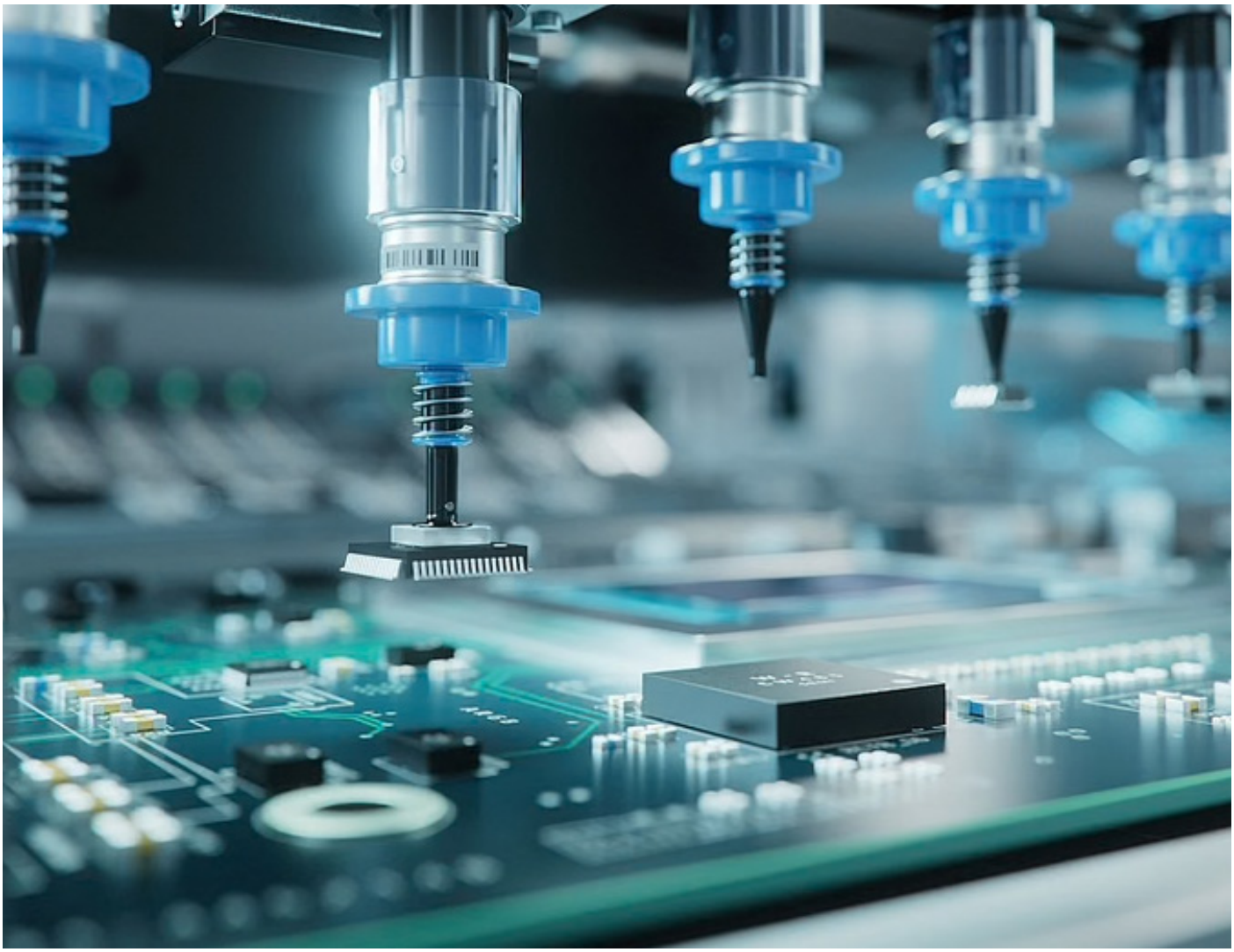
A brief description of these sub-assemblies is given below in Table 7

Table 7: Key Sub-assemblies used in Networking and Telecom Equipment

Sub-assembly / Modules used in Networking & Telecom Equipment	Details
Optical Transceivers (SFP) 	A SFP (small form-factor pluggable) is a hot-pluggable transceiver that allows devices to communicate with one another through data transmission. SFPs provide the required optical or electrical reach via copper or fiber optic cables. SFPs transmit and receive data at the same time, eliminating the need for additional equipment to perform those processes separately. They are mainly used in computer networks to facilitate high-speed internet connections. The transceiver connects to the device via a specially designed SFP port. Typically, the right port is the receiver and the left port is the transmitter. An audible click ensures that the transceiver is connected and ready for use. **Typical Norms of usage across equipment: 2% to 3% of BOM**
Power Supplies 	Power Supplies in Networking & Telecom Equipment are small systems, just like cells. They can be embedded in the telecom infrastructure and are often used in outdoor solutions. The products in this series are light and designed especially for installations with limited space offering a high density of the installed power. The system includes high-efficiency rectifiers, AC and DC connections, battery connection and a Controller. In addition to advanced supervision, short depth and easy installation are essential part of this system. **Typical Norms of usage across equipment: 4% to 6% of BOM**

Sub-assembly / Modules used in Networking & Telecom Equipment	Details
RF Filter Units 	RF and Microwave Filters are used to filter out unwanted signals from entering a system. With the increase of wireless standards in the existing frequency bands, filters now play an extremely important role and are required to minimize interference. They are designed to operate at specific frequencies and allow/attenuator RF signals at different frequencies. RF Filters have two types of frequency bands - passband and stopband. Signals which lie in the passband can pass through with minimal attenuation while signals which lie in the stopband experience heavy attenuation. Based on the required application and size of the wireless system there are a number of filter types - Notch Filters, SAW Filters, Cavity Filters, Waveguide Filters etc. Each one has different properties and different form factors. **Typical Norms of usage across equipment: 2% - 3% of BOM**
RF Embedded Antennas 	Embedded chip antennas are compact and integrated antennas designed to be directly mounted on a printed circuit board (PCB) or embedded within electronic devices. These antennas are often used in wireless communication applications, such as Wi-Fi, Bluetooth, GPS, and IoT devices, due to their small size and ease of integration. Embedded chip antennas offer the advantage of saving space, reducing manufacturing costs, and simplifying the design process. Their performance can vary based on factors like PCB layout and surrounding components, but advancements in antenna technology have led to the development of highly efficient embedded chip antennas that provide reliable wireless connectivity in a wide range of devices, from smartphones and tablets to smart home devices and industrial sensors. **Typical Norms of usage across equipment: <1% of BOM**

Sub-assembly / Modules used in Networking & Telecom Equipment	Details
RF Power Amplifiers 	RF power amplifiers effectively convert low-power RF signals into high-power RF signals by driving the antenna of a transmitter. Considerably high adoption of RF power amplifiers is observed in consumer electronics as the devices demand an amplified radio frequency signal, for efficient functioning. Additionally, RF Power Amplifiers are one of the most expensive and integral components of all base stations for wireless cellular and mobile infrastructures, and with drastic developments in telecom infrastructure, the need for RF Power Amplifiers is increasing. **Typical Norms of usage across equipment: ~1% of BOM**



E. Contribution of Imports vs. Domestic Sources of these Components & sub-assemblies

It is most commonly understood across the industry and across stakeholders that most telecom components are being imported and the domestic ecosystem is not available for OEMs and EMS firms to use. The status on each of these categories are discussed below:

1. Electronics – Semiconductors / Optics

Due to the lack of any major Semiconductor Fabs /OSATs operational in India, none of the Semiconductor Devices / chips or the Optical Products required for Telecom Applications are manufactured in the country. These are **100% imported** in India. The recent Semiconductor India Program is expected to facilitate the establishment of Fabs and OSATs in India, potentially resulting in some level of domestic production in the future. **However, this development is unlikely to materialize within the next 2-3 years at the earliest for Telecom Chipsets.**

However, it is noteworthy that the Government of India has undertaken a Telecom Chipsets development program and is actively working with Indian Fabless Semiconductor firms to develop a series of Telecom Chipsets. Once these are developed and with local fabs, India could then see some amount of Semiconductors being sourced locally. The Telecom Chipsets being initiated for development are[15]

Next-generation Broadband CPE chipset

- **Key IPs:** xPON-ONT & WiFi 6/6E/7
- Products: Home gateway for FTTH (Fiber to the home)

5G Modem + Radio chip for Dongles/IoTs/Mobile Edge/Satcom

- Key IPs: 5G Modem Baseband + RF, Processor
- Products: Dongles / Edge devices /Satcom IOT

Multi-radio chip Micro-controller for Gateways

- i.Key IPs: Microcontroller, Multi-Radio Baseband + RF, Analog
- Key Radio IPs: NB-IoT/ZigBee/LoRa/Wi-Fy (BaseBand & RF)
- Products: IoT, Industry 4.0 and Edge Gateway

xPON OLT chips for fiber broadband infra equipment

- i.Key IPs: Serdes, xPON MAC, Switch Fabric
- Products: Broadband Head-end Units

Digital Signal Processor for Radio and Baseband Processing

- Key IPs: Architecture, Vector ALU/FPU, FFT, LDPC cores
- Products: Wireless infra 5G/6G RRH/BBU, RU/DU

[15] https://usof.gov.in/en/application-for-chipset

L2/L3 Packet Switch chipsets with Embedded Processor

- Key IPs: Serdes/MACs, DPI engine, Lookup engine, Schedulers
- Products: Campus and Enterprise/DataCenter Networks

2. Passives

The Passive Electronic Components include products such as Capacitors, Resistors, Inductors and Magnetics. These components are the essential for any electronic goods. The Passive components come in two forms:

- **Surface Mounted Devices (SMD)**: refer to electronic components that are mounted directly onto the surface of printed circuit boards (PCBs). Unlike traditional through-hole components, which require leads to be inserted into holes on the PCB, SMDs are placed on the surface, allowing for more compact and efficient designs. This technique is part of Surface-Mount Technology (SMT), which has become the standard for manufacturing electronic circuits due to the many advantages it offers, including reduced size, improved performance, and lower production costs.
- **Through Hole Technology (THT):** Through-Hole Technology (THT) components are electronic components that are mounted onto printed circuit boards (PCBs) by inserting their leads through predefined holes on the board. This method of assembly involves soldering the component leads on the opposite side of the board to secure them in place. THT components are known for their strong mechanical bonds, making them suitable for applications that may experience physical stress or require high reliability, such as in industrial equipment, aerospace, and military applications.

In Telecom Equipment, the usage of SMD Vs THT is in the 70:30 ratio approximately across various TEs.

It is important to note that the current Indian Component ecosystem mainly includes THT component manufacturers, and **no SMD manufacturers exist in India.** Therefore, it will be important to have large-scale SMD manufacturing in India to cater to the TE segment competitively.

3. Printed Circuit Boards

The Bare PCB manufacturing industry is relatively old and established in India. There are about 130+[16] manufacturers in India, mainly in the Single Sided (SS) and Double Sided (DS) PCBs. There are a few firms in the Multi-Layer (ML) up to 6L segment as well and some 2-3 firms in the HDI / > 6L ML PCBs. However, most firms have limited technology capabilities that do not suit telecom applications (Both the No. of layers such as 16L/24L, etc, and the Quality of these PCBs), have smaller manufacturing capacities, and are not very cost-competitive.

Some Indian TE firms have started using DS PCBs from India in limited quantities. However, most Indian PCB manufacturers lack the Technology and quality required for large-volume TE Manufacturing and are not globally competitive.

[16] ELCINA input

4. RF

There are no large and qualified RF device manufacturers in India. Most RF products are imported in the country.

5. Electromechanical / Mechanical Products

Most TE firms have localized this to certain levels. They have in-house manufacturing capabilities or developed vendors to undertake these activities. However, many TE firms believe that Indian Electromechanical / Mechanical product manufacturing is still not globally competitive compared to China. If local manufacturing becomes more competitive, localization could improve further. Unlike other products, the technology and capabilities exist in India for these products.

6. Sub-assemblies

Most of the sub-assemblies identified in Table 5 are imported into the country, and recently, assembly operations for a limited range of Optical transceivers started in India.

In summary, while efforts are being made to localize, this is currently feasible only in the Mechanical / Electromechanical products group as shown in Table 8 below

Table 8: Contribution of Domestic and imported components used in Networking and Telecom Equipment

Category	Specific Components	% of BOM	Domestic Contribution %	Imports Contribution %
Electronics	Semiconductors + Optics	40% to 60%	0%	100%
	Memory Modules	5% to 8%	0%	100%
Passives	Reisstors, Capacitors, Inductors & Magnetics	9% to 15%	5%	95%
Printed Circuit Boards	Bare PCBs	5% to 8%	1-2% (Only 2-4L)	>98%
RF	RF Devices	5% to 6%	0%	100%
Electromechanical	Connectors, Switches & Plastics, Sheet Metals etc.	15% to 25%	20-30%	70-80%
5 key Sub-assemblies	Optical Traansceivers, Power Supplies, RF Filter Units, RF Embedded Antennas & RF Power Antennas	~10%	0%	100%

Source: Feedback Analysis, Interviews with Industry Members

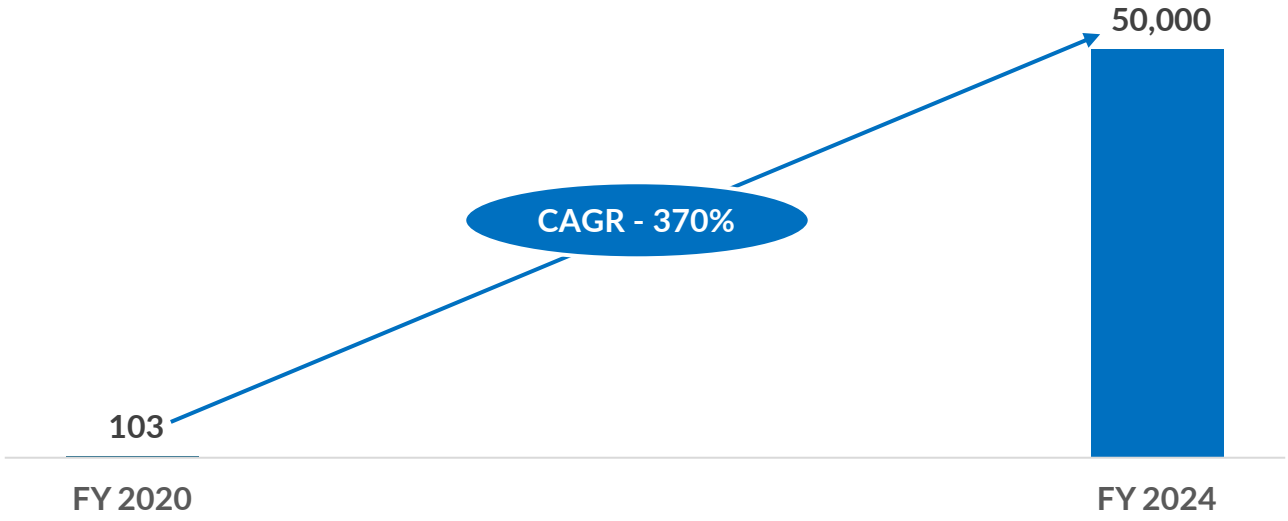
CHAPTER 03

Market for Telecom Components & Sub-assemblies in India (Current & Likely Future Potential)

