

The Internet of Things and Global Development

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Harnessing the Internet of Things for Global Development



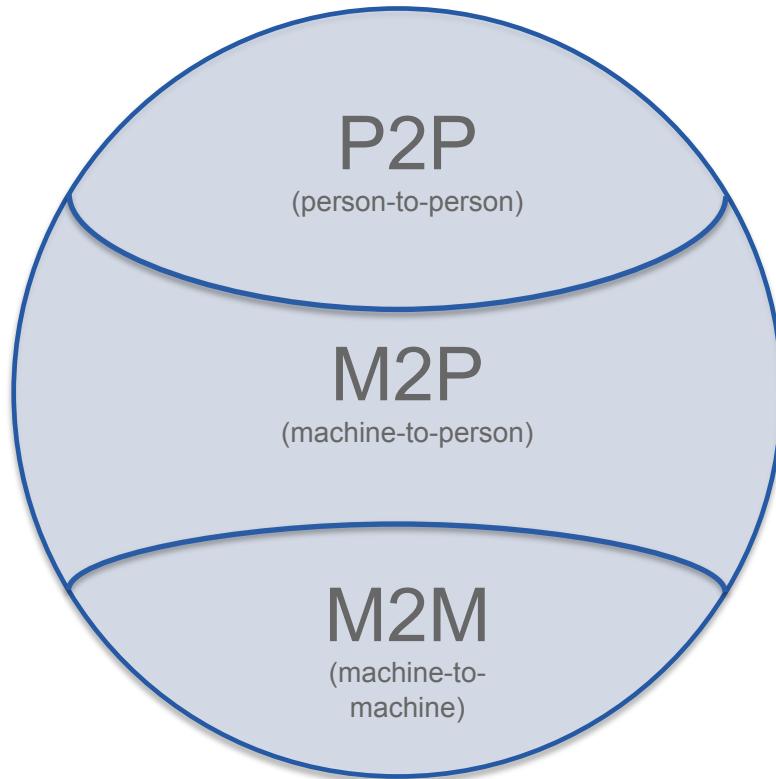
A CONTRIBUTION TO THE UN BROADBAND COMMISSION
FOR SUSTAINABLE DEVELOPMENT



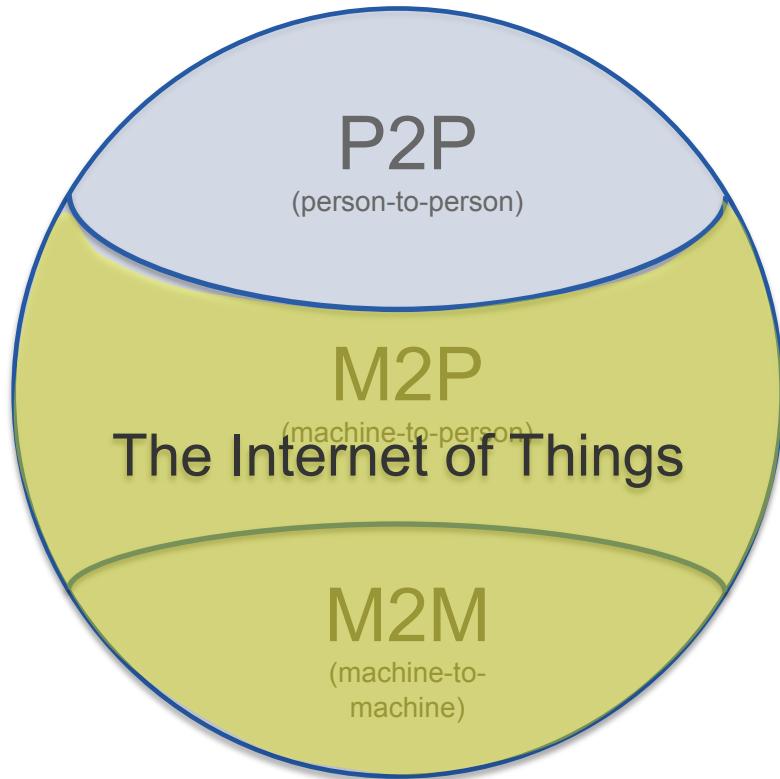
A Contribution to the UN Broadband Commission



