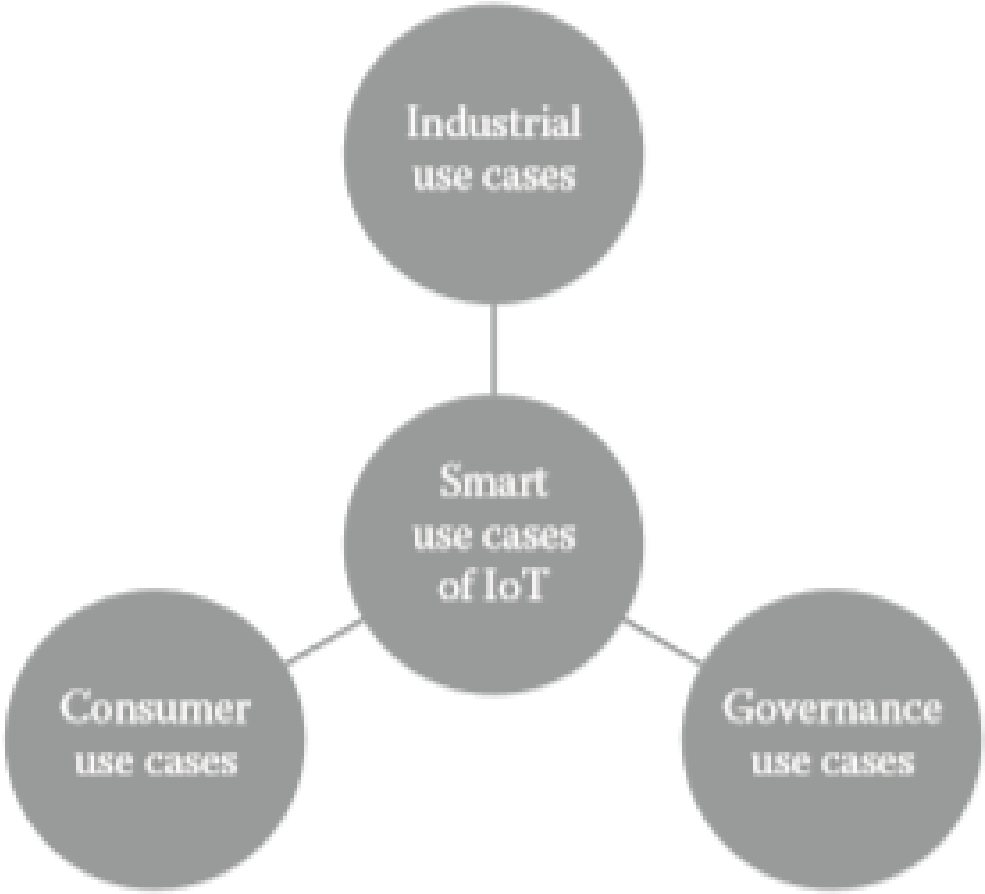
Smart use cases of IoT

Three broad categories:

- Industrial use cases
- Consumer use cases
- Governance use case



Under industrial use cases, we have mainly focused on two broad use cases:

- Smart energy
- Smart transportation systems

Under consumer use cases, we have mainly focused on the following:

- Smart homes
- Smart buildings
- Smart education systems

Under governance use cases, we have mainly considered smart cities.

Governance use cases

- The most prominent use case that comes in this category is smart cities.
- The ultimate objective of smart cities is to improve the quality of life of its citizens.

The key features of smart cities, which are realized using IoT technology, are the following:

- Orchestration: It is vital **to collect data** pertaining to **various domains** of the city which will help us to understand the pain points faced by the citizens.
- This data is mainly collected with the help of **sensors and other types of data gathering equipment**, which form the foundation of the IoT ecosystem.

- Interconnection: One of the main problems that exist in cities is **the lack of co-ordination between the various city domains**, which in turn contributes to their working in individual siloes.
- It is very important to ensure proper **co-ordination and data sharing among the various city domains**. For this to happen, it is mandatory to devise techniques that enable one city domain to send, receive, and view data of other city domains.
- This can be done by **collating the IoT data and providing a dashboard view of the entire city**, which can be accessed by the various city agencies/domains for appropriate decision-making.