A. Growth of Telecom Equipment manufacturing in India

Telecom Equipment in India was entirely / mostly imported about 5 years back. The Covid pandemic and the geo-political situation with China has pushed the Government of India to encourage domestic manufacturing of Telecom Equipment. India manufacturing of Telecom Equipment grew by a CAGR of 370%[17] during the period of FY 2019-20 to FY 2023-24 as shown below in Figure 7 below

Figure 7: Growth of Telecom Equipment Manufacturing in India



Source: Ministry of Communications Press Release on 10 JUL 2024 by PIB Delhi

[17] https://pib.gov.in/PressReleasePage.aspx?PRID=2031963#

B. Current market size by Components & sub-assembly

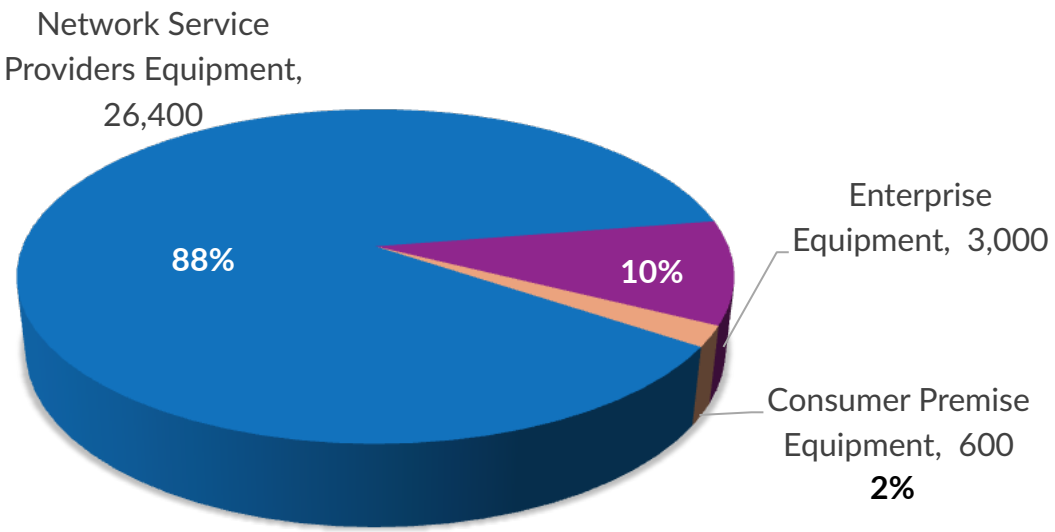
The approach to estimating the market or Telecom Equipment Components is given below

- Considered the Manufacturing of Telecom Equipment in India (Fy 2023-24)
- Applying the Material Cost to Revenue Norms of 60%[18] on the Total Manufacturing estimate.
- Applied the required BOM for estimating varying categories of Telecom Components as highlighted in the previous chapter in this report.

Based on the usage norms as set out earlier, the market for Telecom Components in India for Made in India Telecom Equipment was estimated as INR 30,000 Crores (USD 3.6 billion), as shown below in the following Figures.

Figure 8: Market for Components Used in Made in India Telecom Equipment by Segments

2023-24 Overall Components market by Segments (for Made in India Telecom Equipment), INR 30,000 Crores (USD 3.6 B)

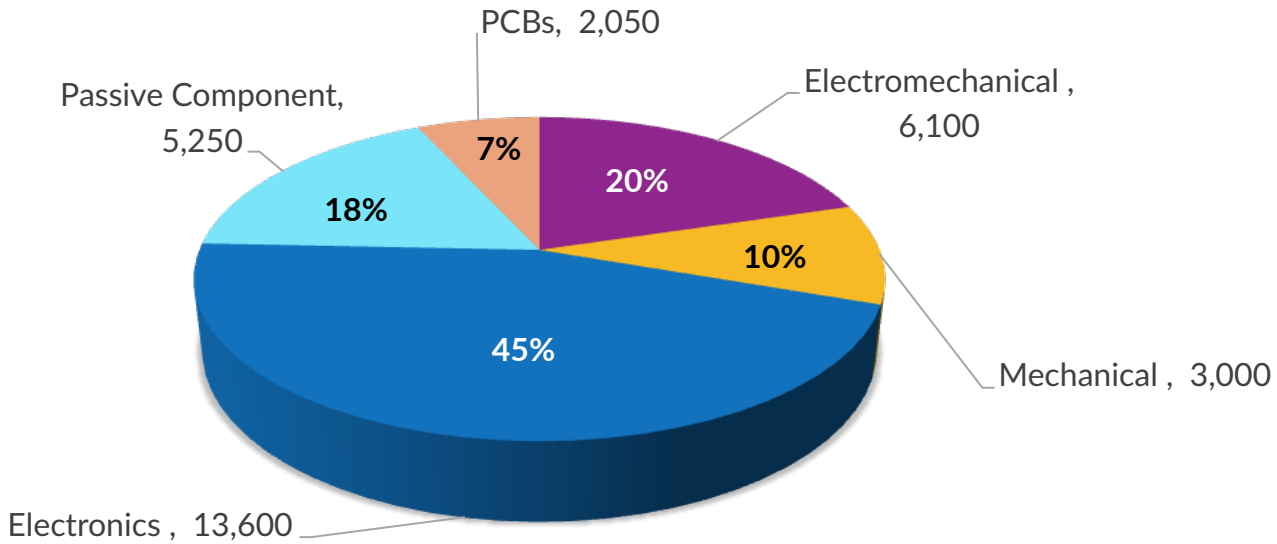


Source: Feedback Advisory Analysis

[18] Feedback Advisory analysis - Industry estimate through primary research and also validated through the analysis of Annual Reports of Telecom Equipment companies in India

Figure 9: Market for Components used in Made in India Telecom Equipment by Categories

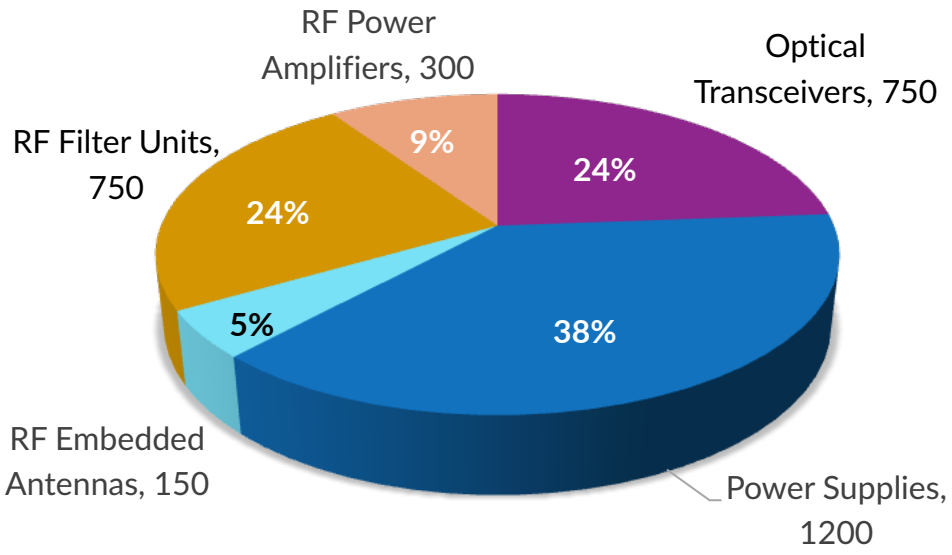
2023-24 Overall Components market by Segments (for Made in India Telecom Equipment), INR 30,000 Crores (USD 3.6 B)



Source: Feedback Advisory Analysis

Figure 10: Market for Sub-assemblies used in Made in India Telecom Equipment by Categories

Current Market of Sub-assemblies in INR 3,150 Crores (~USD 380 million)



Source: Feedback Advisory Analysis

C. Likely Future market size by Components & sub- assemblies

Likely Future Market for Telecom Equipment in India

The ongoing deployment of advanced technologies like 5G necessitates significant investment in new infrastructure, including base stations and antennas, to enhance coverage and capacity. BSNL has recently started investing in 4G, whereas JIO and Airtel plan to continue the capex investment to expand the reach of 5G services in India. The drivers of 5G extend beyond increased data consumption and video streaming to include a range of transformative use cases poised to revolutionize various sectors. Key drivers include the integration of advanced analytics and artificial intelligence (AI), which enable organizations to leverage data generated by 5G for real-time decision-making and predictive analysis, thereby enhancing operational efficiency and customer experiences. Additionally, 5G is crucial in adopting Industry 4.0 principles by providing seamless connectivity for machinery and devices on the factory floor, promoting automation and improving productivity. The Internet of Things (IoT) also flourishes with 5G due to its enhanced bandwidth and low latency, allowing for a greater number of connected devices, ultimately leading to smarter cities, streamlined supply chains, and enhanced healthcare solutions.

Businesses are adopting digital solutions, such as cloud computing and IoT, which require robust and secure communication infrastructures. This has led to an increased demand for enterprise-grade telecom equipment.

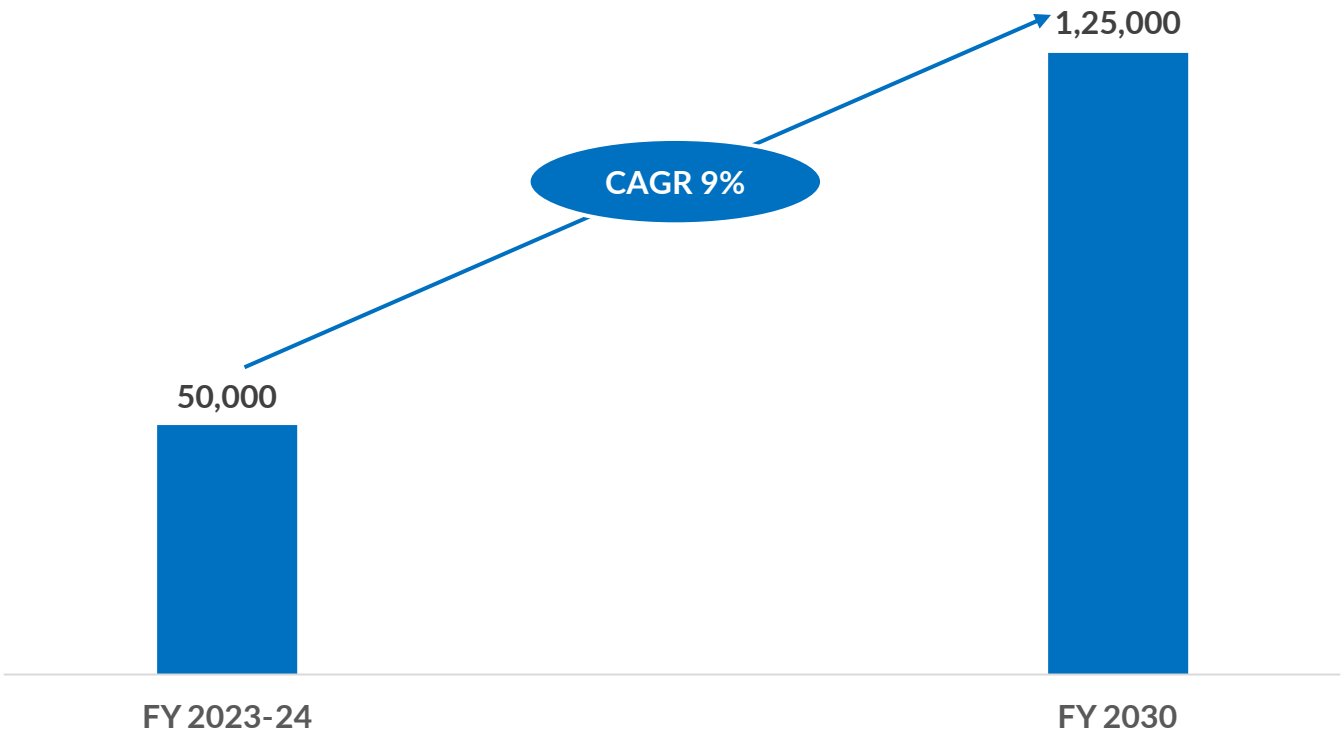
The overall demand for telecom equipment in India has been growing at a CAGR of 15-17%[19] during the period of FY 2021-2024. New Project Capex along with the replacement demand will continue to drive the investment for the telecom and digital services in India. Considering a similar growth of the last few years for the next few years, the Overall capex demand in Telecom Equipment is likely to reach around INR 125,000 crores (USD 15 billion) by 2030, as shown in Figure 11 below.

Secondly, Niti Aayog has also estimated the Telecom Equipment manufacturing in India to reach around USD 15 billion in its recently released report 'Electronics: Powering India's Participation in Global Value Chains'. This also validates our estimate of likely Telecom Equipment spending in India.

[19] Media reports, industry stakeholders interviews

Figure 11: Current and Likely Future Telecom Equipment Manufacturing in India

Telecom Equipment Manufacturing in India (INR Crores)



Source: Feedback Advisory Analysis

Likely Future Market for Components and Sub-assemblies for Made in India Telecom Equipment

The same approach used for estimating the current market of Telecom Components is also used to estimate the Future market of Components – Based on the likely future manufacturing of Telecom Equipment in India. The Likely future market for Components by 2030 is given below in Figure 12 & Figure 13.

