

1) What are the challenges and opportunities faced by policy makers and regulators in embracing transformative technologies for greater impact?

Transformative technologies offer significant advantages to national authorities, businesses and citizens. One such technology is satellite internet of things (IoT). The benefits of increased IoT adoption are well understood, some of which include:

- Increasing efficiency and production in the manufacturing sector through predictive maintenance, automated quality control and automated supply chain management.
- Environmental monitoring through smart devices which can measure air and water quality. One such example is measuring the quality of drinking water in wells.
- Assisting in smart agriculture through monitoring soil quality, crop stability, livestock and other factors. This increases the efficiency of agricultural practices and lowers the initial investment.
- Logistics and asset tracking for land, sea and air ensuring real time location information of shipments and vehicles.

It is worth noting that IoT, while a transformative technology itself, is also an enabler for other transformative technologies, including AI deployment. Advanced and impactful software models can only be built on real-world, real-time data provided by onsite IoT devices. This is true for all sectors of deployment, be it manufacturing, environment analysis, agriculture or shipping and logistics.

Satellite 5G Narrow-Band IoT provides access to these services and opportunities in areas which cannot be accessed through terrestrial infrastructure, whether due to cost or geographic constraints.

The benefits brought by Satellite 5G Narrow-Band IoT extend to disaster monitoring, whether through climate monitoring or early warning sensors in sensitive areas such as fault lines, floodplains or ocean buoys. Governments can use the data generated for evidence-based policy making ensuring the maximum potential of new policy initiatives.

However, in order to realize the opportunities presented, certain challenges need to be overcome:

- **Access to spectrum:** Satellite IoT is dependent on access to the radio frequency. The reliability of these devices can be of vital importance, particularly where they are depended on for human safety, such as early warning systems. These devices need to be protected from interference and have adequate access to bandwidth.
- **Standardization:** The true benefit of satellite IoT is the data it generates and provides to its adopters. This data is most impactful when it is interoperable with other

systems. This is particularly valuable for government deployments. As such, a level of standardization is required for different systems to integrate with each other.

- **Capacity building:** Satellite IoT, like all emerging technologies requires a high degree of understanding and institutional capacity to effectively regulate. As such, capacity building within government institutions is vital.
- **Regulatory harmonization:** Satellite IoT works best when it is complementary and integrated with terrestrial networks. Regulators should look to providing and strengthening the means through which satellite and terrestrial operators can contract and collaborate. This can include mechanisms like spectrum leasing, transfer and roaming. The global nature of satellite networks also requires international collaboration towards cross border interference.

IoT's role as a transformative technology has been demonstrated globally:

- Kenya has deployed IoT sensors in waste disposal bins to track waste levels allowing disposal trucks to efficiently respond to where they are needed most rather than operating on a standard schedule. This prevents waste bins overflowing or delays in waste disposal.
- Tanzania has seen the use of RFID seal sensors and location trackers on oil trucks to prevent and respond to theft attempts. The sensors provide realtime tracking of the oil trucks location as well as notifying headquarters whenever the seal of the oil truck is breached.
- USA has seen the deployment of IoT devices in rural areas to measure water quality of wells. The devices assess the drinkability of water. The sensors are able to assess the levels of various metals and contaminants and are connected through NTN 5G providing constant seamless coverage despite the rural location.

2) What are the key regulatory measures and guiding principles to follow to foster positive and inclusive impact on transformative technologies?

The best regulatory measures to achieve positive and inclusive impacts from transformative technologies are always those that act as enablers.

- **Public-private partnerships:** ensuring regulation is aligned with the actual limitations and capabilities of technology requires governments to engage with the private sector to leverage expertise and resources.
- **Stakeholder engagement:** Regulation should be informed by engagements with all stakeholders including academia, industry and civil society. This can ensure all challenges are addressed.
- **Sandboxes:** regulatory sandboxes empower evidence-based policy development by assessing the real impact of technology in a simulated environment as close to open market as possible.

- **Capacity building:** Policy makers need to stay informed and up to date on new technologies as well as responses from global regulators and policy makers. This will also aid in ensuring a level of harmonization.
- **Protective frameworks:** Before the benefits of transformative technologies can be realized, it is vital that the protective frameworks are in place. These protective frameworks include data protection and cybersecurity regulation, policy and capacitated institutions able to conduct investigations and assess security standards.

At present there is a shortage of real metrics measuring IoT deployment across the market and IoT solutions remain relatively incomplete owing to a lack of connectivity. Non-terrestrial-network (NTN) connectivity presents the meaningful solution to this lack of coverage and the current top-down network reliability problem. Where regulators wish to see this coverage gap plugged, integrating NTN IoT will allow for the transformative technologies to reach grassroots level.

3) **How to drive positive behaviors of market players? How to minimize risks while maximizing benefits.**

The positive behavior of market players is driven largely by ensuring a free and accessible market with a strong competition policy preventing market dominance by legacy players. Where negative behavior is observed by one or more market players, a swift regulatory response is vital. Other methods to establish a positive market include:

- Collaborate with industry on the development of industry codes and guidelines which implement the standards of regulation such as data protection and cybersecurity.
- Incentivize positive behavior by making licensing, spectrum authorizations or other government authorizations subject to behavior markers. This can include ESG requirements, universal service fund requirements or digital inclusion requirements. This should be carefully balanced with other corporate benefits such as tax breaks or reductions in the cost of doing business. If too many constraints are placed on industry operators it can disincentivize them from investing in the country.
- From a market perspective, governments should look towards supporting the development of regulation and policies which enable and provide the framework for critical verticals to integrate with IoT at an affordable cost. This collaboration enables faster deployment and lays the groundwork for accurate meaningful data collection to inform the deployment of further transformative technologies such as AI.