Defining the Internet of Things

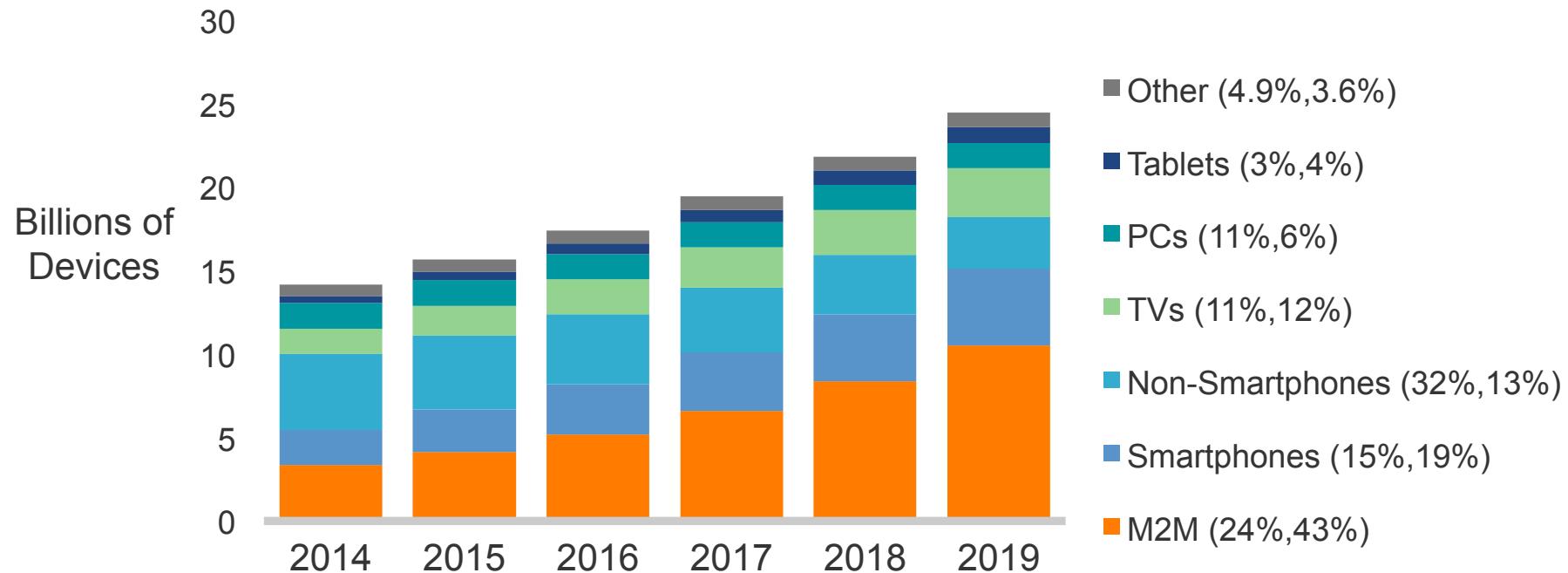


Defining the Internet of Things



Worldwide Connected Device Growth

14.2bn in 2014 to 24.4bn by 2019

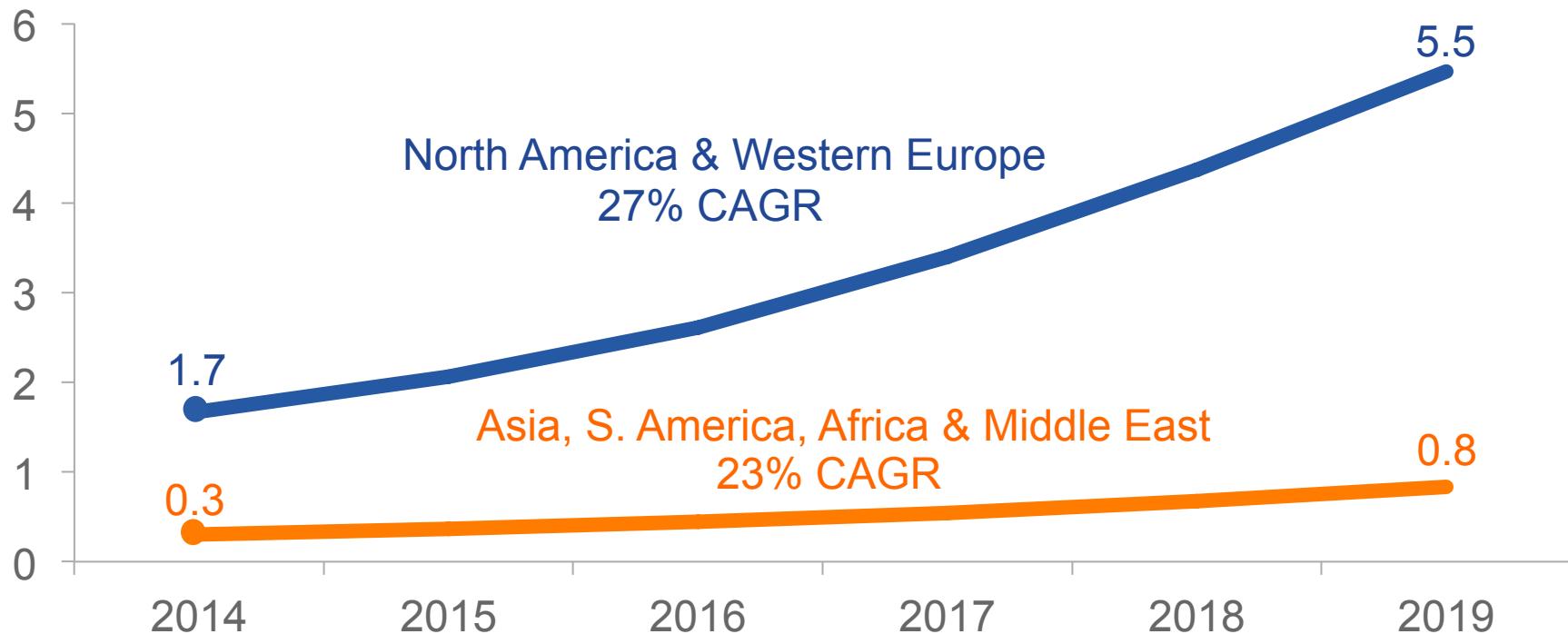


* Figures (n) refer to 2014, 2019 device share

Source: Cisco VNI Global IP Traffic Forecast, 2014–2019

Growing Divide in M2M

M2M per capita

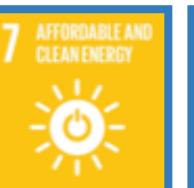




SUSTAINABLE DEVELOPMENT GOALS

AND THE

IOT



SUSTAINABLE
DEVELOPMENT
GOALS

IoT for Improving Water Access

The Problem



- Roughly one million hand-pumps supply water to over 200 million rural water users across Africa
- But up to one third of all hand-pumps are not working at any given time
- 30-70% broken within two years

IoT Intervention

Connected Water Flow Sensors



- Simple water sensors monitor water flow and usage
- SMS messages sent to municipal authorities, water service providers (and donor community if donor funded) when usage drops in order to accelerate repair times and reduce down time

IoT for Improving the Vaccine 'Cold-Chain'

The Problem



- One-fifth of children in developing countries go unvaccinated every year for preventable diseases
- Major cause is vaccine spoilage – most require storage between 2 and 8 degrees Celsius
- Over 200,000 cold storage units in place in developing countries – mostly monitored with pencil and paper

IoT Intervention

Connected Thermometers (Cellular)



- Cellular-enabled temperature sensor
- Remotely monitors vaccine and drug storage temperatures
- Measures temperature & location

IoT for Preventing Fires in Informal Settlements

The Problem



- Fires can move quickly in informal settlements and slum areas as homes are close together;
- Greater threats from faulty wiring and indoor open fires;
- Density of these settlements makes combating fires difficult

IoT Intervention



- Development of low-cost, fire sensors networked together to quickly detect and relay when fires have broken out;
- Network not only sounds alarms and communicate to others threatened (via SMS and other modalities), the networked sensors could identify via GPS where the fire has started and notify authorities on where to target fire mitigation efforts.