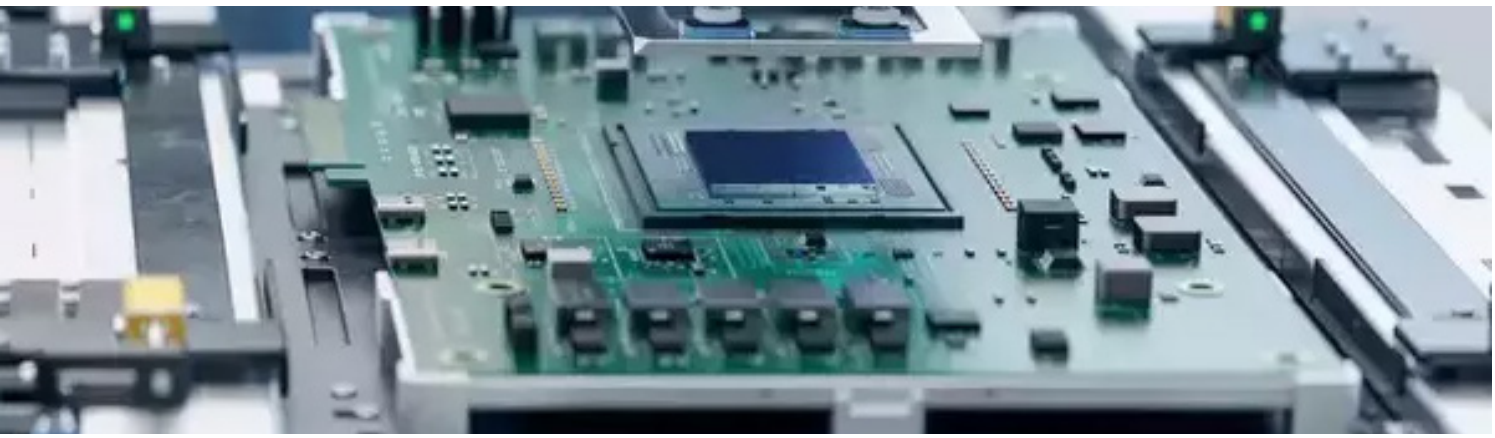
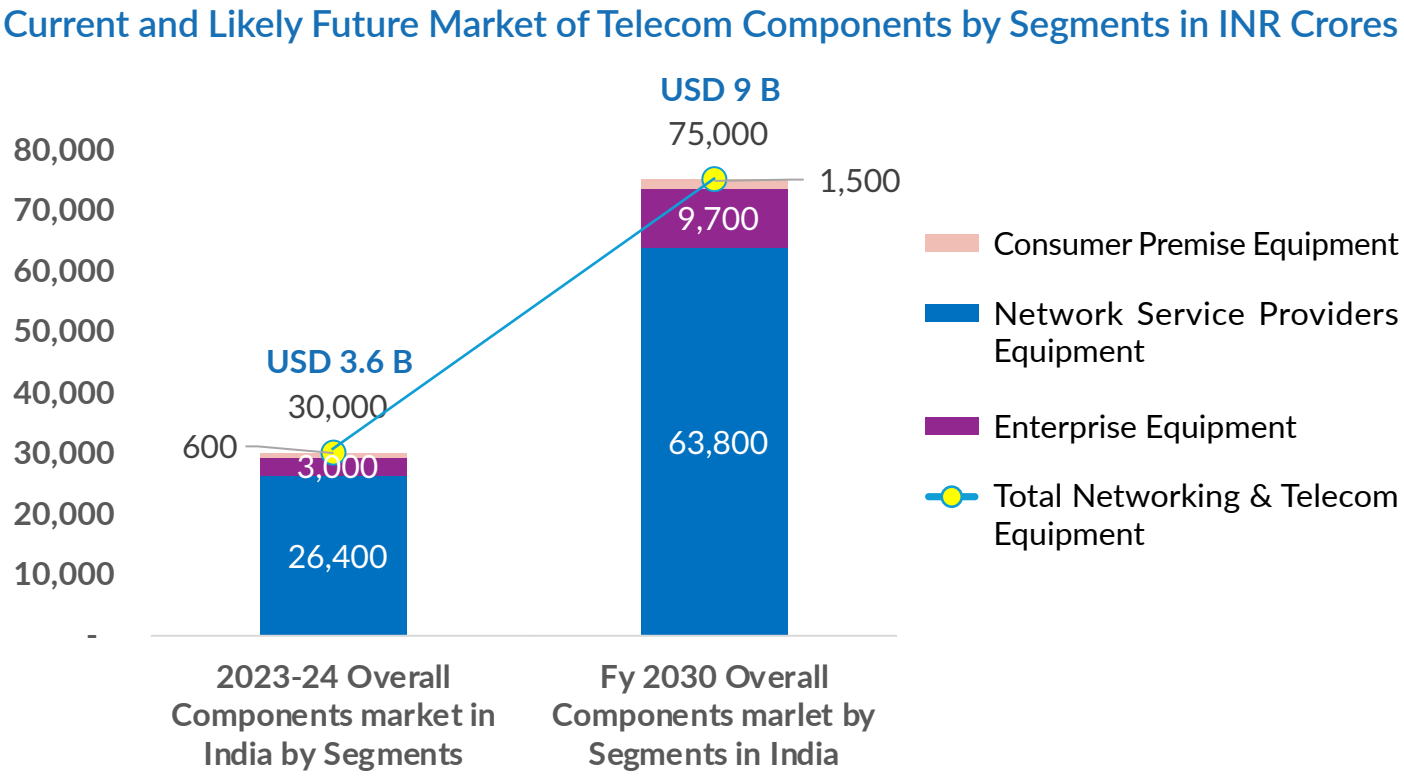
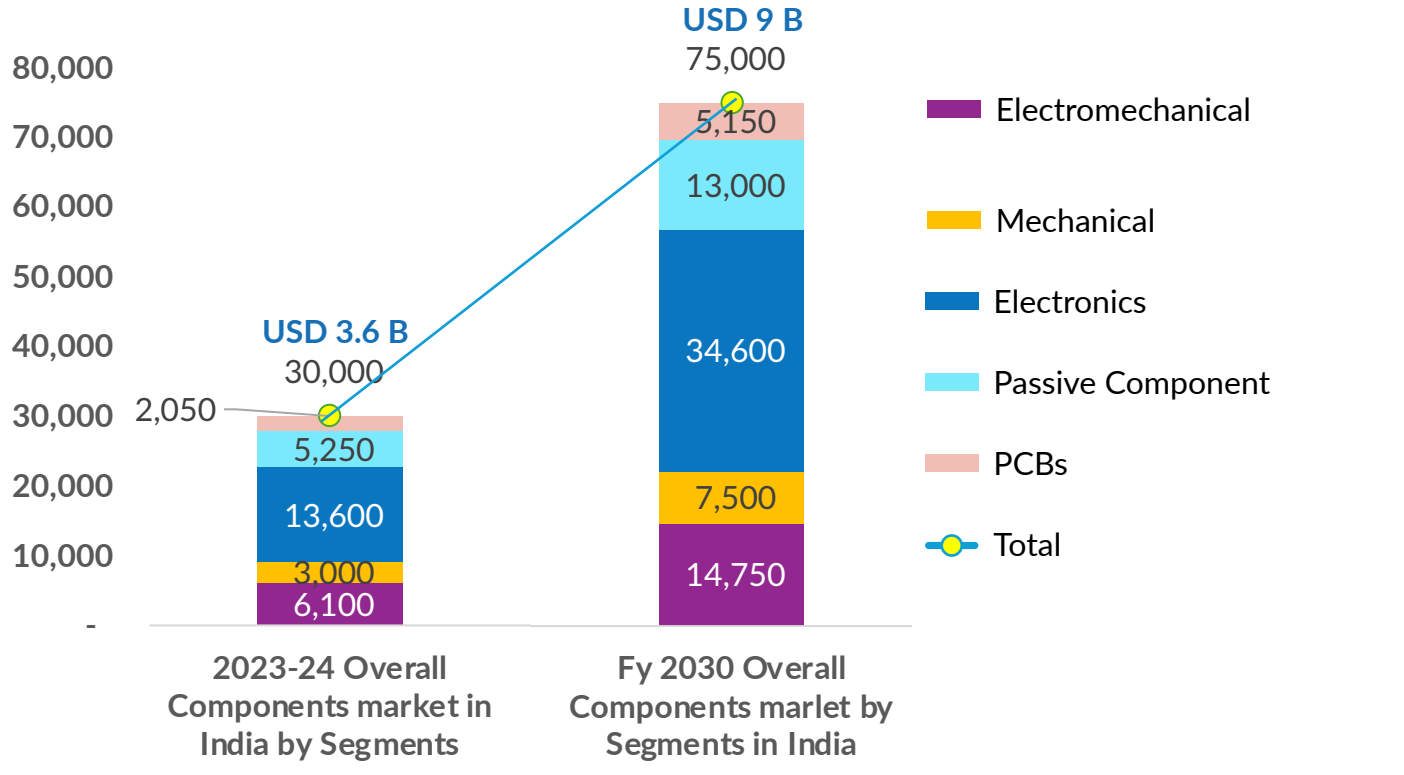


Figure 12: Current and Likely Future Market for Components used in Made in Telecom Equipment by Segments



Source: Feedback Advisory Analysis

Figure 13: Current and Likely Future Market for Components used in Made in India Telecom Equipment by Categories



Source: Feedback Advisory Analysis

Creating an Exports Led Telecom Components Manufacturing Industry in India by 2030

Creating a component ecosystem requires global market access and cannot rely solely on domestic market needs. Therefore, concentrating on the global components market for telecom will be ideal, providing the necessary scale for global players to relocate their component operations to India. **An export-led market for components will be ideal for India to aspire to rather than only creating a domestic market for components.**

Establishing a robust component ecosystem necessitates access to global markets and cannot depend exclusively on the demands of the domestic market. For India to effectively develop its telecommunications component ecosystem, it is essential to focus on the global components market. This strategy would enable Indian manufacturers to achieve the scale required to attract international players to relocate their component operations to India, thereby fostering a competitive environment that encourages innovation and technological advancement.

By prioritizing an export-led market for telecom components, India can position itself as an integral part of the global supply chain, attracting foreign investments and partnerships that drive growth. This approach not only enhances the technological capabilities of Indian manufacturers but also opens up opportunities for collaboration with leading global firms. Moreover, catering to international demands will enable Indian companies to specialize and optimize their production processes, ensuring that they meet stringent global standards and serve diverse customer needs.

In contrast, limiting efforts to merely creating a domestic market for components could result in a smaller operational scale, reducing the incentive for multinational corporations to invest in India. An export-driven strategy would yield substantial economic benefits, including job creation, improved infrastructure, and increased knowledge transfer. Ultimately, by fostering a vibrant export-led telecom components market, India can enhance its competitiveness on the global stage and reinforce its aspirations to be a significant player in the global telecommunications industry.

The Global Telecom Equipment market is expected to reach USD 1 Trillion[20] by 2030. Applying the same norms for components as used in the Indian market, the Global Telecom Components market is estimated to reach USD 600 billion by 2030.

Given India's current status in the Components for TE, different categories could have a different level of global penetration by 2030. For example, electromechanical/mechanical products could aim to have an ambitious 10% share of the global market by 2030, while electronics, which has yet to take off, can aim for a realistic 0.5% global penetration by 2030. This is tabulated below in Table 9

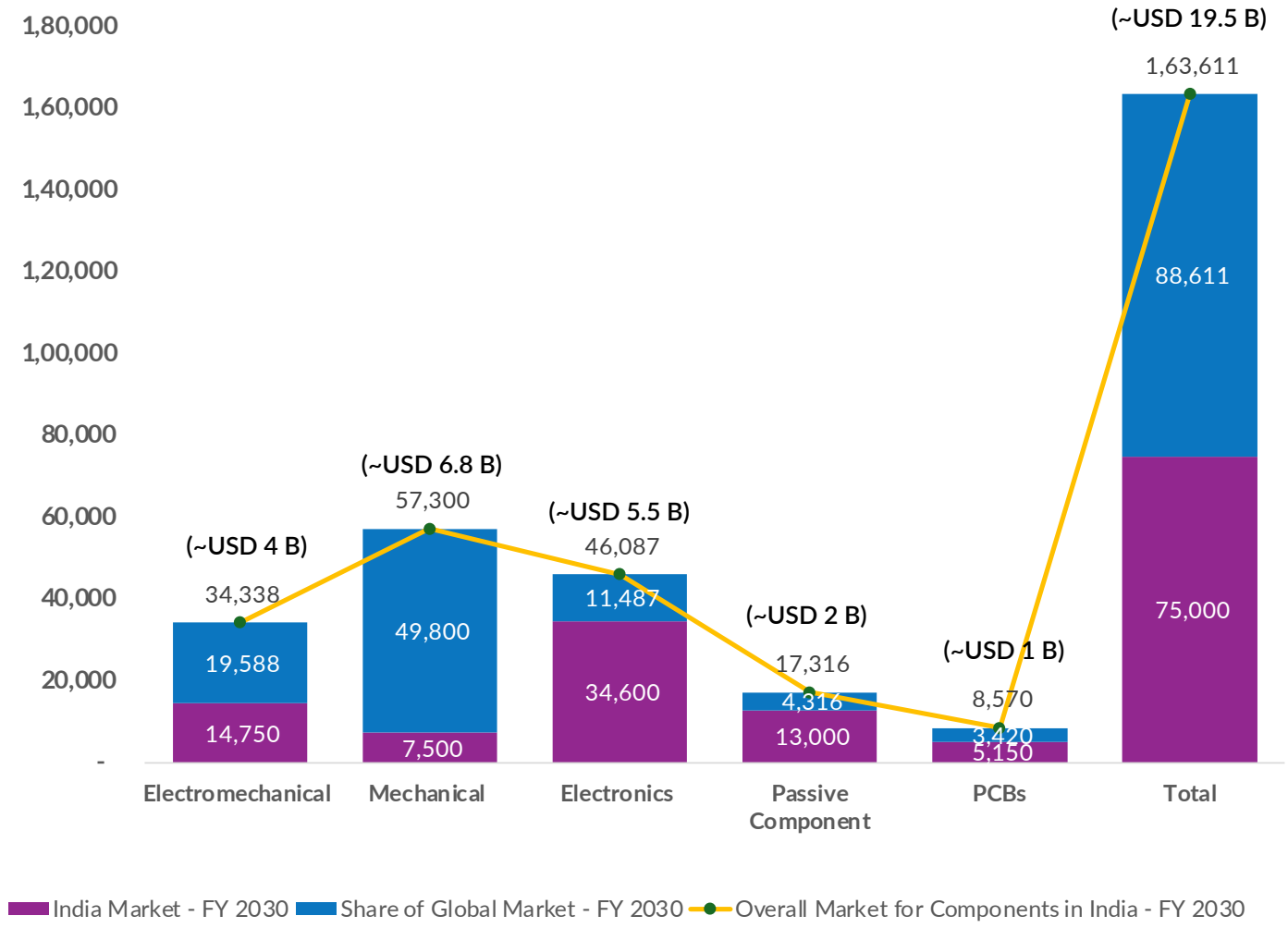
[20] Bharat – A Telecom Product Nation Report

