

Internet of Things (IoT) and Web of Things (WoT) : Applications, Market Trends with Global User Statistics

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ABSTRACT

The large-scale proliferation of connected devices across diverse sectors has fundamentally altered mechanisms of data acquisition, processing, and utilization under the paradigm known as the Internet of Things (IoT). We will try to generate a systematic overview of IoT and present a structured comparison with the emerging Web of Things (WoT) framework. The analysis covers market growth patterns, global device adoption, application domains, interoperability concerns, and anticipated technological trends. Quantitative market indicators, comparative datasets, and architectural perspectives are employed to support analytical insights relevant to researchers and decision-makers and also a comparative overlook is achieved.

Keywords : IOT, WOT, interoperability, challenges ,devices

I. INTRODUCTION

The Internet of Things (IoT) represents an interconnected environment of physical entities equipped with sensing, computing, and communication capabilities that enable autonomous data exchange over the internet [1], [2]. These entities include consumer devices, industrial equipment, and large-scale infrastructure components, collectively enabling automation and intelligent system behavior across multiple domains [5], [8].

A defining characteristic of IoT systems is their ability to operate with minimal human involvement, facilitating continuous data flows and real-time decision support [6]. However, the rapid evolution of IoT has resulted in fragmented ecosystems characterized by heterogeneous protocols, proprietary platforms, and limited cross-system compatibility [4].

To mitigate these limitations, the Web of Things (WoT) has been introduced as a standards-oriented approach that applies established web technologies—such as HTTP, RESTful services, JSON, and Web APIs—to IoT environments [3], [10]. WoT enables physical devices to be abstracted as web-accessible resources, thereby simplifying integration and enhancing interoperability [13].

Historically, the foundations of IoT can be traced to early networked systems and the vision of ubiquitous computing proposed in the late twentieth century [2]. In contrast, WoT emerged more recently through standardization initiatives aimed at unifying fragmented IoT infrastructures using web-based principles [3], [4].

II. IMPORTANCE OF IoT AND WoT

A. Importance of IoT

1) Economic

IoT technologies are expected to generate substantial economic value by 2030, with significant influence across manufacturing, healthcare, transportation, and energy sectors [7], [21]. By enabling automation and predictive capabilities, IoT solutions contribute to cost reduction and productivity enhancement [5].

2) Technological

IoT ecosystems integrate sensing devices, communication networks, cloud platforms, and analytics engines to support real-time monitoring and control [1], [8]. The integration of artificial intelligence within IoT systems—commonly

referred to as AIoT—further enhances system autonomy, predictive analytics, and adaptive decision-making [9].

3) Social and Environmental

IoT-driven smart city solutions improve urban mobility, environmental monitoring, and public safety services [14]. In agriculture, IoT-based precision farming techniques enable optimized resource usage, thereby promoting sustainability and environmental protection [6], [15].

B. Importance of WoT

1) Economic

WoT contributes to economic efficiency by reducing development and integration overheads in heterogeneous IoT deployments [10], [11]. The adoption of standardized web interfaces shortens development cycles and accelerates deployment of interoperable IoT services [12].

2) Technological

From a technical perspective, WoT directly addresses interoperability challenges by introducing a protocol-agnostic abstraction layer built upon web standards [3], [13]. The use of Thing Descriptions (TDs) enables consistent device representation and simplifies application development across platforms [10].

3) Social and Environmental

WoT supports sustainable digital infrastructures by enabling unified access to sensor data related to energy consumption, water management, and waste monitoring [9]. Such integration facilitates smart energy systems and enhances renewable energy adoption [14].

III. MARKET SIZE AND GROWTH TRENDS

The IoT market has demonstrated sustained and exponential growth over the past decade, driven by increasing adoption in consumer electronics, industrial automation, and enterprise digital transformation initiatives [20], [21]. Market projections indicate continued expansion supported by Industry 4.0, smart infrastructure, and data-driven operational models [22].

Although WoT represents a comparatively smaller market segment, it functions as a critical enabling layer within the broader IoT ecosystem [23]. By simplifying system integration and reducing deployment complexity, WoT indirectly accelerates IoT adoption, particularly among small and medium-sized enterprises [10].

IV. IoT VS WoT : COMPARATIVE ANALYSIS

We would compare IoT and WoT on 5 point scale that is Conceptual Definitions, Technical Comparison, Market Size Comparison, Enabled Devices Comparison and Application Areas.