- Intuitiveness: It is the ability to **use the data collected from sensors** and other IoT devices in order to **make intelligent decisions** for the welfare of the citizens. For example, data collected **from weather sensors may** be used to **predict the onset of a cyclone** in a specific region. **Intuitiveness lies in how quickly** and **efficiently this information is used** in order to ensure safety and security of citizens by devising appropriate strategies.

The strategic governance framework

- The four layers mentioned in Figure provide a logical framework, which can be used by the various city leaders to evaluate the various implementation options that are available in hand.
- For example, the first layer is about city objectives; if the prime objective of city leaders is to conserve water based on some metrics, which denoted poor water conservation (layer 2), then they have to examine the possibility of building an interconnected water network in the city, which has all the features to track real-time water consumption patterns of the citizens (layer 3). After making decisions about the design and the features, which are required in the water conservation system, the city leaders will have to examine similar water conservation measures and systems, which are implemented in other cities and derive the best practices so that they can be incorporated in the system under consideration.

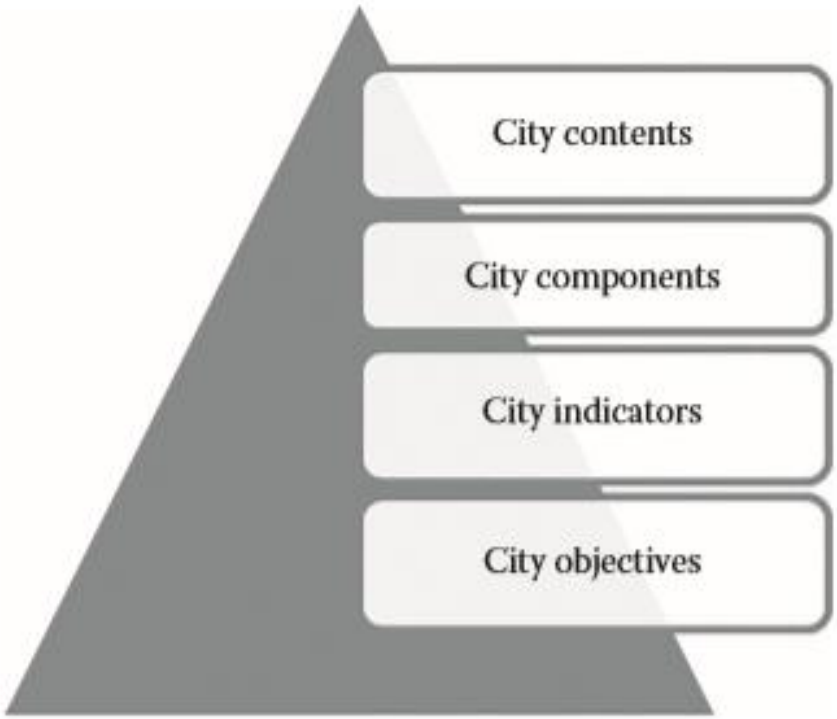


Figure 11.3 Strategic governance framework for smart city.

City objective

- In order to arrive at the city objectives, the various domains that exist in the city like finance, energy and utilities, education, public safety, health care, and so on should be **examined in detail to identify the sectors** that need improvement.
- It is a vital aspect to include the **citizen's views** in the decision-making process in order to ensure that the entire cycle of evaluation and decision-making process is seamless.
- After analyzing the various domains, it is **important to prioritize** the sectors which need improvement and the amount of improvement which is required.
- This is a vital component which will finalize the city objectives and link them to the various projects, policies, and investments, which are planned for the city. While planning the city objectives, it is also very important for the city leaders **to analyze the existing technological infrastructure and the present maturity level of a city** that is whether it is a digital city, U-city, or so on.