Table 9: Assumptions for Made-in-India Telecom Components in the Global Telecom Components market

Categories of Telecom Components	Assumption of India's Global penetration by 2030
Electromechanical	2.0%
Mechanical	10.0%
Electronics	0.5%
Passive Component	0.5%
PCBs	1.0%

Overall, this report assumes that India could address a minimum of 2% of the Global market in the next 6 years once it embarks on an ambitious Components localization route. **An Exports Led Components Market could then reach ~INR 165,000 Crores (USD 19.5 billion) as compared to the ~INR 75,000 Crores (USD 9 billion) for the Domestic market only.** This is set out in Figure 14 below

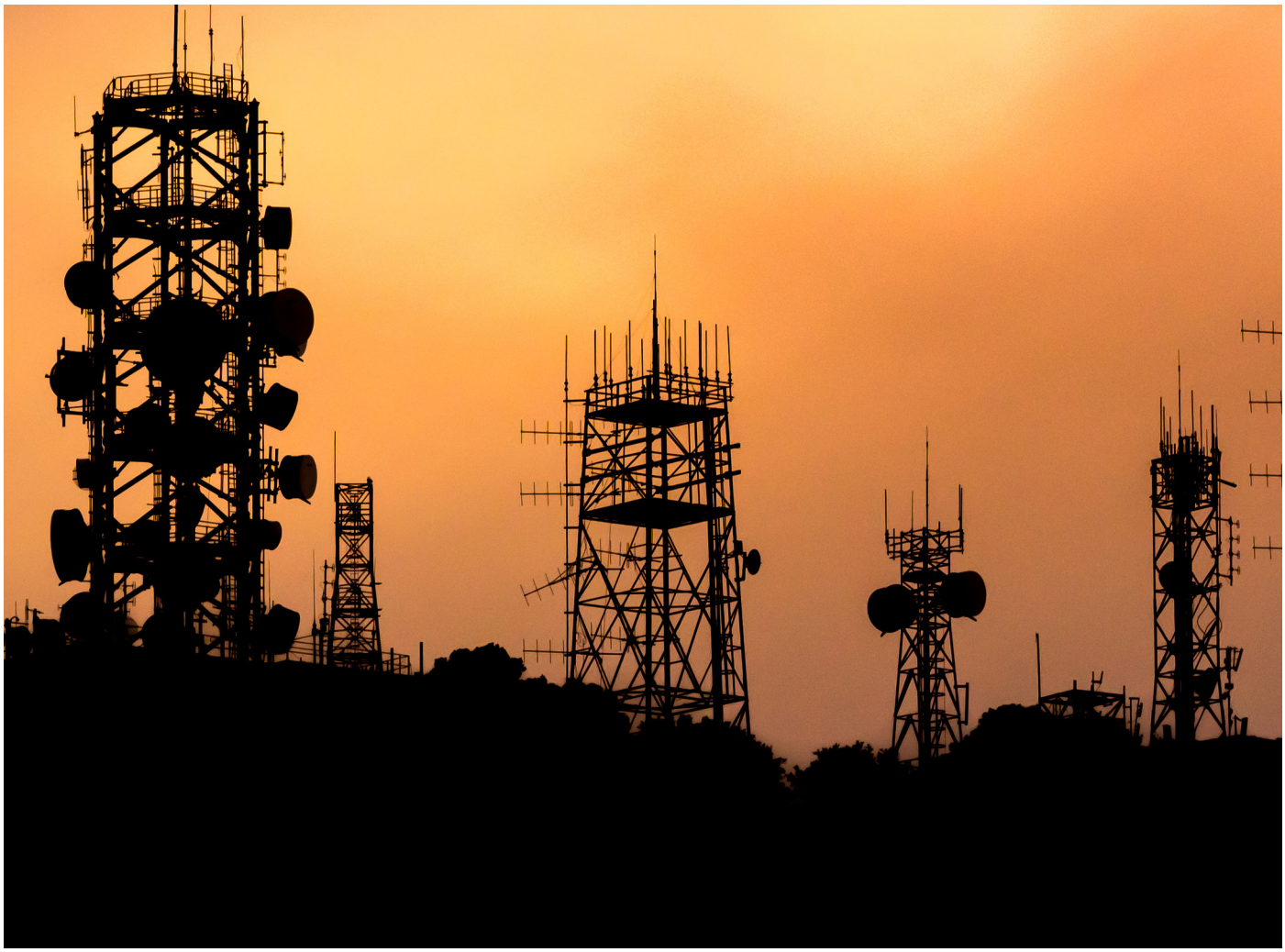
Figure 14: An Exports Led Likely Future Market for Components used in Made in India Telecom Equipment by Categories



Opportunity Summary for Sub-assemblies

Sub-assemblies of focus in Telecom Equipment	Global Current Market in USD B*	FY 2030 Global market in USD B*	Norms of Usage	India Market in USD M (Current)	India Market in FY 2030 with a 5% share of the Global market in USD M
SFP Optical Transceivers	10.87	32.62	2.3%	162.9	1,972.8
Power Supplies	23.5	35.3	4.9%	352.3	2,504.0
RF Filter Units	13.5	39.2	2.8%	202.4	2,384.5
RF Embedded Antennas	3.4	12.7	0.7%	51.0	741.9
RF Power Amplifiers	5.23	19.7	1.1%	78.4	1,149.5
Total Focus Sub-assemblies	**56.5**	**139.52**	**11.8%**	**846.9**	**8,752.7**

*Based on various published Global Reports



CHAPTER 04

Challenges for developing a Components & sub-assembly ecosystem in India

A. Lack of Component Availability in India Creates Significant Import Dependency for OEMs

India's telecommunications and technology sectors face considerable challenges due to a significant dependency on imports for most components utilized by original equipment manufacturers (OEMs). This reliance on foreign sources for essential components presents a critical vulnerability in the supply chain, impacting the competitiveness and sustainability of domestic manufacturers.

One primary reason for this import dependency is the limited availability of advanced component manufacturing technology within India. The lack of cutting-edge technological capabilities hinders local firms from producing high-quality components that meet international standards. Consequently, OEMs are compelled to source these components from overseas, leading to increased costs and longer lead times.

Furthermore, the absence of large-scale manufacturing facilities and the resultant lack of economies of scale exacerbate the situation. Without the ability to produce components at a scale that can lower production costs and enhance efficiency, Indian manufacturers find competing with their global counterparts challenging. This limitation further restricts their capacity to meet the specifications of advanced telecommunications equipment, preventing them from capitalizing on emerging market opportunities.

Additionally, the lack of access to raw materials poses a significant barrier to developing a robust manufacturing ecosystem in India. Many key raw materials required for component production are either unavailable or are sourced primarily through imports, which complicates the supply chain and adds to manufacturing costs. This situation affects the overall production capabilities and restricts innovation within the industry.

Finally, the absence of a cohesive components ecosystem in India contributes to OEMs' challenges. A well-established ecosystem comprises a network of suppliers, manufacturers, and service providers that can synergize efforts, share resources, and drive innovation collaboratively. Such an ecosystem needs to improve the growth and development of the local industry, inhibiting advancements in technology and manufacturing practices.

Addressing these challenges is vital for India to enhance its manufacturing capabilities, reduce import dependency, and foster sustainable growth in the telecommunications sector. Efforts to develop domestic manufacturing technologies, improve access to raw materials, promote economies of scale, and cultivate a comprehensive components ecosystem will be essential in achieving these goals. Such initiatives will bolster the country's technological capabilities and contribute to its broader economic objectives.

B. Cost competitiveness in Components manufacturing in India[21]

Indian manufacturers reportedly face a local cost disadvantage compared to other nations, particularly in East Asia. This disadvantage poses significant challenges for domestic manufacturers of network and telecommunications equipment (TELECOM EQUIPMENT), as their limited profit margins are affected by these cost disparities, which impact overall business viability. Several key factors contribute to these cost disabilities:

- **Cost of Capital:** In India, the cost of financing or commercial borrowing is notably higher than in other exporting nations, with a margin of at least 3%. Manufacturers in major export economies benefit from financing at more favorable terms, including concessionary interest rates and attractive financial packages designed to support domestic manufacturing. Stakeholders have reported that countries such as China, the United States, and Japan offer credit to local manufacturers at interest rates ranging from 3% to 4%.
- **Cost of Infrastructure:** In addition to the expenses associated with raw materials, the effectiveness of manufacturing operations is highly dependent on the cost of essential supplies, including land, construction, logistics, and utilities such as electricity and water. Reducing these recurring costs is imperative to foster a competitive ecosystem for the National Advanced Technology and Equipment Manufacturing (NATEM) sector.
- **Compliance Costs:** The costs associated with compliance, including obtaining permits, enforcing contracts, registering property, starting a business, and adhering to direct and indirect taxes, have remained relatively high in India. These elevated costs not only deter indigenous manufacturing but also contribute to increased reliance on imports. Initiatives promoting ease of doing business may alleviate this detrimental cycle; however, meaningful progress can only be achieved by enhancing the manufacturing ecosystem.
- **Cost of Testing and Certification:** The additional expenses related to testing and certification, the presence of multiple standardization agencies, and delays in obtaining timely testing represent further obstacles for domestic NATEM manufacturers. Standardization is essential for providing

[21] Inputs from the TRAI Recommendations on NATEM

predictability, expanding market access, and mitigating risks for producers and consumers alike. Streamlining standardization practices within the local ecosystem is crucial to reduce the costs and time associated with necessary testing and certification, thereby supporting the rapidly evolving industry.

- **Incentives for Manufacturing in Other Countries:** The cost differential may be further exacerbated by the various incentive schemes implemented by many countries to promote domestic manufacturing. Such incentives can enhance the competitive edge of foreign manufacturers relative to their Indian counterparts.

Indian NATEM players face significant cost disabilities when compared to their Chinese and Vietnamese counterparts. Table 10 given below provides a comparison of cost disabilities between India, China and Vietnam.

Table 10: Cost disabilities in India Vs China and Vietnam

S.No	Factors resulting in cost reduction	India	Vietnam	China
1	Fiscal incentives based on incremental production (PLI) *	4% -7%*	0%	1%-2%
2	Corporate income tax exemption/reductions	0.73% 0.95%	1.5% 2%	2%
3	State subsidies in India for capital investments	0.6%-1.2%	NA	NA
4	R&D subsidy	0.15%	0.4% 1%	2%
5	Industrial land development support	0.40%	0.50%	0.60%
6	Infrastructure development cost (Building etc.)	Negligible	0.30%	1%
7	Labour subsidy	Negligible	0.50%	2%
8	Cost of power	Negligible	1%	1%
9	Subsidy for machinery and equipment	0%	0.20%	3%
10	Exemption/reduction of the land rental costs	0%	0.50%	0.60%
11	Interest subvention on working capital	0%	1.5% 2%	3%-3.5%
12	Logistics	0%	0.50%	1%
13	Other factors improving the "Ease of doing Business*	-	1.5%-2.5%	2%-3%
14	Duty-free imports for creating fixed assets, and inputs not available domestically	0%	0.50%	-
Total		5.88% - 9.7%	8.9% - 11.5%	19.2% - 21.7%
Cost disability differential for India vs. Vietnam and China		-	1.8% - 3.22%	12%-13.32%

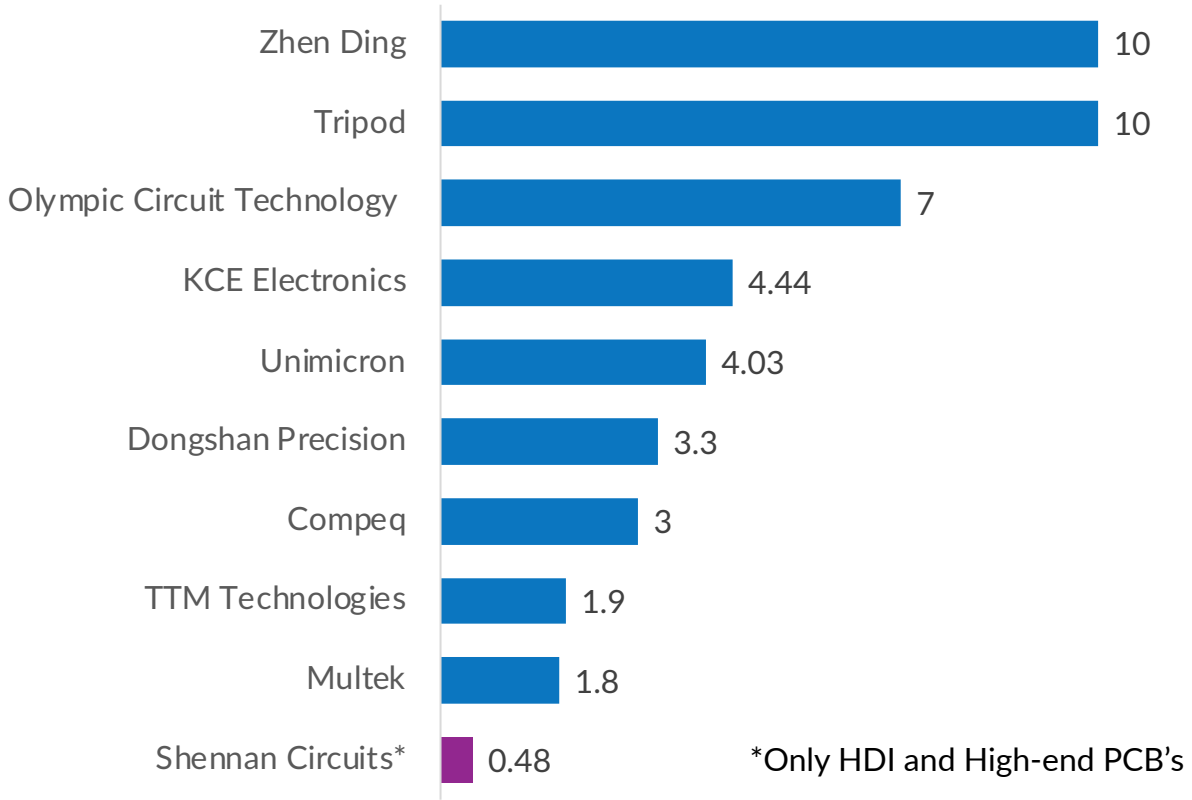
* PLI Incentive is considered under manufacturing subsidies.

