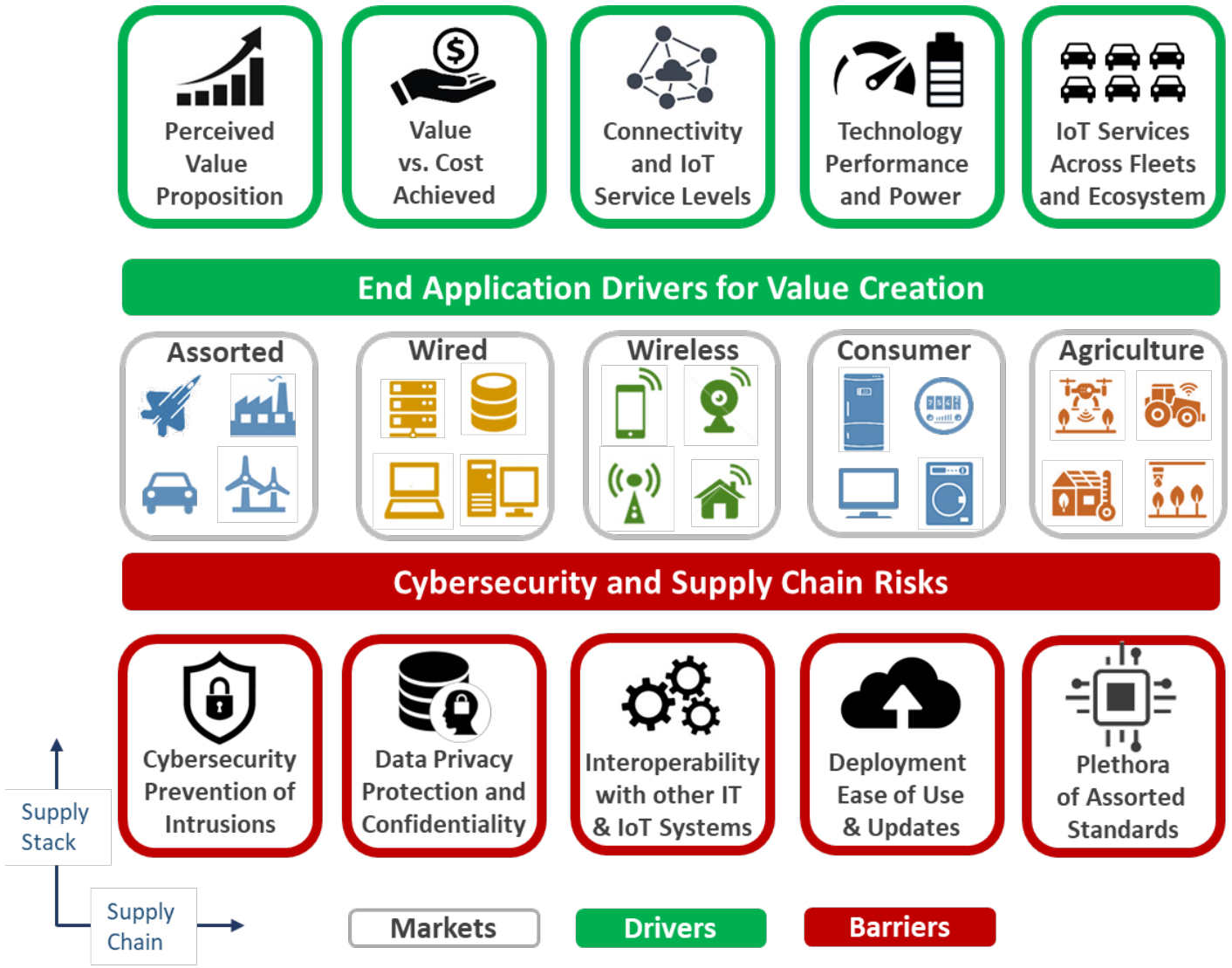
Sub Working Group Outline on
Augmented Logistics and Smart Supply Chains