City Indicators

- Most of the times, city objectives are qualitative or empirical in nature.
- Hence, it is **necessary to quantify** them in order to arrive at various metrics.
- For this purpose, it is essential to link them to various existing and published city indicator indices.
- **These indices benchmark the cities using well-defined and proved methodologies.**
- Some of the standard city indicators which are available are **Global City Indicators Facility (GCIF), Green City Index**, and so on.
- Each of these indicators uses a different set of parameters for the evaluation of cities. Different cities may require different indicators based on their priorities and objectives. For example, if a city's objective is to improve the financial sector, then Green City Index might be appropriate.

City Components

- At some point or the other, city objectives are linked to **physical components, assets, resources, or locations**. For example, if the city objective is to improve water conservation, then the following assets or resources are involved in that; some of them are as follows:
  - Water network components like pipes, valves, and so on (asset)
  - Water operators (resources)
  - IT infrastructure (asset)
  - Logistics for water operators (resources)

- For the success of the laid out city objectives, it is essential to perform a detailed evaluation of the various components, which are a part of the system under consideration, and design a system to **optimize the utilization of each system component**

City Content

- Once all the other aspects of the city system under consideration are evaluated carefully, it becomes necessary to **look at** the multifarious **implementations**, which have been done in other cities across the world.
- It is necessary to do a careful examination of the various implementations in order **to derive the pros and cons of the various implementations**.
- It is very important to generate a framework comprising best practices from the various city implementations, which in turn could form the foundational component for the implementation of city objectives for the city under consideration

Industry use cases of IoT

Intelligent energy conservation using smart grids

An architecture for intelligent energy conservation

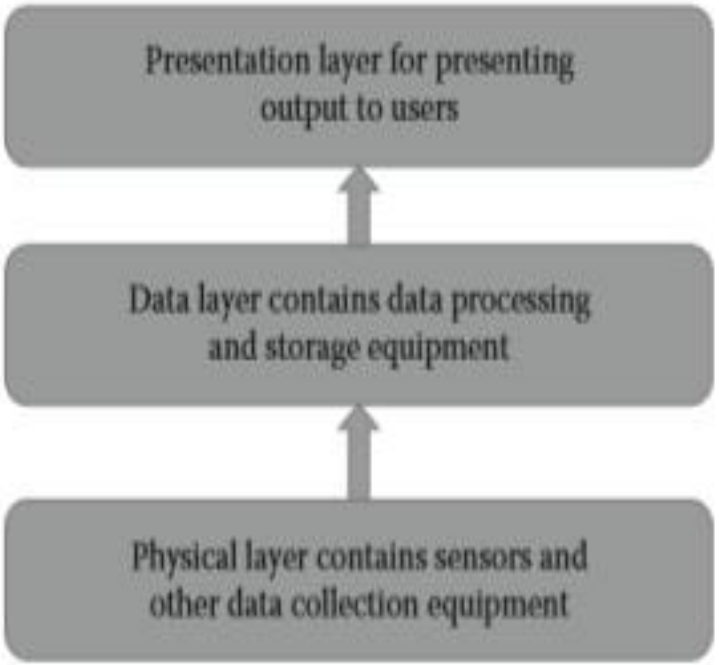


Figure 11.4 Architecture for intelligent energy conservation.

- The lowest layer pertains to **the actual physical devices and contains sensors and other smart meters** which are used to obtain data about energy conservation and usage. The data from this layer are collected and sent to the next layer that processes it.
- **Smart meters:** They have the **capability to track the power consumption** and **send the readings to the energy supplier** periodically. The **duration** at which the readings are sent back to the energy supplier **is configurable**.
- These smart meters help **the consumers to keep track of their power consumption** and will help the **energy companies** to create **custom usage plans** according to the consumption patterns. This will also provide a lot of **customer satisfaction** as the customers can **track their usage** on a regular basis. This in turn will help in the **reduction of calls to the customer care centers**.