C. Lack of scale in Indian Components manufacturing

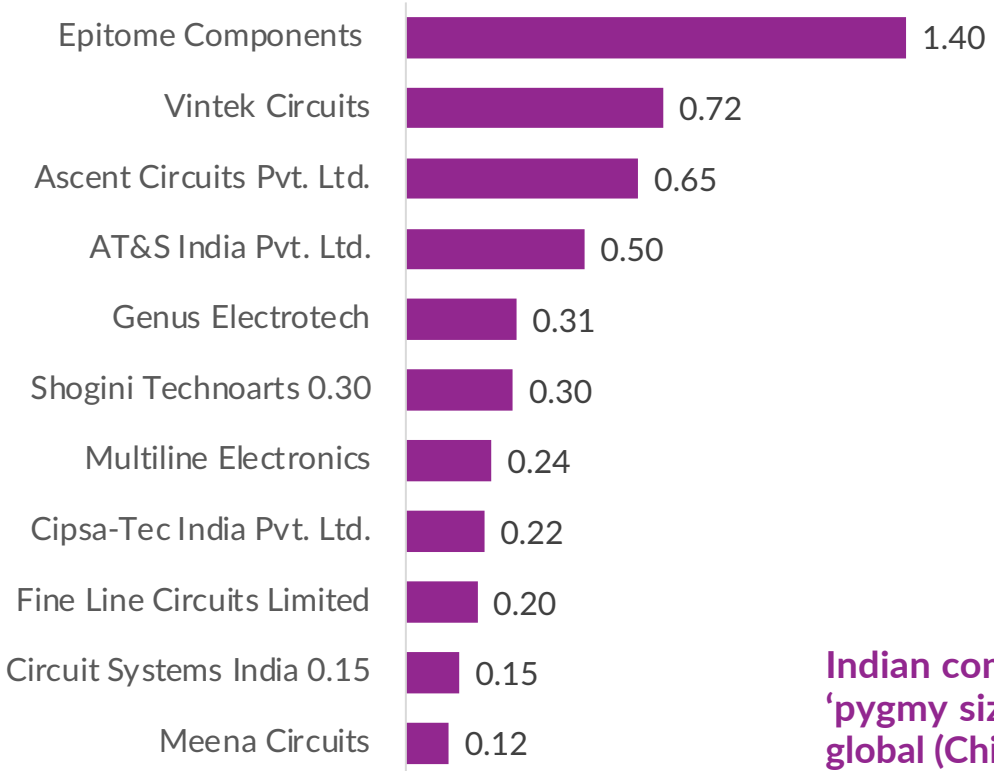
The component manufacturing sector in India encounters substantial challenges, primarily attributed to the lack of large, innovative units that can drive the industry forward. This shortcoming results in an ecosystem that lacks the necessary global scale and capabilities, ultimately rendering it uncompetitive in the international arena. The sector is predominantly comprised of a few smaller entities, each with annual turnovers of approximately INR 2 billion or less. This fragmentation hampers the ability to achieve the critical mass needed for significant investment, technological advancements, and economies of scale. As a result, these constraints impede India's position and growth within the global component manufacturing market, preventing the industry from realizing its full potential and effectively competing with leading nations.

One example of the lack of scale is shown here in terms of PCB Manufacturing - Lack of scale of Indian PCB companies can be seen by the fact the largest Global PCB firm has 8X the capacity of Large Indian firms . This is shown below in the Figure 15 below

Figure 15: PCB Manufacturing Capacity comparison between Indian Companies and Global Leaders



Top Indian Cos. - Annual Production Capacity - Million Square meters



Indian companies are relatively 'pygmy sized' compared to top global (Chinese) companies

D. Lack of raw materials and need for ecosystem creation

The components landscape encompasses various elements, each possessing distinct requirements for raw materials and manufacturing ecosystems. These components include advanced films, copper laminates, multiple chemicals, tools, and dies, each necessitating specific inputs and processes tailored to their unique functional attributes.

The component manufacturing ecosystem in India appears to be underdeveloped and needs more robustness to compete effectively on a global scale. The landscape is predominantly populated by small and medium-sized enterprises (SMEs), which often need more resources, technological capabilities, and scale to nurture and expand this ecosystem comprehensively. As a result, these smaller firms struggle to invest in the advanced manufacturing techniques, research and development initiatives, and infrastructure improvements necessary to create a more integrated and competitive components sector.

Furthermore, the absence of larger, pioneering firms capable of leading industry advancements exacerbates the situation. Such entities typically possess the experience and financial strength to drive innovation, establish effective supply chains, and engage in collaborative partnerships. With this leadership, the ecosystem can be cohesive and achieve the critical mass required for meaningful growth.

E. High Capital Expenditure and Its Impact on Investment-to-Turnover Ratios in the Components Sector

The sector is characterized by a relatively low capital-output ratio in electronic components and subassembly manufacturing. Typically, this ratio ranges from 1:1 to 1:2 for Through-Hole Technology (THT) passive components, 1:5 for Surface-Mount Device (SMD) passive components, and 1:10 for subassemblies. This capital-output ratio is significantly lower than that of finished goods manufacturing, which stands at approximately 1:20. Such ratios indicate that the production value generated from a given investment in the components and subassembly sector is comparatively less than that achieved in manufacturing finished goods and assembly operations.

The disparity in capital efficiency is further exacerbated by the higher cost of capital in India and the comparatively lower returns on investment. This makes the manufacturing of electronic components more costly than in competing countries such as China, Vietnam, and Thailand. Nonetheless, it is noteworthy that electronic components and subassemblies generally add a higher value than their counterparts in assembly and finished goods manufacturing. Value addition in the components sector is estimated to fall between 30% and 50%, whereas for finished goods, it typically ranges from 20% to 25%.

The combination of a low capital-output ratio and significant value addition poses considerable challenges for establishing component and subassembly manufacturing ventures in India. These factors contribute to a comparative disadvantage that hinders the sector's development and competitiveness on the global stage. This situation highlights the necessity for targeted policy interventions and support mechanisms to address these barriers and enhance the viability and growth prospects of the sector.

Components manufacturing is very different compared to other product manufacturing and needs to be treated differently

F. Interactions & dealing with Chinese firms

In light of the current geopolitical climate, the complexities faced by Indian firms in engaging with Chinese companies—such as delays in visa approvals and travel restrictions—have significantly impeded efforts to localize elements of the electronics value chain. These challenges create obstacles in fostering greater independence and resilience within the Indian manufacturing sector.

The global production landscape for electronic components is heavily concentrated in China, with a significant portion of manufacturing capacities located within Chinese firms. As China serves as a critical hub for producing Electronics System Design and Manufacturing (ESDM) value chain items, sourcing inputs, parts, and capital goods from China is a routine necessity for Indian businesses. Any delays or disruptions in this sourcing process can adversely impact manufacturing operations in India, causing inefficiencies and potential bottlenecks.

G. Ease of Doing Business issues – issues relating to exports

End user certificate (EUC) mandate for license: Several telecom companies have begun manufacturing for export operations in India. These companies have high volume and dynamic supply chains and primarily sell to partners, resellers and distributors who further sell products to end-users. The SCOMET licenses for these products require that an end-user certification (EUC) be provided for each end-user. For companies engaged in large scale transactions through complex supply chains, they are not able to operationalize collecting EUCs in such high volumes. Further, this is not a requirement imposed by other countries with similar export control regimes for large-scale export operations. Unless this requirement is relaxed, companies will not be able to scale their exports.

Multiple/Duplicative Request from Local Indian Authorities: After submission of export license applications, applicants typically receive multiple, duplicative requests for documentation and information from Indian embassies and consultants in the destination country(ies). While these inquiries are pending, export license applications are placed on hold. The requests seek information/ documentation that is (i) already included in the initial application or (ii) could have been provided with the initial application to expedite processing. These requests typically add weeks to the license application processing times.

Current export license for prototypes/testing not extended to contract manufacturers: Export of prototypes are subject to the General Authorization for Intra Company Transfers (GAICT). The process does not acknowledge contract manufacturers to apply on behalf of the principal for third party transfers. Further, the application processing is similar to mass products. Therefore, waiting 3 months or more for export licenses for prototypes will severely limit industry's ability to develop new products for manufacturing in India. Several countries have export license exceptions for intra-company shipments and/or sample shipments. These exceptions permit intra-company shipments and a limited number of exports to third parties (e.g. testing houses, manufacturing facilities) for product testing, research and development.

Military end-use customer: Sales to military end-customers, are subject to additional screening processes by the government, which will lead to further processing time. This requirement does not exist in most other geographies. In a few countries, military end-use restrictions are limited to certain items and certain regimes. For example, in the U.S., the export control norms restrict military end-use in China for certain products.

CHAPTER 05

Roadmap for Boosting Components & Sub-assembly in the Telecom Equipment in India

A. Introduction

MAIT and its members have been actively fostering indigenization in the manufacturing of Indian IT and Telecom Equipment. A primary focus of our endeavors has been enhancing domestic manufacturing capabilities by incorporating Indian components and subassemblies. This report represents an additional initiative aimed at outlining a strategic pathway to bolster the production of telecommunications components and subassemblies in India

MAIT recognizes that the Government of India is anticipated to release a 'Components Policy' in the near future. As discussed in Chapter 4, telecom components are inherently complex and will be needed to develop the components and sub-assemblies sector for telecom equipment. This is crucial to achieving deep localization and establishing a sustainable manufacturing ecosystem for Telecom Equipment in the country by 2030.

The potential opportunity for export-led Component manufacturing in India is very attractive, and it is valued at **~INR 165,000 crores (~USD 19.5 billion)** by 2030.

Some proactive policy measures must be introduced to realize this opportunity. This chapter outlines some of these recommendations.

B. Recommendations Framework

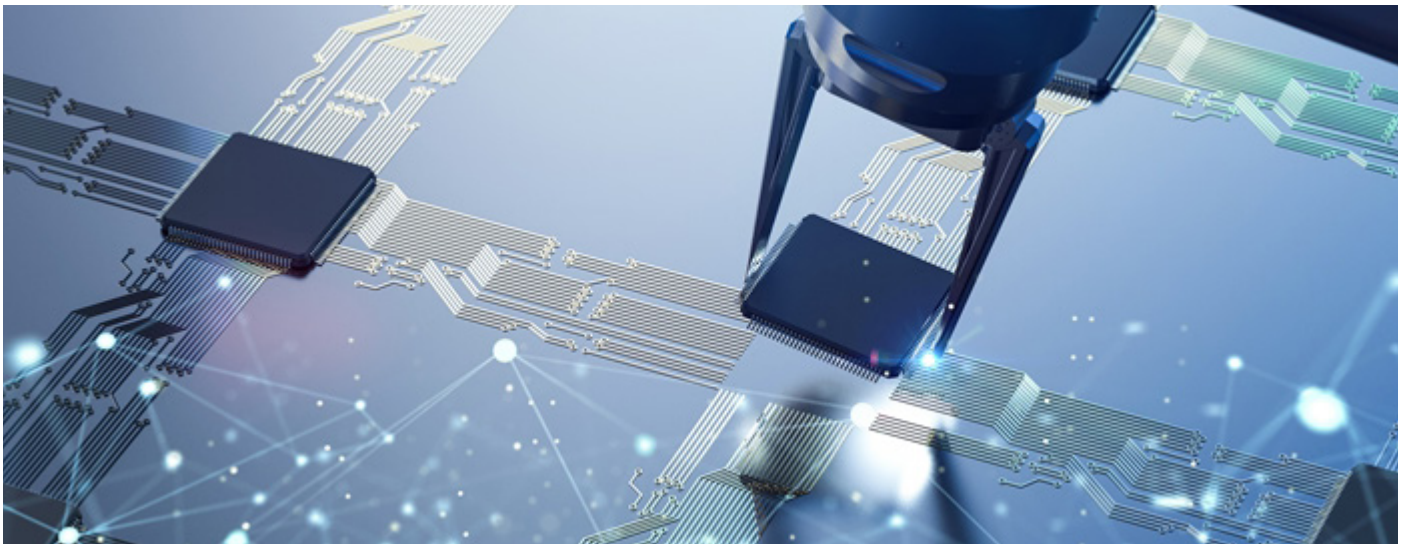
Figure 16: MAIT's Recommendation Framework

1. Priority for Localisation in Telecom Components & Sub-assemblies for India
2. Need to set out a Telecom Components Manufacturing Vision
3. Involve Global NATE OEMs to encourage their Level 1 Vendors to invest in India
4. Conduct an investment drive to popularize this Policy and encourage firms to invest (Global & Indian)
5. Set out a Telecom Components Policy addressing the Industry Challenges
6. Identify Indian Domestic Component firms willing to partner with Global firms to create 'Domestic Champions'
7. Involve Indian MSMEs to partner & work with Global and Indian Champions

C. Specific Recommendations

1. Priority for Localization in Telecom Components & Sub-assemblies for India

Given the state of the current Telecom Components and Sub-assemblies, where a bulk of these are imported, it is vital to set up a realistic target for localization, which can be achieved by the Industry and make a meaningful impact in creating an ecosystem in the country.



MAIT suggests that India adapts the following localization priority for the Nation as shown in Table 11

Table 11: PCB Manufacturing Capacity comparison between Indian Companies and Global Leaders

Timeline for a possibility of creating ecosystem in India	Remarks	Potential BOM addressed by 2030

Immediate
 	
Reason: Mechanicals are already undertaken in India by some firms, need to get this done across and Sub-assembly Units are easy to attract than Components to begin with (e.g. Mobile ecosystem) and they are also a large market* to address for India.
 	
Also, Telecom Sub-assemblies are not included in the proposed MeiTy's Components Policy
	• **Specific sub-assemblies to be made in India**
	  • SFP Pluggables – Optical Transceivers
	  • Power Supplies (SMPS)
	  • RF Filter Units
	  • RF Power Amplifiers
	  • RF Embedded Antennas
	
	• **Specific Components**
	  • Enclosures, Plastic & Mechanical Fabrication
		• Overall Sub-assemblies: 11 -12%
		  • 2 – 3%
		  • 4 – 5%
		  • 2 – 3%
		  • ~1%
		  • 0.5 – 1%
		
		• 8% to 10%
		
		Total: 20% to 22%

Near Term Reason: These are already included in the list of Components with MeiTy, need to ensure, Telecom Segment requirements (specifics to Telecom) are included in these projects.	**Specific Components** • Interconnects & Cables • Heat Sinks / Thermal Management	• 8% • 2% Total: 10%
Mid Term Reason: Passives are already included in the list of Components with MeiTy, need to ensure, Telecom segment requirements. The ISM's Policy for ATMP and DLI should help in addressing the needs of Telecom Segment for Discrete Semi's and Controllers etc.	**Specific Components** • Printed Circuit Boards • Passives (Cap. Res. Ind. & Magnetics) • Transistor, Diodes, Logic, LED • Voltage regulator, Power Controllers, Linear, Timing	• 10% • 4% • 4% • 8% Total: 24%
Long Term The ISM's Policy for FAB & ATMP is already in place and would depend on the commissioning of these units.	**Specific Components** • ASIC, xPU Programmages, Communication • Memory / HDD	• 40% to 45% • 8% to 10% Total: 50% to 55%

2. Need to set out a Telecom Components Manufacturing Vision.

The government needs to articulate a comprehensive 'Telecom Components Manufacturing Vision' supported by a dedicated budget and consistent policies. This vision would guide the development of a robust manufacturing sector in India, fostering innovation and investment. A specific budget would show the government's commitment to creating a competitive ecosystem, attracting both international and Indian investments, and driving technological advancements in telecom components. Consistent policies would provide stability for manufacturers, aiding long-term planning and reducing import dependency. Aligning this vision with "Make in India" can transform India into a global telecom manufacturing hub by 2030. The vision can focus on Opex incentives for scaling up existing TE facilities and Capex incentives for components where India has limited capability.