Several Factors Influence IoT Adoption & Growth At-scale



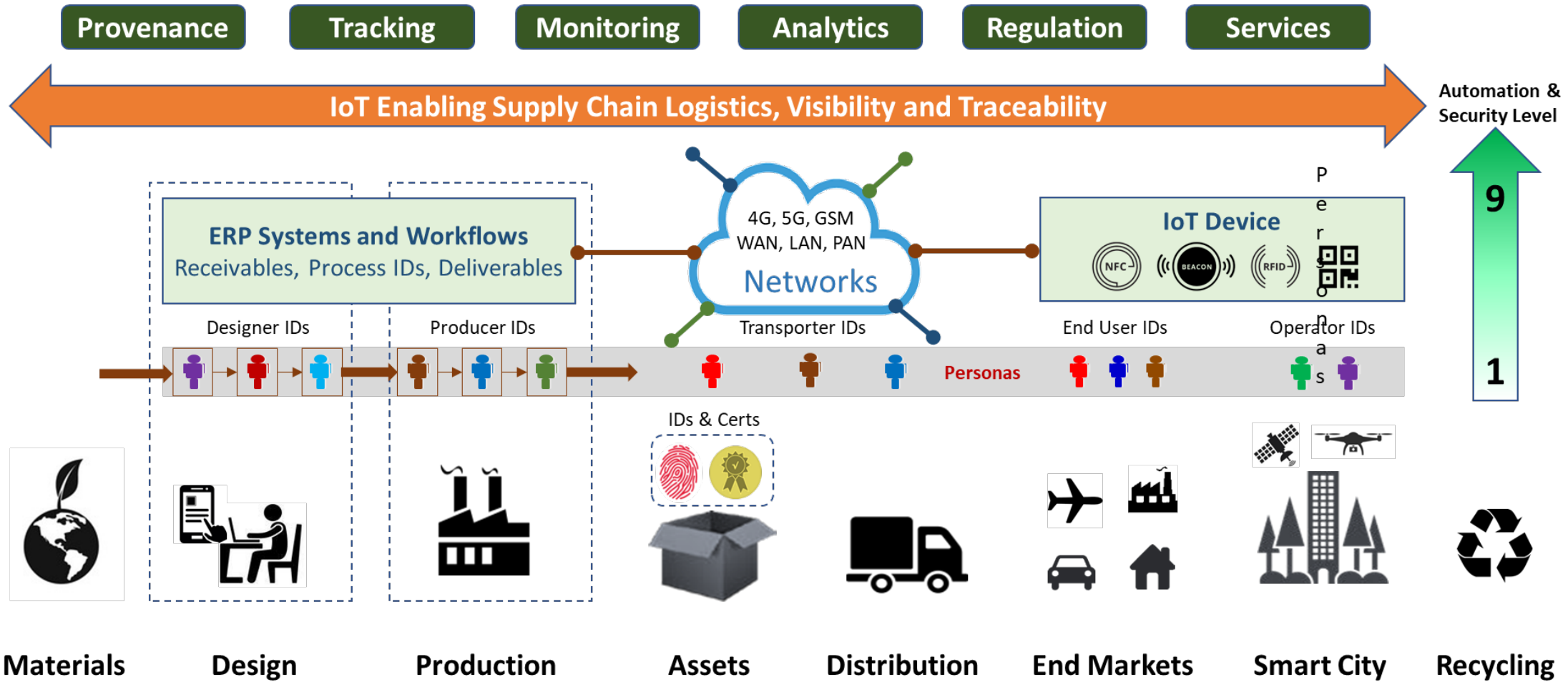
- Diverse markets and maturity levels of enterprises managing supply chains
- Disaggregation of supply chains with many products produced in Asia
- Several stakeholders in supply chains with varied experience and education
- Lack of interoperability and security of systems used to trace products
- No visibility in the supply chain to prevent intrusions and tampering

Scope – Global Supply Chain Logistics & Traceability

- **Leveraging IoT for supply chain logistics**
  - Track goods from design, production, distribution, delivery and end use.
  - Allow logistics process to consider various levels of automation in the enterprise
  - Digitalize processed and workflows to establish provenance with a trusted source
  - Maximize efficiency and supply chain resilience for a variety of sectors and asset types