IoT for Off-Grid PAYG Electricity



The Problem



- Electrification rates in Sub-Saharan Africa average 58% in urban areas and only 12% in rural areas.

IoT Intervention



- M-Kopa, a pay-as-you-go Energy Service Company (ESCO) for off-grid customers in Kenya, leverages machine-to-machine (M2M) technology to fulfill its mission of providing high-quality energy at an affordable rate to everyone.

IoT for Enhancing Air Quality

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TECHNOLOGY

The Problem



- The World Health Organization attributes one in eight deaths worldwide to polluted air
- Lung damage, heart disease, strokes, and cancer may all result from dirty air
- 600,000 people died in 2012 alone due to indoor air pollution in homes

IoT Intervention



- Air quality sensors to track pollutant levels: outdoor & indoor
- e.g. The Fresh Air in Benin project aims to develop a network of sensors that will capture and send data every 20 minutes via GSM connectivity
- Indoor black carbon & CO2 sensors tracking cookstove pollution



IoT for Feeding Communities

The Problem



- How will we feed 9 billion people by 2050?
- Greater weather condition variability
- Water shortages

IoT Intervention



- Soil moisture and nutrient sensors (e.g. tea plantations in Sri Lanka)
- Localized weather stations (east Africa)
- Nano Ganesh (India)
- RFID tags for livestock (Botswana, Senegal, Namibia)

IoT for Preventing Poaching

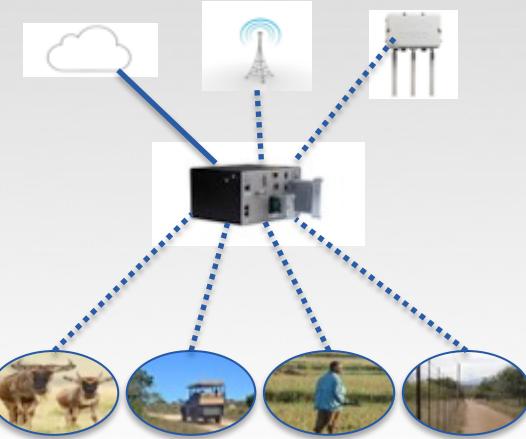


The Problem



- Big game poaching reaching tipping point in Africa
- 100,000 elephants killed in last 3 years for their tusks (estimated 25% of the species)
- Rhino poaching up 9300% from 2007 to 2014

IoT Intervention



- Securing wildlife park perimeters with sensors to detect presence of animals, vehicles, poachers (sensors: seismic, acoustic, thermal cameras...)
- Tagging animals for tracking
- Other natural resource management (illegal logging)

IoT for Responding to Epidemics

The Problem



- More than 3 million people die from vaccine-preventable diseases each year
- Approximately 1.5 million of these deaths are in children less than 5 years old.
- West Africa experienced the largest outbreak of Ebola in history in 2014, with a death toll of over 11,000

IoT Intervention



- USAID's STAMP2 / "Smart Band-Aid" remote monitoring of baseline vital rating — heart rate, temp and oxygen saturation — and then measures all changes from the baseline

IoT for Health and Sanitation

The Problem



Indonesia — Shrine Bakhat-Pont/Mercy Corps; Fitria Rinawati/Mercy Corps



Indonesia — Key Matisse/Mercy Corps

- Low rates of post-latrine use hand-washing hygiene impacting malnutrition via infectious disease
- Limitations of behavior change interventions
- Assessing limitations of survey response data

IoT Intervention



Evan Thomas/Portland State University



- Instrumentation of latrine use and hand washing stations



IoT for Mitigating Disaster Risk

The Problem



- Natural disasters, like the 2004 Indian Ocean tsunami, devastate communities all over the world.
- EM-DAT recorded 6,873 natural disasters worldwide between 1994 and 2013
- 1.35 million lives were claimed – about 68,000 lives on average each year.