3. Involve Global Telecom Equipment OEMs to encourage their Level 1 Vendors to invest in India

The Government should actively engage with global telecom equipment Original Equipment Manufacturers (OEMs) to encourage their Tier 1 vendors to invest in India. This should be accompanied by commitments to potential incentives and enhancements to the Ease of Doing Business (EODB) environment. By fostering partnerships with prominent global OEMs, the government can leverage their existing networks and influence to attract Tier 1 suppliers, who are critical players in the telecom manufacturing ecosystem.

Encourage OEMs to encourage their Tier 1 vendors to invest in India

Incentivise OEMs who source components from India for their global manufacturing operations.

- **This incentivization can be in the form of access to local market for the global OEM, who enables export of telecom components to their global factories.**
- **Enabling this model will not only promote domestic manufacturing but also encourage exports from India**

4. Need to address the problems of sourcing from Chinese Vendors urgently

The current restrictions on Chinese vendors might be reconsidered to bring the ecosystem to India. It is important to consider that it took 30+ years for China to develop the current manufacturing leadership and its ecosystem. Localizing and developing an ecosystem in India (without allowing or restricting the availability of Chinese suppliers) will take a couple of decades for India, especially in the Telecom equipment domain. The concerned authorities need to understand that if they want to move fast on "Make or Made in India" drive, they will have to allow & treat Chinese suppliers like any other country suppliers/investors to establish initially in India. The same strategy or policy being pursued by countries like Vietnam, Thailand, Malaysia and even Western world towards Chinese suppliers. Once the eco system is established, it will be easier for local supply base to learn and multiply the competency.

5. Need to improve the EODB metrics in the country in Telecom Equipment and Components market,

Offering a tailored package of incentives, such as tax breaks, subsidies, and infrastructure support, would make India an attractive destination for these vendors, facilitating the establishment of local

manufacturing units. Moreover, improving the EODB conditions by streamlining regulatory processes, reducing bureaucratic hurdles, and ensuring transparency would further incentivize investment, providing a conducive environment for business operations. Such an approach would not only boost the domestic manufacturing capabilities of telecom components but also integrate India's telecom sector into global supply chains, enhancing its competitiveness. This strategy aligns with the broader objectives of increasing foreign direct investment and developing a self-reliant economy, ultimately contributing to job creation, technological innovation, and economic growth in the country.

5.a Reforms in India's SCOMET regime to promote exports

- Eliminate End-User Certification Requirement for Stock and Sale Licenses, provided OEMs certify their end-use and maintain robust transaction screening programs. This would include elimination of the requirement to seek exemption from EUC requirement from Policy Relaxation Committee (PRC).
- Require Ship-To Entity Validation with Initial License Application, updating rules to require OEMs to submit evidence of corporate registration, company profile, capacity for sales/distribution, etc. with initial license applications.
- Clarify Military Use Requirements, updating rules to align with global best practices and clarify documentation and defined timelines required for approval for military use.
- Create and Export License Exemption for Samples/Prototypes to allow limited number of products to be exported on temporary or permanent basis for intra-company transactions and/or to product laboratories and manufacturing sites.

6. Identify Indian Domestic Component firms willing to partner with Global firms to create 'Domestic Champions'

Some of the global companies that are leaders in their segment can be invited to invest in India in given in Table 12

Table 12: List of Key Global firms in Telecom Components

Specific Components / Sub-assemblies	Key market leaders
SFP Pluggables – Optical Transceivers	• Coherent Corp. (U.S.) • Cisco Systems, Inc. (U.S.) • Brocade, A Broadcomm company, USA • Molex, LLC (U.S.) • Lumentum Operations LLC (U.S.) • Finisar Corporation, USA • Sumitomo Electric Industries, Japan • Fujitsu Optical Components Limited (Japan) • Intel Corporation (US) • Huber & Suhner AG, Germany

Specific Components / Sub-assemblies	Key market leaders
Power Supplies	• DELTA (present in India in the Consumer Segment but not in Telecom) • Lite-On Technology • MEAN WELL (have India distribution office only) • Chicony Power • Siemens (present in India in manufacturing other non Telecom products) • AcBel Polytech • Schneider (present in India in manufacturing other non Telecom products) • ABB (present in India in manufacturing other non Telecom products) • Omron • Puls • Phoenix (have India distribution office only) • TDK-Lambda
RF Filter Units	• Skyworks Solutions Inc (USA) • Qorvo (USA) • Broadcom (USA) • Filtronic Plc (UK) • Teledyne Microwave Solutions (USA) • API Technologies Corp. (USA) • Mini-Circuits (USA) • K&L Microwave Inc (USA) • Commscope (USA)
RF Power Amplifiers	• NXP Semiconductors, Netherlands • Qualcomm Technologies, Inc., U.S. • MACOM, U.S. • BONN Elektronik GmbH, Germany • OPHIR RF, U.S. • Infineon Technologies AG, Germany • CML Microsystems Plc, U.K. • Broadcom, U.S. • Analog Devices, Inc., U.S. • ETL Systems Ltd, U.K. • ETS-Lindgren, U.S. • Murata Manufacturing Co., Ltd., Japan

Specific Components / Sub-assemblies	Key market leaders
RF Embedded Antennas	• EnGenius Technologies, U.S. • Mobile Mark, Inc., U.S. • Antenova Ltd., U.K. • Airgain, Inc., U.S. • Abracon, U.S. • The Antenna Company N.V., Netherlands • Taoglas, Ireland • Tallysman, Canada • Laird Connectivity, U.S. • TE Connectivity, Switzerland • Maxtena Inc., U.S. • Myers Engineering International, Inc., U.S. • Kyocera Avx Components Corporation, U.S. • Infinite Electronics International, Inc., U.S. • 2J Antennas, U.S. • Avnet, Inc., US
Printed Circuit Boards	• Unimicron Technology, Taiwan • Compeq Mfg. Co. Ltd, Taiwan • Tripod Technolofy Corporation, Taiwan • Samsung Electro Mechanics, South Korea • Korea Circuits Co. Ltd, South Korea • BHFlex South Korea • Ibiden Co.Ltd, Japan • Fujikura, Ltd, Japan • Meiko Electronics Co. Ltd, Japan • Nippon Mektron Ltd, Japan • Jabil Inc, USA, • Plexus Corp, USA • TTM Technologies, USA • Advanced Circuits, USA • Wurth elctronik group, Germany • Becker & Muller Circuit Printing, Germany
SMD Passives	• TDK, Japan • Murata, Japan • Taiyo Yuden, Japan • Kyocera AVX, USA • Sanyo, Japan • Kemet, Taiwan • Samsung, South Korea • Samwha, South Korea • Vishay, USA • Yageo, Taiwan • Walsin, Taiwan • TE Connectivity, USA • Panasonic Japan

7. Set out a Telecom Components Policy addressing the Industry Challenges

Recommendations for the Telecom Components Policy to address the Industry challenges:

7.a Financial Incentives for the Creation of Pioneering Component / Sub-assembly Manufacturing Units

Given that most electronic, electromechanical, and mechanical components have already been included in the proposed Ministry of Electronics and Information Technology (MeitY) Component Policy and the Semicon India Program, the government should concentrate on those areas overlooked in the previous policies. Specifically, this focus should be directed towards telecom sub-assemblies. These Sub-assemblies include:

- SFP Pluggables – Optical Transceivers
- Power Supplies (SMPS)
- RF Filter Units
- RF Power Amplifiers
- RF Embedded Antennas

To attract investments in these Sub-assemblies, the report suggests that companies committing a minimum investment of >INR 1000 crores or more in these Sub-assemblies should be supported by providing them with **40% to 50% of capital expenditure support on a pari passu basis.** This support should be capped at three to four units per domain.

These pioneering units are anticipated to catalyze the development of additional manufacturing facilities for the Components / raw materials and other inputs necessary for the production of these Sub-assemblies. Furthermore, they should be eligible for support under a Product-Linked Incentive (PLI) scheme, which offers an average incentive of **5% over five to six years.**

The government can also look at **providing additional benefits** to these pioneering units if they **successfully bring their supply chain / ancillary units** to India.

Single window clearance systems for such Pioneering units can also be looked at.

These incentives will enable firms to look at the Indian market favorably compared to other competing countries and derisk their Global Supply Chains.

7.b Infrastructure and Logistics Support

The Government is proposing to set up two new Telecom Manufacturing Zones (TMZs) to address the need to develop state-of-the-art manufacturing facilities and establish Bharat as a preferred destination for Telecom equipment production. The report recommends that these TMZs be made open to these Pioneering Units in Sub-assembly and other Telecom Component investors.

These TMZs can also feature options such as Plug & Play facilities and Dormitories for workers and should be able to provide high-quality uninterrupted power.

Establishing high-quality common infrastructure within component parks is vital for fostering an environment conducive to manufacturing and innovation. Key infrastructural elements include well-constructed roads, efficient drainage systems, reliable water supply, and robust telecommunications networks. These foundational amenities play a crucial role in ensuring seamless operations. They enable businesses to concentrate on their core activities—production and innovation—without being burdened by recurring issues related to basic infrastructure.

8. Conduct an investment drive to popularize this Policy and encourage firms to invest (Global & Indian)

To effectively implement the proposed policy and stimulate growth within the component manufacturing sector, it is essential to conduct a comprehensive investment drive that raises awareness of the policy and actively encourages investment from both global and Indian firms. This initiative can involve a multi-faceted approach, including targeted outreach, promotional campaigns, industrial seminars, and collaborative partnerships.

9. Involve Indian MSMEs to partner & work with Global and Indian Champions

Engaging Indian Micro, Small, and Medium Enterprises (MSMEs) in partnerships with global and leading Indian companies is crucial for developing India's telecom manufacturing ecosystem. MSMEs contribute significantly to innovation, job creation, and competition in sectors like telecommunications. A strategic approach that fosters collaboration with industry leaders can enhance the role of MSMEs.

Key initiatives include mentorship and knowledge-sharing programs with established companies to guide MSMEs through the complexities of telecom manufacturing. These programs can involve workshops and training sessions to improve technical competencies and production processes. Additionally, platforms such as industry exhibitions and networking events can facilitate collaboration and integration into global supply chains. Financial support is also essential, with targeted funding schemes and incentives from the government and financial institutions to empower MSMEs and enhance their partnerships with larger firms.

10. Focus on Skilling, innovation & R&D

Developing a multi-pronged strategy to enhance the skill set of the workforce for the expanding telecom component ecosystem is essential for sustaining industry growth and competitiveness. This strategy should include comprehensive training programs tailored to the specific needs of telecom manufacturing and Components industry requirements. Collaborative efforts between educational institutions, government, and industry leaders can establish specialized courses and certifications that align with current and future industry demands. Integrating advanced technologies and hands-on learning experiences into curricula will ensure workers are adept at handling modern manufacturing processes and innovative technologies. This can be done through:

- Set up dedicated telecom component research labs in collaboration with premier institutions like IITs and NITs.
- Launch skilling programs under initiatives like Skill India to train a workforce in areas such as PCB design, semiconductor fabrication, and RF engineering.

Annexure A

Key Competing Countries for Components

A. Vietnam

Vietnam is currently one of the biggest exporters of consumer electronics globally. A somewhat overlooked industry is its telecom manufacturing industry, which is one of the biggest globally. Few countries specialize in telecom equipment manufacturing, yet Vietnam is at the forefront of this.

The establishment of several new domestic telecom businesses, like Viettel and Saigon Post, broke the dominance of the Vietnam Post & Telecommunication Group (VNPT). VNPT had a monopoly on the telecommunication market prior to that.

Since the foundation of the industry, Vietnam has been seeing an increasing number of manufacturers of telecom equipment. The products are either made by specialized businesses or by integrated departments of large telecom service providers. In 2019, the Vietnamese government claimed that the country is now able to produce 70% of all telecom equipment. They also shared a vision to promote telecom equipment manufacturing further, namely by bringing Vietnam to a top 4 position globally.

Vietnam has quickly emerged as a manufacturing hub for telecom equipment. There are three reasons behind this.

- Domestic companies are capable to produce most of the products.
- Vietnam is one of the pioneers to launch commercial 5G services.
- It has developed strong manufacturing capabilities for 5G equipment.

5G and 6G Equipment

Vietnam and Singapore are the pioneers in Southeast Asia to launch the trial of the 5G technology.

- In 2019, Ericsson and Viettel, which is a state-owned company, collaborated on a project that resulted in the first 5G connection being made in Vietnam.
- The Vietnamese Government has set out a plan to develop 5G technology domestically. Both in terms of necessary infrastructure and the production of relevant equipment and components.
- Viettel and Vin Group, two of the largest companies in Vietnam, have proven their capabilities in manufacturing 5G equipment.
- Viettel is now a top 6 company that produces 5G terminal equipment globally. The other companies include Ericsson, Huawei, Samsung, Nokia, and ZTE. By the end of 2021, Viettel reported that they successfully developed transceivers and mastered the design of two chipset lines of 5G technology. The company is working to master semiconductor production technology, which will be used as key components for 5G chipset.

- Viettel researches and develops signal processing equipment (CU-DU), 5G core network system, and provides new technologies such as Beamforming and Multi-User Massive Mimo – providing high-speed services to users.
- Vin Group announced its plan to develop 5G mobile phones and 5G telecom equipment in 2019. However, the conglomerate changed its direction in 2021, by deciding to not continue with smartphone production. Instead, the development project of the base station 5G gNodeB was transferred to Viettel.
- Under the agreement of the two companies, Vin Group is now responsible for the development and supply of Radio equipment (RU) 8T8R, Antenna 8T8R, and Massive MIMO 64T64R devices (integrated RU and Antenna).