- **Leveraging IoT for supply chain traceability**
  - Establish provenance and traceability of digital & physical goods and data linked to identifiers
  - Deliver trusted & secure assets linked to labels (digital passports) for the benefit all stakeholders
  - Consider varied levels of trust among enterprises in the value chain and across global markets
  - Create digital threads to regulate market preference/access/usage compliant to policies

Scope – Supply Chain Logistics & Traceability



Augmented Supply Chain Logistics

- **Definition of IoT Devices and Systems**
  - RFID antennas and readers; RFID gateways
  - GPS related components
  - Others to be identified
- **History of IoT in Supply Chain Logistics**
  - Current State
    - Most common devices; Implementation and Adoption
    - Common use cases; Logistics and Distribution/Manufacturing
    - Standard Processes (Plan, Order, Source, Transform, Fulfill, Return)
    - Connectivity specific to supply chain use cases (WiFi, BLE, 5G, LoRaWAN, etc.)
    - Global implications due to nature of supply chains
  - Representative Use Cases (others to be identified)
    - Track & trace
    - Inventory Management
    - Distribution (example – medical cold chain/vaccine distribution)

Future State of IoT in Supply Chain Logistics

- **Significant and transformative potential use cases (examples)**
  - Artificial Intelligence of Things (AIoT) – impact on supply chain
  - Increase in Machine to Machine (M2M) communication
  - Predictive Maintenance impact on asset management and parts supply
  - Perpetual Inventory Management – all inventory across enterprise tracked all the time
  - Advanced data analytics based on ubiquitous IoT data
  - Interoperability
- **Anticipated benefits based on advances in IoT**
- **Barriers to future adoption and advances**
  - Equipment specific barriers
  - Persona specific barriers (change management at enterprise level)
  - Applicable broad overall barriers (to be identified elsewhere in report and can be tied to supply chain here)

Recommendations for Supply Chain Logistics

- **Investment or other action by federal government**
  - Infrastructure
  - Standards definition and compliance enforcement (if needed)
  - Incentives to speed adoption
  - Education and act as convener of stakeholders
- **Investment by industry vertical**
  - Device or system implementation where applicable
  - Incentives to speed adoption
  - Monetization – discuss and research methodology; could be derived from data availability, data sharing, ability to differentiate product or service
  - ROI based
- **Other recommendations related to implementation or deployment and not related to investment**

Global Supply Chain Trusted Traceability

- **Definition of IoT Devices and IoT Systems**
  - Any used in Industrial, Automotive, A&D, Medical, Agriculture, Consumer, etc.
  - Computing and Comms equipment used for supply chain logistics and traceability

- **History of IoT Traceability and Supply Chain Challenges**
  - Limited on no supply chain provenance and traceability of device assets and data
  - Supply chain disaggregation drives vast attack surface threats and vulnerabilities
  - Security vulnerabilities in Design, manufacturing, packaging, delivery, field use
  - IoT Device security pervasive in only a few verticals (DRM, Smartcards, etc.)
  - Untrusted devices produce untrusted data (risks, plus untrusted AI applications)
  - No linkage among workflows and asset IDs creating end-to-end digital thread
  - Digitalization of Design/Production workflows lagging compared to HR, Finance, Sales
  - Lack of awareness on security of IoT Devices, Electronics and IoT supply chain
  - Limited investments to incentivize policies and market behavior toward traceability

Use Cases and Threats for Supply Chain Traceability

- **Typical Vulnerabilities applicable to any products or assets**
  - Tampering, cloning, or counterfeiting ($3 trillion in 2022)
- **Threats and vulnerabilities applicable to IoT Systems, HW & SW)**
  - ***Security:*** Mirai Botnet, BLU Third Party Collection of Data, Colonial Pipeline (HBOM → SBOM)
  - ***Traceability:*** Western Chips in Drones, Kojima-Toyota Incident, Supermicro (disputed)
- **Global implications related to supply chain for IoT Electronics**
  - Devices assembled in Asia, no customs control, vast attack surface → nation state attacks
- **Use case examples and benefits of traceability**
  - Food and Drug Safety
  - Counterfeit Prevention
  - Sustainability (sourcing, monitoring)
  - Product Recalls and RMAs
  - Logistics Optimization
  - Trusted Materials origin