A. Conceptual Definitions

- Internet of Things(IoT): A large-scale network of inter connected physical devices capable of sensing, communication, and distributed data processing [1], [4].
- Web of Things (WoT): A standards-based framework that models IoT devices as web resources using unified semantic descriptions to ensure interoperability and scalability [3], [10].

B. Technical Comparison

Table I: Technical comparative analysis of IoT and WoT

Aspect	IoT	WoT
Core Focus	Connectivity and device networking	Interoperability and standardized access
Protocols	MQTT, CoAP, Zigbee, etc	HTTP/REST, JSON/JSON-LD, Thing Descriptions
Scalability	High, but fragmented	Higher due to standardized web layers
Interoperability	Low to moderate	High
Ease of Integration	Challenging	Easier with web standards

As shown in Table I which presents a comparative view of the Internet of Things (IoT) and the Web of Things (WoT) by highlighting key technical and functional aspects, and it clearly shows how WoT builds upon and improves traditional IoT systems. At its core IoT primarily focuses on connectivity and device networking, enabling physical objects to sense, collect, and transmit data over networks.

The main objective of IoT is to connect devices efficiently, often using lightweight communication protocols such as MQTT, CoAP, and Zigbee, which are well-suited for resource-constrained environments. However, because these protocols are diverse and often vendor-specific, IoT ecosystems tend to become fragmented, making large-scale integration and coordination across platforms challenging. In contrast, the Web of Things (WoT) emphasizes interoperability and standardized access rather than just connectivity. WoT adopts widely used web technologies such as HTTP/REST, JSON, JSON-LD, and W3C Thing Descriptions, allowing IoT devices to be represented as web resources. This approach enables devices from different manufacturers and using different underlying protocols to communicate seamlessly through a common web-based abstraction layer.

From a scalability perspective, while IoT systems are inherently scalable, their growth is often limited by fragmentation and lack of uniform standards. WoT overcomes this limitation by relying on standardized web layers, which are already proven to scale globally. As a result, WoT systems achieve higher and more manageable scalability, especially in heterogeneous and multi-vendor environments. Interoperability is another major differentiating factor. Traditional IoT systems typically exhibit low to moderate interoperability due to protocol diversity and proprietary implementations. WoT, on the other hand, is explicitly designed to ensure high interoperability, enabling smooth integration across devices, platforms, and application domains.

Finally, in terms of ease of integration, IoT solutions are often complex and challenging to integrate, requiring protocol translation, custom middleware, and specialized expertise. WoT significantly simplifies integration by using familiar web standards and APIs, making application development easier, faster, and more developer-friendly.

Overall, the table demonstrates that while IoT lays the foundation by connecting devices, WoT enhances IoT ecosystems by providing a standardized, interoperable, and scalable framework, making it more suitable for large-scale, cross-domain, and future-ready applications.

C. Market Size Comparison

Table II: Comparison of IoT and WoT Market Size (Present and Projected)

Year	IoT_Market_USD_Billion	WoT_Market_USD_Billion
2022	400	0.6
2024	714	1.38
2026	1200	2.5
2028	2000	4
2030	3000	5.2
2032	4062	6.62

Table II shows the present and projected market growth of the Internet of Things (IoT) and the Web of Things (WoT) from 2022 to 2032. The IoT market shows rapid and sustained expansion, growing from USD 400 billion in 2022 to over USD 4 trillion by 2032, reflecting its widespread adoption across industries. In comparison, the WoT market remains smaller but demonstrates steady growth, increasing from USD 0.6 billion to USD 6.62 billion over the same period. While IoT dominates in market size, the rising trajectory of WoT highlights its increasing importance as an interoperability-enabling layer within the broader IoT ecosystem [24]. This data is depicted in chart 1.