Cables - coaxial, twisted pair, and fiber optic cables

VNPT had the first-ever factory in Southeast Asia to manufacture glass fiber until 2019 – the core component used in the optical communication of FO cables. Before the establishment of VNPT's factory in Bac Ninh (Northern Vietnam), glass fiber was imported from developed countries and used for fiber optic cable manufacturing locally.

Apart from the market leaders who account for much of the telecom equipment production, Vietnam has many private-owned and foreign-invested companies that produced different kinds of cables for decades.

Antennas – Key firms in Antennas manufacturing are

- Samsung Electronics (South Korea),
- Partron (South Korea),
- Yokowo (Japan),
- Galtronic (Canada),
- Dung Nam (Vietnam)

Import Duties exemption for Telecom Equipment from Vietnam to EU and USA

- Since the effective date of the EU-Vietnam Free Trade Agreement (EVFTA), most telecom equipment (under Chapter 85) are directly eligible for tariff elimination when exported from Vietnam to the EU.
- The rest, including reception apparatus for radio broadcasting and reception apparatus for television, will also see eliminated of tariffs by 2025 – 2030.
- Although Vietnam has not signed a free trade agreement with the US, the countries currently have a bilateral trade agreement. As a result, many telecom products enjoy tariff-free schemes when imported to the US.
- Some groups of products such as insulated wires, cables, insulated electric conductors, and connectors for optical fibers still have tariffs of between 2.7% and 5%.

Vietnam is a major producer of telecom equipment and a pioneer in the participation in the development of new technologies. The industry has been active since the mid-90s, and the government invests much money to develop the industry.

Thanks to its low labor costs and favorable free trade agreements, Vietnam has become a top destination to set up telecom equipment manufacturing. Increasingly more companies seek to relocate manufacturing activities to the country, avoiding tariffs from the US-China trade war.

Telecom equipment manufacturing has previously been concentrated and 'controlled' by state-owned companies. Increasingly, more private-owned and foreign-invested companies are active in the industry.

Some of the leading and mid sized companies in the Telecom & Components has been listed as below

1. Viettel Group
2. Vin Group
3. Vietnam Posts and Telecommunications Group
4. Samsung Electronics Vietnam Thai Nguyen Company Ltd
5. Lg electronics vietnam hai phong co., ltd
6. Luxshare-ICT(Vietnam) Limited
7. Fuyu precision component company limited
8. Ericsson Vietnam Company Limited
9. Goertek Technology Co., Ltd
10. Nokia Solutions and Networks Technical Services Vietnam Company Limited
11. cisco systems vietnam company limited
12. New wing interconnect technology co ltd
13. Tcl Smart Device (Viet Nam) Company Limited
14. Inventec technology vietnam company limited
15. Neweb vietnam co ltd.
16. Amtran vietnam technology company limited
17. Hansol electronics vietnam co ltd
18. CE link viet nam company limited
19. Viettel Manufacturing Corporation
20. Panasonic system networks vietnam co. ltd
21. Partron vina co. ltd
22. Vietnam Post And Telecommunication Industry Technology
23. Ace antenna co. ltd

24. ANSV Telecommunication Equipment Company Limited
25. Post and Telecommunication Equipment Co.
26. Sagemcom broadband hai phong limited
27. Aiphone communications (vietnam) co. ltd
28. RQ technology electronics vietnam company limited
29. Skyworth Vietnam Co Ltd
30. Maspro vietnam co ltd
31. Trong nhan telecommunication co., ltd
32. Yamato protec (dong nai) co. ltd
33. Southern Star Telecommunication Equipment
34. Signal Cable (Vn) Co., Ltd.
35. AP telecommunications accessories and equipment company Ltd
36. HA Noi network technology development company limited
37. Lancs Vietnam Network Technology
38. Tai Tung Communication Co., Ltd.
39. Precision Technology Co., Ltd.
40. Trieu gia mechanical company limited
41. Electronics- telecommunication hoang dieu company limited
42. Thanh Tin Electronic And Telecommunications Company Limited
43. E Components Co.,ltd
44. NHK electric communication

Vietnam - a preferred FDI destination in Telecom Equipment

Vietnam offers numerous benefits, including closeness to China, competitive manufacturing costs, a favorable investment climate, and excellent manufacturing capabilities. However, challenges like infrastructural development and talent shortages must be addressed. In addition, labor, trade, and financial freedom are the prospective areas where India need to expedite its reforms to provide conducive business environment.

Vietnam offers low manufacturing prices, regional and global market access, and an attractive investment climate. Moreover, Vietnam's youthful and proficient workforce, low salaries, improvements in infrastructure, political stability and good governance foster a favorable economic climate.

The Vietnamese government is simultaneously concentrating on enhancing manufacturing capabilities and pressuring businesses to advance up the value chain for better quality finished goods.

The regional advantage of Vietnam's location in Southeast Asia, close to the Asia Pacific region, China, and the ASEAN groups, strengthens its position in the global value supply chain and economic ties with other Asian nations. Vietnam also benefited from low labor costs vis-a-vis other Asian competitors, including India. Low-cost labor is thus a significant driver for attracting investments, including the ones moving out of China. Over the years, various reforms undertaken by the Vietnamese government have improved the investment environment, making it conducive for investors. The government offers numerous incentives, including tax cuts and streamlined relaxed procedures enabling ease of doing business. The government's commitment to attracting foreign investment has resulted in a more business-friendly environment.

Vietnam has entered into 18 bilateral, regional, or multilateral trade agreements. The latest accords, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the EU-Vietnam Free Trade Agreement (EVFTA), are seen as enhancing Vietnam's attractiveness as a center for manufacturing and exporting.

Vietnam offers proximity to China, competitive manufacturing costs, a favorable investment climate, and better manufacturing capabilities. However, challenges like infrastructural development or talent shortages should be addressed. However, Vietnam has effectively utilized its favorable business climate and growing consumer market to attract the departing multinational enterprises (MNEs) from China and new investments.

B. South Korea

Korea's communication device industry centers on wireless terminals such as smartphones, but Korean companies are working to foster communication equipment as a new competitive field in the 5G era.

The Korean network equipment industry has grown fast as small, medium and middle-standing companies expand their overseas operations, with Samsung Electronics taking the lead.

Currently, Samsung Electronics accounts for over 50% of the production and export of mobile communication equipment, but more middle-standing companies, including Dasan Network, Solid, and Ace Technology, have annual sales of USD 91 million.

- Network equipment makers have seen sales through 5G investment.
- High growth potential for Korean companies including SMEs is expected due to
- increased demand for small cells and repeaters.
- Samsung Electronics chose 5G as its future growth business and invested heavily in related chipsets, terminals and equipment.
- Samsung Electronics' Network Division expand the market by collaborating with global telecommunications companies to apply a number of 5G technologies with the aim to increase global market share.

- Samsung Electronics signed a 5G fixed wireless access service (FWA) communication
- equipment contract with Verizon, U.S.

Major Foreign-Invested Companies in Network equipment

- Nokia Solutions and Networks Korea – 100% subsidiary of Nokia, Sweden - Communication equipment, systems
- Ericsson-LG – 75%-25% JV between Ericsson, Sweden and LG, Korea - Wired/wireless exchange equipment, transmission equipment, communication system
- China Mobile International Korea (100% owned by China Mobile) - interconnection point for mobile switching center of LTE

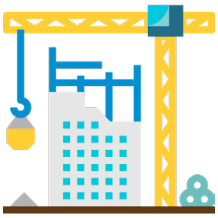
Key Policies

I-KOREA 4.0

(Strategic goal) I-KOREA 4.0 aims to establish strategies to realize a people centered 4th Industrial Revolution based on innovative growth, safety and inclusiveness.

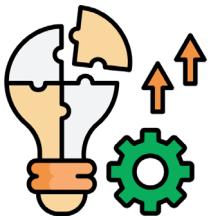
(Strategic tasks) I-KOREA 4.0 consists of the following tasks: establish hyper-connected intelligent infrastructure, innovate national R&D system and establish three tasks for enhancing the country's quality of life to lead innovative growth.

Promotions Strategies and Tasks



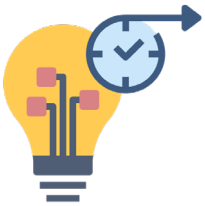
Construction of Hyper-Connected Intelligent Infrastructure

- Hyper-connected network (5G, IoT)
- Data
- Intelligent technology (AI)
- Blockchain



National R&D System Innovation

- Strengthen R&D construction
- Strengthen Regional R&D Foundation cooperation
- Provide researcher-oriented support
- Spread research outcomes
- Enhance competence of research institutes and universities
- Pursue global cooperation



Foster Future Technology

- Engines for innovation-driven growth
- Bio and ICT
- Nano, material, and unmanned vehicle
- Response to climate change
- Space, nuclear energy, and radiation

Create New Industrial Ecosystem

- Software and cloud
- Intelligification and innovation of all industries
- Digital content and media
- 3D printing and devices
- Regulatory reforms

Prepare for the Future Society and Improve Quality of Life

- Resolve problems related to people's day-to-day lives
- Creative convergence talents
- Job creation
- Communication costs and high-quality broadcasting
- Innovation of science and ICT culture and postal service

Source: Ministry of Science and ICT, The Fourth Industrial Revolution Centered on Science and ICT

(Establishing hyper-connected intelligent infrastructure) Develop convergence services to create innovative industries and services that can enhance the quality of life by promoting 5G intelligence and building a data utilization ecosystem beyond the world's first commercialization of 5G

(Innovating the national R&D system) Eliminate partitions between departments and innovate national R&D systems including researcher-centered R&D as an integrator and a coordinator of national R&D projects

(Enhancing the quality of life of the nation) Create a safe ICT and R&D environment such as preventing disasters in the network and securing cyber safety, solving people's day-to-day life problems, and support job creation by producing creative and convergent talents

5G + Strategy

The Korean government established and implemented a nationwide 5G Plus (5G +) strategy to maximize the ripple effect on 5G front and rear industries and secure global leadership in new 5G-based industries.

- In order to maximize the effect of early 5G commercialization, the government will push ahead with the national strategy to foster new 5G-based industries and revitalize the private-led market.

GOAL : The government will foster strategic industries, including 10 5G-based core industries and 5 core services, to achieve 15% market share in the global market in 2026, create 600,000 jobs, export USD 73 billion and achieve KRW 180 trillion in production.

PROMOTION STRATEGY : The government and the public sector will introduce and utilize 5G, and demonstration projects and pilot projects will be carried out to establish a public-private cooperation system so that the market will be revitalized at a fast rate.

- Lead the initial market with 'public leading investment' such as the demonstration of 5G + core service, public service and smart city 5G introduction
- Enhance government support for 'private investment expansion' including 5G tax and investment support, 5G test and demonstration infrastructure and content and technology commercialization
- Revitalize 5G service through 'institutional reforms' such as improvement of the 5G tariff system, establishment of a safe 5G user environment and regulation reform of 5G convergence services
- Strengthen global competitiveness through 'building the industrial foundation' by securing global leading technology, strengthening the competitiveness of the information security industry, promoting startups and fostering talent
- Promote globalization of 5G services through 'overseas expansion support' such as support for mutual entry of large and small companies, 5G international standardization and international cooperation

Ten core industries and Five Core Service of 5G + Strategy

10 Core Industries	5 Core Services
1. Network	 Immersive content
2. Next generation smartphones	
3. VR.AR device	 Smart factory
4. Wearable device	
5. Intelligent CCTV	 Autonomous vehicle
6. (Advanced) Drone	
7. (Connected) Robot	 Smart city
8. 5G V2X	
9. Information security	 Digital healthcare
10. Edge computing	

Network equipment

As for the production location of network equipment, they are concentrated in the Seoul Capital Area (Gyeonggi), and the concentration will be further intensified by the relocation of Samsung Electronics' network business.

- As of 2017, most small and medium-sized companies including Ace Technology KMW and SOLiD GEAR are located in the Seoul Capital Area, and Samsung Electronics' Network Division is located in Gyeongsangbuk-do (Gumi).
- At the end of 2018, Samsung Electronics Gumi Plant moved its network equipment production lines to Suwon, where the company has its 5G R&D organization, to build a smart factory.
- Due to the relocation of major companies, the Seoul Capital Area (Gyeonggi) has emerged as a key area for the production of network equipment.

South Korea is one of the most globally integrated countries, with a large and sophisticated economy and large domestic firms that are already enjoying mature status. It is a leading producer of semiconductors, and there is an enormous market for suppliers of equipment, materials, and services for semiconductor production. Market demand is expected to be further driven by increasing connectivity through innovative technologies such as 5G networks, connected cars, IoT, etc.

The Korean government has incentivized its domestic industry with tax breaks, lower interest rates, eased regulations, and reinforced infrastructure to promote its equipment manufacturers as global leaders. Further, South Korea is inviting global suppliers to work with its homegrown manufacturers.

ICT Tax Incentives

Low-cost finance for infrastructure items is readily available to manufacturers in Korea. Low-cost finance, in the form of speedy, easy loans from financial institutions and investor backing, is needed for the initial development of India.

Some of the main corporate tax- credits and incentives in Korea are discussed below

- **Special tax deductions for SMEs :** The country allows for tax deduction to the extent of 5% to 30%, depending on corporate location, size, business types, etc., with a cap of KRW 100 million on income.
- **Integrated investment Tax incentives :** Under the new tax credit scheme, they have been simplified and integrated into a single investment tax incentive scheme.
- R&D tax credit for SMEs meeting annual sales revenue and asset value thresholds and engaging in R&D activities.
- **Tax credit for technology transfer among SMEs (Korean patent box regime) :** Tax credit and reductions have been introduced to facilitate the transfer of technology between companies to enhance technical competencies in the country.

Prominent South Koran firms in Telecom and Components are listed in Annexure 1

C. China

In the context of China, a pivotal element in the nation's push towards indigenous innovation has been the direct financial support extended to Chinese firms. The Chinese government has provided substantial funding to over 100 government research institutions, involving more than 600,000 technicians and specialists in various research and development (R&D) efforts focused on telecommunications equipment and other high-technology goods. This initiative aligns with the launch of the "Made in China 2025" (MIC 2025) strategy in 2015, which aims to enhance China's economic competitiveness by advancing its position in the global manufacturing value chain, particularly in core component manufacturing, emerging technologies, and by reducing dependency on foreign enterprises.