Future State of IoT Enabled Supply Chain Traceability

- **Barriers to adoption and advances needed**
  - Interoperability across a complex, diverse supply chain network
  - Data assurance (via a continuous, verifiable, traceable digital thread)
  - Security of processes, technology, and stakeholders across the supply chain
  - Market preference for assured supply from domestic and allied suppliers
  - Certificate Authority linked to physical products and traceability data
  - Enterprise change management and Persona-specific barriers
- **Significant and transformative potential examples**
  - Enterprise-level digitalization of People, Processes, Assets (incl. Technology)
  - Cryptographic linking of receivables, process, deliverables in all value chains
  - Process and asset IDs plus Trust Scores related to provenance and chain of custody
  - Platform identities, certificates, attestation for tracking, tracing, and servicing
  - Linking physical & digital assets (HBOM, SBOM, DBOM) with product lifecycles
    - Digital paper trail relation to US Cybersecurity labeling and EU Digital Passports
    - Digital thread for traceability of all materials and data that can create value

Future State of IoT Enables Supply Chains Traceability

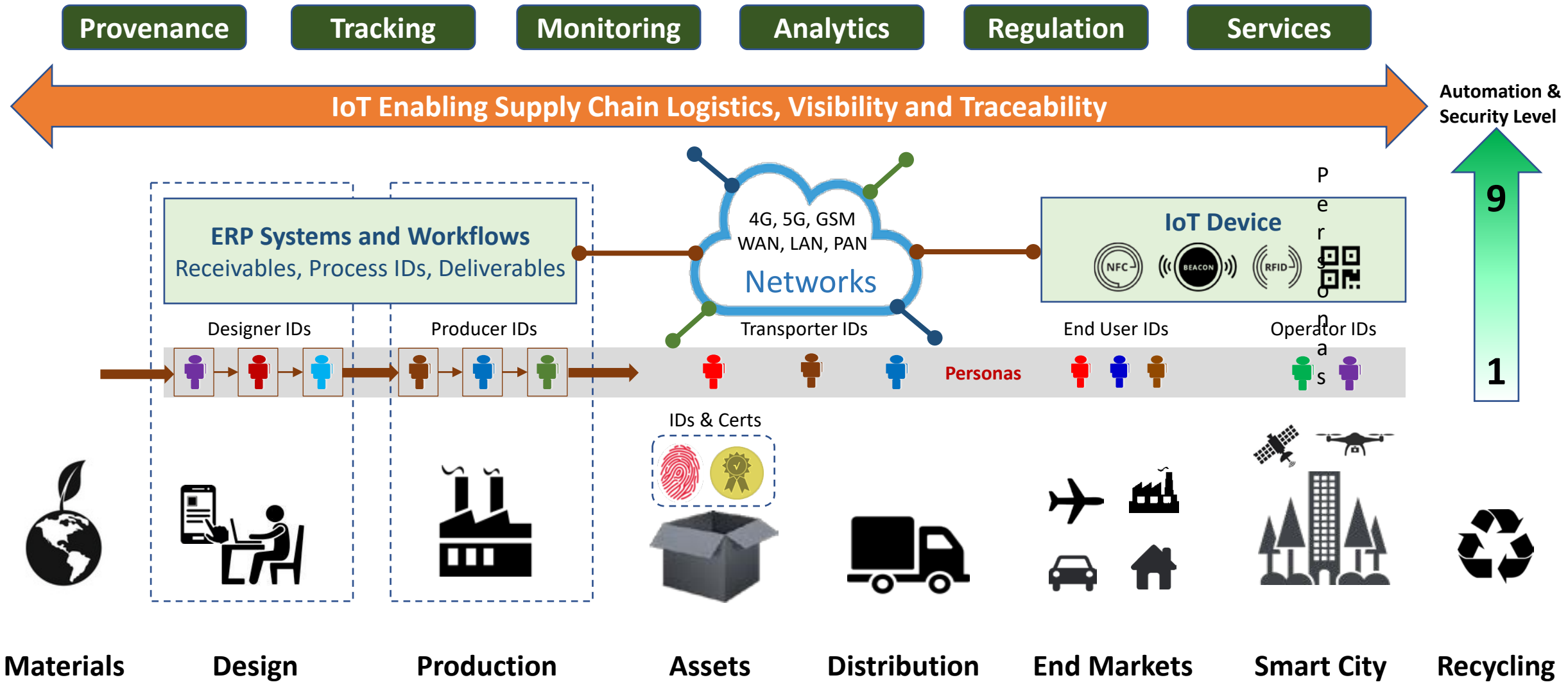
- **Anticipated benefits based on advances enabled by IoT solutions**
  - Product-as-a-Service, subscription-based business models, new revenue streams
  - Product optimization, predictive maintenance, digital twins, data-driven services
  - Data market places, data availability, data licensing, audit, and rights
  - Data access by enterprises in the value chain including by Personas with PII
  - Digitalized market access (deliverables tied to monetization practices)
  - Business models for IoT Services and data-enabled ML/AI applications
- **Investments needed for traceability of the electronics IoT vertical**
  - Traceability Infrastructure for electronics and semiconductors used in IoT (incl. recycling)
  - Global standards harmonization, compliance enforcement (prescriptive vs. restrictive)
  - Incentives to speed adoption (e.g. cybersecurity labels, digital passports, digitalization subsidies, market preferences, restrictions, controlled market access/usage of products)
  - International collaboration with trusted allies on traceability with customs controls
  - Orchestration and massive PPP collaboration to digitalize supply chains “piecemeal”