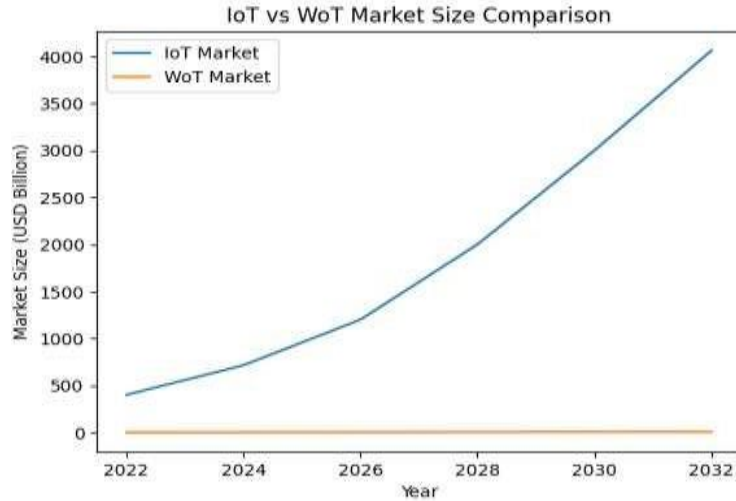


Chart 1: IoT and WoT Market Size Comparison

D. Enabled Devices Comparison

Table III: Comparison of IoT enabled and WoT enabled Devices

Year	IoT_devices_billion	WoT_pct_of_IoT	WoT_devices_billion_est
2015	4.9	0.05	0.00245
2016	6.4	0.1	0.0064
2017	8.4	0.2	0.0168
2018	10.2	0.4	0.0408
2019	11	0.8	0.088
2020	11.7	1.2	0.1404
2021	12.6	1.6	0.2016
2022	14.3	2	0.286
2023	16.6	2.5	0.415
2024	18.8	3	0.564

Table III depicts the growth of IoT-enabled and WoT-enabled devices from 2015 to 2024. The total number of IoT devices shows a steady rise from 4.9 billion to 18.8 billion, indicating rapid global adoption. Although WoT-enabled devices constitute a small fraction of total IoT devices, their share increases consistently from 0.05% to 3%, resulting in growth from approximately 0.002 billion to 0.564 billion devices. This trend highlights the gradual but accelerating adoption of WoT as an interoperability framework within expanding IoT ecosystems[24]. This data is depicted in chart 2.

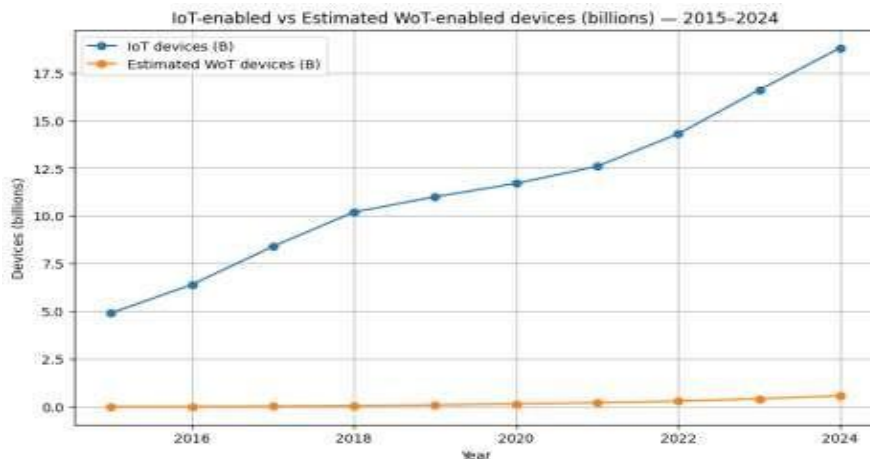


Chart 2: IoT enabled vs Estimated WoT enabled devices

E. Application Areas

- **IoT Applications**

IoT technologies are widely deployed in smart homes, health care systems, industrial automation, agriculture, and smart cities [1], [6], [14]. Industrial IoT applications support predictive maintenance and operational optimization, while healthcare IoT enables remote monitoring and wearable-based diagnostics [15], [16].

- **WoT Applications**

WoT facilitates seamless integration across heterogeneous platforms in smart homes, industrial systems, and cloud-based IoT services by exposing devices through standardized web APIs [10], [13]. This approach is particularly effective in multi-vendor and cross-domain environments [11].

V. CHALLENGES AND FUTURE DIRECTIONS

A. Challenges

The rapid expansion of IoT infrastructures introduces substantial security and privacy risks due to increased attack surfaces [17], [18]. Interoperability challenges arising from protocol diversity remain a critical limitation, which WoT seeks to mitigate [3], [10]. Additionally, scalability concerns persist as IoT systems generate massive volumes of heterogeneous data [19], [20].

B. Future Outlook

Advances in 5G networks, low-power wide-area technologies, edge computing, and artificial intelligence are expected to further accelerate IoT adoption [8], [9]. WoT is anticipated to play a central role in enabling scalable, interoperable, and developer-friendly IoT ecosystems in the future [13], [23].

VI. CONCLUSION

IoT has emerged as a transformative technological paradigm with far-reaching economic, societal, and environmental implications. The Web of Things complements IoT by introducing a standards-driven interoperability framework that addresses fragmentation and integration challenges. Although IoT adoption currently exceeds that of WoT, the growing importance of interoperability positions WoT as a key enabler of future connected systems.

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