Additionally, the venture capital (VC) landscape in China has experienced rapid growth, with increased focus on the digital sector. In 2020, the information technology sector alone attracted 837 venture capital investments, while the semiconductor and electronics sectors secured 419 investments. China's credit policies are strategically designed to channel loans to small and medium-sized enterprises (SMEs), facilitated by the People's Bank of China (PBC) through measures such as differentiated reserve ratios, loan refinancing, and rediscounted loans to help these industries boost their capital.

Over the past thirty years, China's R&D investment has increased nearly fortyfold due to the country's strategic planning to promote research and development. China has established numerous National

Economic and Technological Development Zones (NETD Zones, or ETDZs) and Special Economic Zones (SEZs), each offering a distinct mix of incentives and regulatory requirements. These zones have recently incorporated policies to support SMEs and manufacturing R&D, including significant tax deductions for various components within the manufacturing value chain to counter the adverse impacts of COVID-19. The tax deduction rate on enterprises' R&D expenses has risen to 100 percent from the previous 75 percent, effectively allowing companies to deduct RMB 200,000 from their taxable income for every RMB 100,000 spent on R&D.

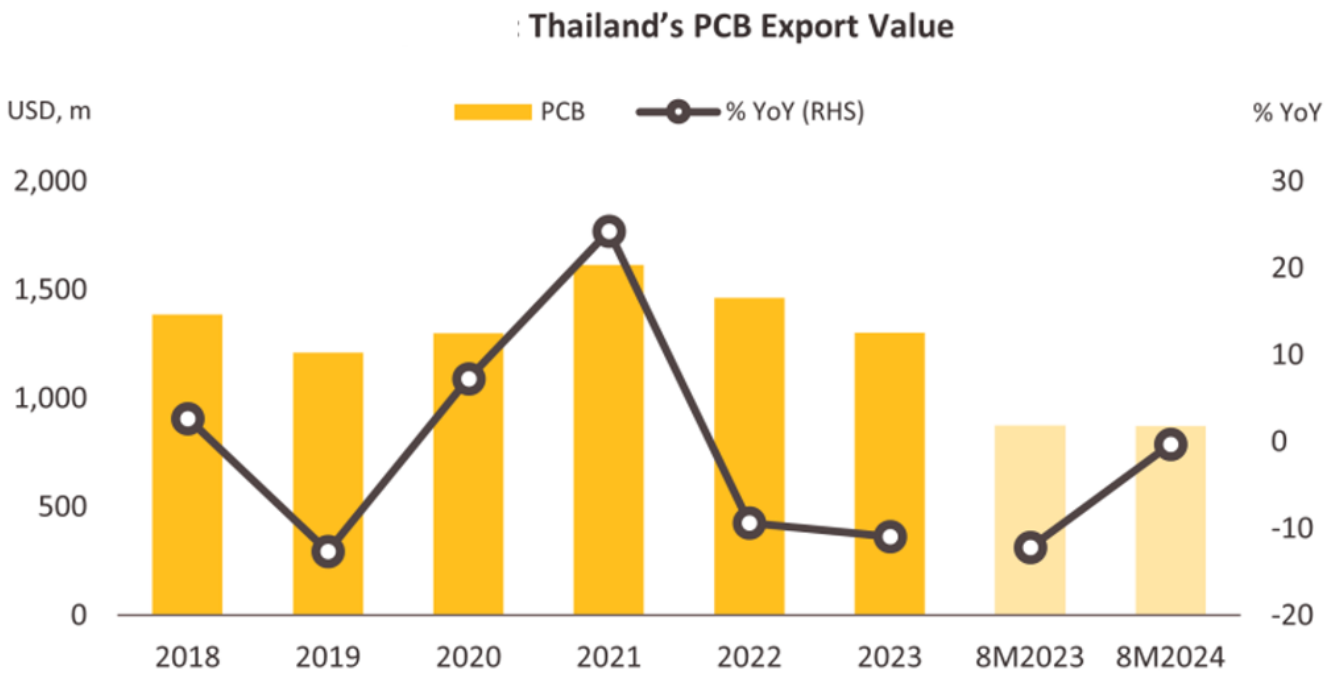
China's dedication to fostering innovation among SMEs, enhancing high-quality development, and strengthening the resilience of the industrial chain is further demonstrated by the central government's commitment to allocate more than 10 billion yuan from 2021 to 2025 to support the growth of "little giants." In addition to this, Certified High and New Technology Enterprises (HNTEs) in China benefit from a reduced corporate income tax rate of 15%, as opposed to the standard 25%, under the country's innovation incentive schemes. These comprehensive measures reflect China's strategic approach to promoting technological innovation and economic growth, positioning itself as a formidable player in the global market.

D. Thailand

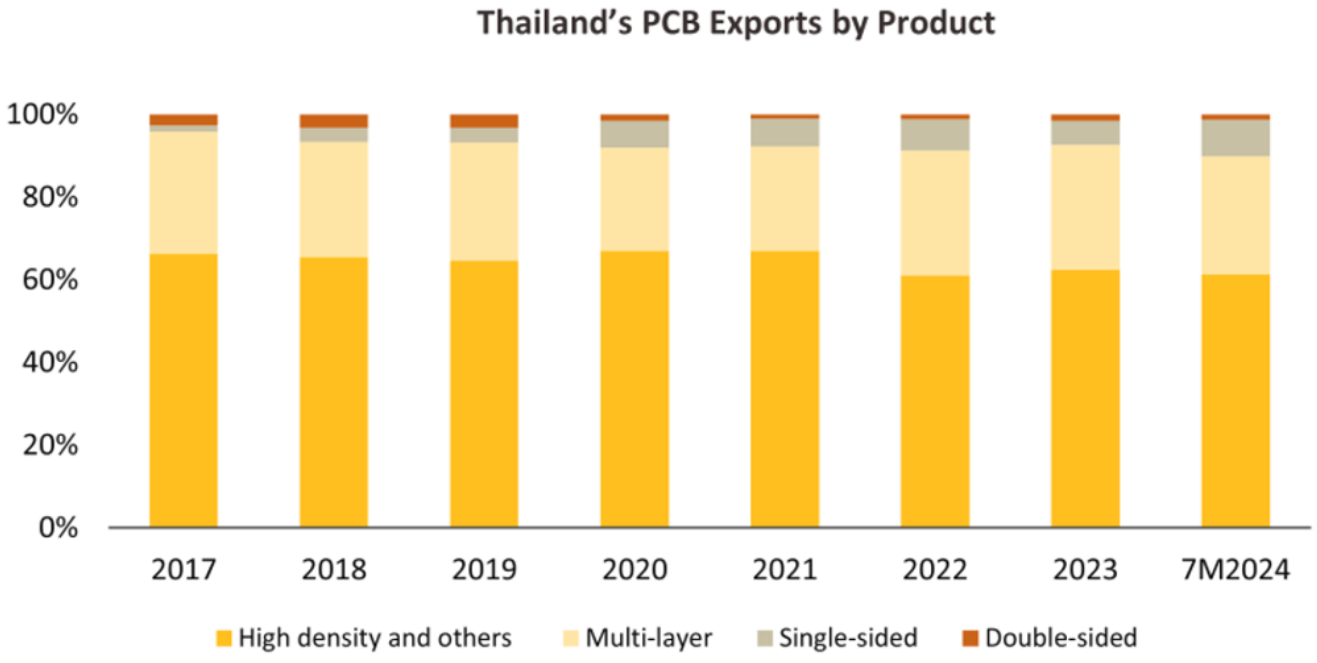
While there is a decent Electronics Manufacturing base in Thailand, of late, Thailand is well known and it has become very active in the Printed Circuit Boards industry. There has a major shift of global players from China, Japan and Taiwan to Thailand in the last 1-2 years. HDI PCBs from Thailand is also exported to meet the Telecom Equipment needs.

Current Size and Growth

- Thailand's PCB industry has experienced rapid growth, driven by factors such as the rise of 5G technology, the increasing demand for Internet of Things-connected devices, the growth of the electric vehicle (EV) industry, advancements in robotics and artificial intelligence (AI), and progress in medical device development.
- The country is now the largest PCB manufacturer in Southeast Asia and the fifth-largest globally.
- In the first nine months of 2024 alone, investment project proposals for the PCB industry soared by 42% year-on-year to 723 billion baht, the highest level since 2015.
- As of September 2024, investors had submitted 95 projects worth 162 billion baht to the Board of Investment (BOI) for investment incentive packages. From 2023 to November 2024, foreign PCB manufacturers submitted 107 investment project proposals worth 173 billion baht. Many announced plans to start operations between late 2024 and 2025.
- The global PCB market is projected to reach $86.17 billion by 2026, with Thailand aiming for a 10% market share, positioning it among the top four global producers. Thailand currently holds a 4% market share (~USD 3.5 billion).



Source: Ministry of Commerce (MOC), Trade Map, E&E Intelligence Unit, Krungsri Research



Source: Trade Map, Krungsri Research

Future Outlook

- The BOI projects continued strong growth in the PCB sector, with a target of 3.3 trillion baht in investment value under its five-year strategy (2023-2027).
- The industry is expected to benefit from the growth of related sectors, such as EVs and data centers.
- The government's "30@30" policy, which aims for EVs to represent at least 30% of total auto production by 2030, will further boost demand for PCBs.
- Thailand is expected to grow its PCB production to represent 4.7% of the world's total production by 2025.

Key Players and Investments

The Thai PCB industry comprises a total of 26 manufacturers. These can be broadly categorized into two groups:

- **Large Corporations (16 companies, representing 61.5% of the total):** These are predominantly international companies, primarily based in Asia (China, Japan, and Taiwan). They are typically original equipment manufacturers (OEMs), producing goods in large quantities according to customer specifications. They possess significant financial resources, easy access to advanced technologies and capital, and generally operate with quick turnaround times. Their focus is often on higher-volume production, particularly catering to the automotive sector (especially for electric vehicles (EVs) and their components).
- **Small and Medium Enterprises (SMEs) (10 companies, representing 38.5% of the total):** These smaller players usually act as subcontractors to the larger corporations. They generally have limited capacity for technology development and lack the financial resources for significant in-house research and development. Consequently, they often face challenges in adapting to rapidly changing market conditions and are less competitive in terms of pricing and technology compared to the larger corporations.

Key Players: While the exact ranking isn't explicitly detailed in the provided text, several key players are mentioned repeatedly and stand out due to significant investments or prominence:

- **Mektec Manufacturing Corporation (Thailand):** A subsidiary of NOK Corporation (Japan's largest PCB manufacturer by sales volume), Mektec is a major player focusing on flexible PCBs (FPCBs) with significant investment for EV industry needs. They're repeatedly cited as an example of successful investment and growth.
- **Compeq (Thailand) Co.:** The world's fifth-largest PCB manufacturer, Compeq has made Thailand a key export base, showcasing the significant investment and capacity they've brought to the country.
- **Well Tek Electronics:** A subsidiary of China's Welgao Electronics, this company represents a significant new investment into the Thai PCB market, highlighting the attractiveness of Thailand as a manufacturing base.
- **Taihua Electronics Technology Company Limited:** Another prominent player showing a commitment to Thailand with a substantial new factory investment.

Other Important Players (mentioned but without detailed investment figures): The provided text also mentions several other global PCB giants with established factories in Thailand including Unimicron, KCE, Gold Circuit, Chin Poon, Dynamic Electronics, Apex Circuit, and WUS. These represent a substantial portion of the industry's capacity and influence.

The market concentration is high, with the largest five players accounting for approximately two-thirds of the industry revenue.

Government Support and Incentives

The Thai government, primarily through the Board of Investment (BOI), offers substantial support to the Printed Circuit Board (PCB) industry. This support is multifaceted and aims to attract both foreign and domestic investment, enhance competitiveness, and ensure the industry's sustainable growth. Here's a breakdown of the specific government support measures

1. Investment Promotion Benefits

- **Tax Incentives:** The BOI provides significant tax exemptions to companies investing in the PCB sector. The level of tax exemption depends on the investment size and the type of activity. For instance, companies investing more than 1.5 billion baht receive an 8-year corporate tax exemption, while those investing less receive a 5-year exemption. These exemptions are crucial in reducing the initial investment burden and increasing profitability.
- **Import Duty Exemptions:** The BOI also offers exemptions on import duties for machinery and raw materials used in the production of export goods. This significantly reduces production costs, making Thailand a more attractive location for PCB manufacturing.
- **Other Privileges:** Beyond tax incentives, the BOI might offer other benefits such as land allocation assistance, expedited permits, and support in workforce development. The specifics of these privileges are case-by-case and determined based on investment scale and national strategic importance.

2. Supply Chain Support

Recognizing that a robust supply chain is vital for the PCB industry's success, the BOI has extended its support to three key supply chain sectors:

- **PCB Production Support Services:** Companies providing services crucial to PCB production (lamination, drilling, plating, routing) are eligible for investment incentives.
- **Raw Material Manufacturers:** Companies producing key raw materials (copper-clad laminate (CCL), flexible CCL (FCCL), Prepreg, dry film, transfer film, and backup boards) receive similar support.
- **Essential Materials and Supplies Producers:** Companies manufacturing essential materials and supplies for the production process also benefit from incentives.

3. Workforce Development:

The government acknowledges the need for a skilled workforce to support the PCB industry's growth. Initiatives in this area include:

- **Collaboration with Universities:** The BOI actively encourages collaboration between universities and PCB companies to develop relevant curricula and training programs. This ensures a steady supply of skilled engineers and technicians for the sector.
- **Skills Development Programs:** Government-led skills development programs focus on improving the technical expertise of the existing workforce to meet the industry's evolving needs, particularly in high-tech areas.

4. Infrastructure Development:

Thailand is making concerted efforts to improve its overall infrastructure, making it an even more appealing location for investment in the PCB industry:

- **Industrial Parks:** The development of advanced industrial parks with state-of-the-art facilities and utilities (power, water, transportation) facilitates investment by providing the necessary infrastructure to support large-scale manufacturing.
- **Transportation and Logistics:** Efficient transportation and logistics networks are critical for the smooth functioning of the supply chain. Thailand's efforts to upgrade its logistics infrastructure directly benefit the PCB industry by lowering transportation and distribution costs.

5. Policy Support and Regulatory Framework:

The government actively promotes the PCB industry through various policy measures:

- **National Semiconductor and Advanced Electronics Policy Committee:** This committee approves frameworks for skilled workforce development and attracts foreign direct investment.
- **National Electronics Circuit Centre (NECC):** This planned center will support research and development activities, and strengthen the supply chain. By facilitating collaboration between researchers, companies, and educational institutions, the NECC is expected to drive innovation and boost the technological advancement of the Thai PCB sector.

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