Future State of Device IoT Supply Chains

- **Investments needed for supply chain traceability by other verticals**
  - Vary by IoT market based on education, adoption rate, and specific use cases
  - Vary by IoT device or system, market-specific applications and use cases
  - Monetization – research methodology and viable; could be derived from data availability, data sharing, ability to differentiate product or service
  - Business Ecosystems – monetization and revenue sharing of partner-based platforms
  - Benefits and ROI among participating stakeholders (platform open to all, not a few)
- **References**
  - NIST Enterprise-level Cybersecurity Framework (CSF)
  - NIST Rick Management Framework (RMF)
  - NIST Cybersecurity White Paper on Consumer IoT Products
  - NIST SP 800-161 on Supply Chain Risk Management (SCRM)
  - NIST IR 8419 Blockchain for Manufacturing Traceability
  - NDAA 2023 section 5949 on supply traceability and prohibitions

More Supporting Material

- **References and Standards**
  - SEMI, ISO, IPC, G32 FIDO, GS1, etc. (possible speakers too)
  - MIT Sloan and HBR on platform-based business ecosystems
- **Proposed speakers (to be confirmed)**
  - Establishment of Vaccine management transport and storage and refrigeration - Mike Hineline https://www.linkedin.com/in/mike-hineline-069ba143/
  - Speakers: Aruna Anand, Continental – Addressed Automotive challenges with best practices https://www.linkedin.com/in/aruna-anand-3566ba28/
  - Don Davidson, (Synopsys), Cyber-SCRM, DBOM, HBOM, SBOM
  - Angela Fernandez, (GS1) global standards and Global Location Number
  - Michael Ford (Self) Methods for Distributed Trust and Traceability
  - Harvey Reed (MITRE) MVP on Data Trust
  - TBD on Enterprise Data Access Control (secure workflows)
  - TBD Suppliers of PLM on enterprise digitalization (digital thread)
  - TBD Luminary on supply chain open source HW (e.g. Rick Switzer)


Provenance
Tracking
Monitoring
Analytics
Regulation
Services
IoT Enabling Supply Chain Logistics, Visibility and Traceability
Automation & Security Level
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ERP Systems and Workflows
Receivables, Process IDs, Deliverables
4G, 5G, GSM
WAN, LAN, PAN
Networks
IoT Device
NFC
BEACON
RFID
Personas
Designer IDs
Producer IDs
Transporter IDs
End User IDs
Operator IDs
Personas
IDs & Certs
Materials
Design
Production
Assets
Distribution
End Markets
Smart City
Recycling