IoT Intervention



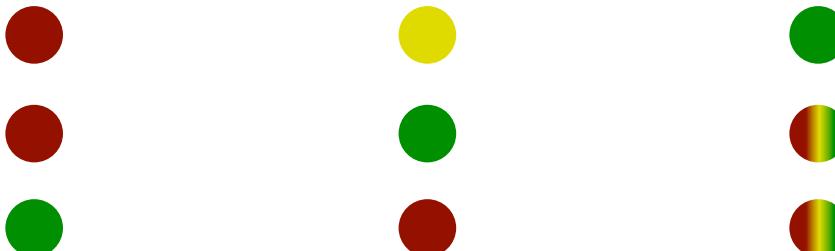
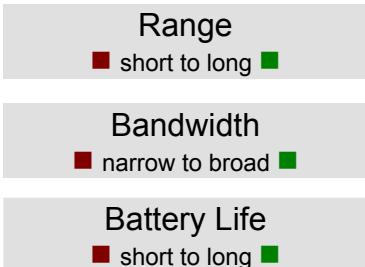
- Early warning systems use kinetic sensors (measuring waves and water flow) are placed on the ocean floor and communicate data on potential tsunamis to disk buoys floating on the ocean surface via acoustic telemetry

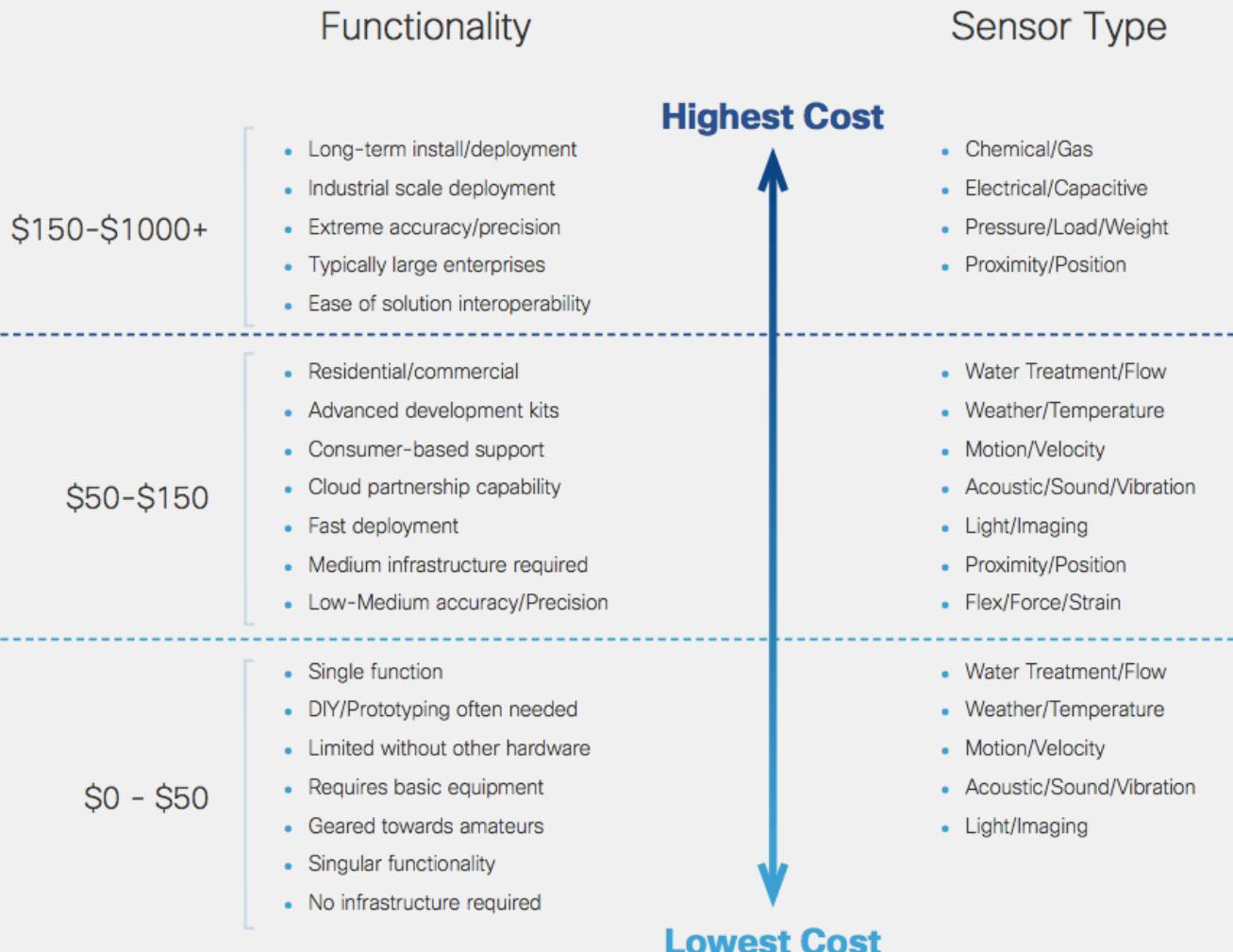
SDG & IoT Table

Sector	SDG	Examples
Health, Water & Sanitation	SDG 3; SDG 6	Sensor- and SMS-enabled village water pumps (Rwanda, Kenya); GSM-connected refrigeration for vaccine delivery in the 'cold chain' (Global); sensor- enabled 'band aid' to monitor Ebola patients' ECG, heart rate, oxygen saturation, body temperature, respiratory rate and position, all remotely (West Africa); water stream gauge with sonar range sensor to monitor river flow and depth (Honduras); water flow sensors and motion detectors in latrines to monitor efficacy of hygiene training and intervention (Indonesia).
Agriculture & Livelihoods	SDG 1; SDG 8; SDG 2	Connected micro-weather stations improving localized weather data and provision of crop failure insurance (Kenya); low-cost mobile-controlled micro irrigation pumps (India); soil-monitoring sensors used to improve tea plantation production (Sri Lanka, Rwanda); RFID-based food supply testing and tracking system (India) and RFID based livestock programmes for tracking, theft prevention and vaccination records (Botswana, Senegal and Namibia).
Environment & Conservation	SDG 12; SDG 13; SDG 14; SDG 15	Radio-based cloud-connected devices to identify and track the presence of illegal fishermen (Timor-Leste); air pollution sensors to monitor urban outdoor air pollution (Benin); acoustic sensors to monitor sea bird populations (global); sensors and connectivity to protect game park perimeters and track animals (Africa); connected unmanned aerial vehicles monitor national parks and connecting images from camera traps (UAE); acoustic sensors in tropical rainforests 'listening' for illegal logging (Indonesia).
Resiliency, Infrastructure and Energy	SDG 7; SDG 9; SDG 11	Networked fire/smoke alarms in high-density urban slums/ informal settlements (Kenya, South Africa); Connected buoys as part of the tsunami monitoring system (Indian Ocean); off-grid micro solar electricity systems for electricity for lower-income households (east Africa, India); connected black carbon- and use sensors to monitor cook stoves (Sudan); sensor-connected matatus (mini-buses) tracking velocity, acceleration, and braking to curb dangerous operation of public transportation (Kenya).
Governance & Human Rights	SDG 10; SDG 16	Retinal scans used for ATMs providing secure biometric cash assistance to displaced refugees (Jordan).