- Following are the main types of processing which are likely to happen on the data:
  - **Store the data** in various meter data management systems.
  - **Route the data** to various asset tracking and management systems if applicable. This in turn will be used **to perform further analysis** like the **power consumption of various assets in a building, predict maintenance schedules** for various assets, and so on.
  - **Analyze the usage patterns** and the various usage scenarios.
  - Use intelligence embedded in the platform in order **to find out energy optimization techniques by finding out peak and nonpeak hours and the difference in the usage levels.**
  - **Send message alerts** to the consumers about their energy consumption levels and customized **energy tariffs or plans, which may be beneficial for them.**
  - **Route the excess power if available to various devices or other infrastructural components, which may need them.**

- The last layer is the presentation layer through which **the processed data can be viewed** by the consumers.
- Some of the commonly used options are mobile devices, tablets, **citizen portals where the citizens** can **log in to view their usage**, **dashboards** for the **energy suppliers to get a consolidated view of usage of their customer base**, and **reporting tools** for generating various types of reports. The various options available in this layer could vary from one service provider to another.

Figure 11.7 Use cases of smart homes.

Consumer use cases: Smart Home

- A growing variety of **smart sensors**, **software solutions, connected devices, cloud services**, and so on is set to enable us in multiple forms and formats in our living and working environments.
- That is, apartment flats, office buildings, manufacturing floors, and other action-centric, lively and lovely places are to **be extremely technology-empowered** and splurged.
- **Ordinary and everyday objects are being digitalized**, connected with one another locally and cloud-enabled.

Home networking and automation solutions includes:

- **Security and surveillance elements:** Security sensors for **windows, doors, motion, glass break, and smoke** can provide critical security information about our homes while at home or in office. **IP-enabled security and surveillance cameras** are very important for ensuring tight, unbreakable, and impenetrable security. Intrusion detection and prevention systems are other prominent security modules.

- **Heating, air condition, ventilation, lighting, and shade control systems:** Comfort is emerging as the decisive factor in next-generation homes. Novel machines are being instrumented to take care of different environmental conditions. Connectivity among various home-bound devices including light switches, wall-mounted touch panels, and so on is being ensured. Robots come in different varieties for doing physical works for people. Cloud-enabled robots will be a critical and crucial cog for humans in the days to unfold.

- **Computing and communications devices:** A wider variety of compute machines ranging from personal computers (PCs), **notebooks/laptops/tablets, Wi-Fi routers and gateways, wearables, and smartphones** are being extensively used in home environments these days. With the seamless convergence, computer and communicator are often interchanged.
- **Entertainment, edutainment, and infotainment media systems:** There are several notable innovations in media technologies and products. Today we boast about fixed, portable, mobile, and handheld devices for ubiquitous learning. IP-enabled television sets are being produced in mass quantities sharply increasing our choice, convenience, and comfort considerably. Web, information, and consumer appliances are plentiful and pioneering. Home theaters, hi-fi music systems, DVD devices, game consoles, and so on are for entertainment.

- **Home networking:**

  All passive, **numb, and dumb items** are getting transformed into digitalized objects.

  These are being **wirelessly and wisely networked** with all sorts of household electronics in order to connect and communicate to derive competent people-centric, networked, and embedded e-services.

  Home networking infrastructures, connectivity solutions, bridging elements, and other brokering solutions are being found more in numbers these days.

  Home network also can connect with the outside world via the pervasive Internet. This enables remote monitoring, management, and maintenance of home devices. Car multimedia, navigation and infotainment systems, and parking management systems, and so on too gets connected to household systems directly or via a box-based middleware for real-time connectivity and interaction.
- **Home access control: E-locks are** emerging as a crucial security measure for home access control.

- **Kitchen appliances, wares, and utensils:** Modular kitchen comprising all kinds of electronics emerges as a key factor for smarter homes. **Coffee makers, bread toasters, electronic ovens, refrigerators, dish washers, food processors,** and so on are being enhanced to be smarter in home environments.
- Relaxing and mood-creating objects: Household items such as **electric lamps, cots, chairs, beds, wardrobes, window panes, couches, treadmills, tables, and sofas** besides the objects in specific places such as gyms, spas, bathrooms, car garages, parking slots, and so on are being linked together in ad hoc manner in order to greatly enhance the experience of users.
- **Health care systems:** Medicine cabinets, pills and tablets containers, humanoid robots, and so on are occupying prime slots in guaranteeing good health for home occupants.