Trade-offs in Connectivity Technologies

Wireless		
Personal Area Networks (WPAN)	Local Area Networks (WLAN)	Wide Area Networks (WWAN)
ANT+ Bluetooth 4.0 LE RFID NFC 802.11.4 ZigBee	Wi-Fi	LoRa Weightless Dash 7 WiMax 2G 3G 4G/ LTE

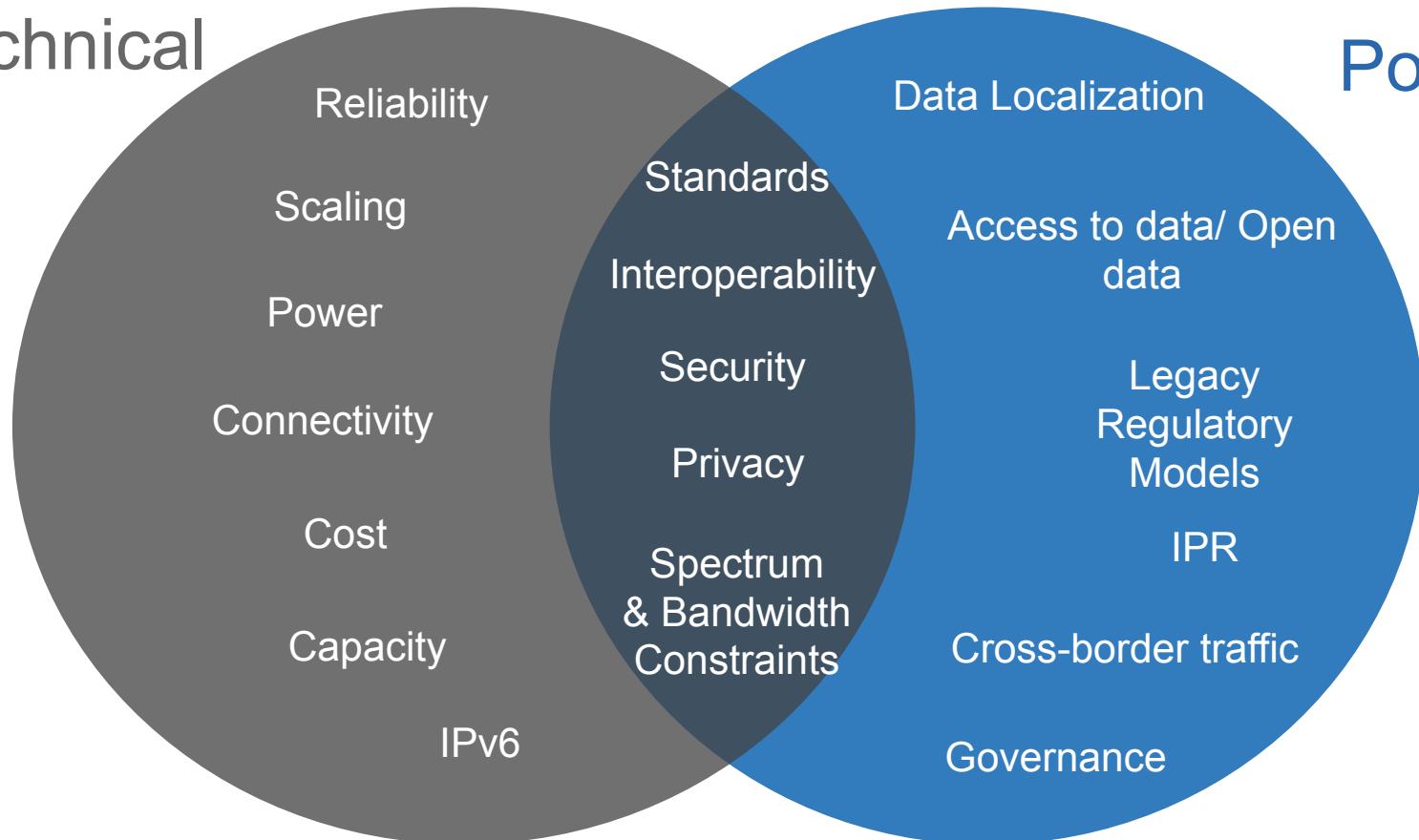




Challenges

Technical

Policy



Recommendations (Policy)

- 1 National policy frameworks for IoT
- 2 Spectrum Planning
- 3 Facilitate Innovation
- 4 Role of Standards
- 5 Foster Trust and Confidence

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