

# **Visible Light Communication Market - Global Industry Size, Share, Trends, Opportunity, and Forecast Segmented By Component (Image Sensor and Visible Light Diode), By Application (Location Based Service, Indoor Applications and Outdoor Applications), By End-User (Transportation, Automotive, Defense, Healthcare and Others), By Region, and By Competition, 2019-2029F**

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## **Abstracts**

Global Visible Light Communication (VLC) Market was valued at USD 1.73 billion in 2023 and is anticipated to project robust growth in the forecast period with a CAGR of 30.66% through 2029. VLC's utilization of Light Emitting Diode (LED) technology contributes to its energy-efficiency, aligning with global efforts toward sustainability and reduced energy consumption. LED-based VLC systems not only provide illumination but also serve as a medium for data communication. This dual functionality makes VLC an environmentally friendly option, particularly in the context of smart lighting solutions. The emphasis on energy efficiency and sustainable technologies has become a key driver propelling the adoption of VLC in various sectors.

### **Key Market Drivers**

#### **Growing Demand for High-Speed Data Transmission**

The Global Visible Light Communication (VLC) market is being driven by the escalating demand for high-speed data transmission across various industries and applications. As the world becomes increasingly interconnected, the need for efficient and rapid data

transfer has become paramount. Visible Light Communication leverages light waves to transmit data, offering a viable solution to the challenges posed by traditional wireless communication technologies.

One significant driver behind the growth of the VLC market is the surge in data traffic, driven by trends such as the Internet of Things (IoT), smart cities, and the proliferation of connected devices. VLC's ability to provide high-speed data transmission, often surpassing traditional Wi-Fi speeds, positions it as a promising technology for applications where large volumes of data need to be transmitted swiftly and reliably. Industries such as healthcare, automotive, and manufacturing, where real-time communication is critical, are increasingly adopting VLC to meet their data transfer requirements.

Additionally, the rising consumer demand for faster and more reliable internet connectivity in homes and businesses is contributing to the expansion of the VLC market. As users seek seamless connectivity for activities like video streaming, online gaming, and remote work, VLC emerges as a technology that can deliver on these expectations, further propelling its adoption globally.

### Energy-Efficiency and Security Advantages

Another key driver fueling the growth of the Global Visible Light Communication market is its inherent energy-efficiency and enhanced security features. VLC operates using LED (Light Emitting Diode) technology, which is not only energy-efficient but also aligns with global efforts towards sustainability and reduced energy consumption.

LEDs used in VLC systems consume less power compared to traditional lighting sources, making VLC an environmentally friendly option. This characteristic is particularly appealing in a world increasingly focused on eco-friendly technologies and minimizing carbon footprints. As organizations and governments worldwide prioritize energy-efficient solutions, the adoption of VLC is likely to rise, contributing to the expansion of the market.

VLC offers improved security features compared to some traditional wireless communication technologies. Since VLC relies on visible light, it is less susceptible to external interference and offers a more secure communication environment. This aspect makes VLC a preferred choice for applications where data security is of utmost importance, such as in healthcare, defense, and finance.

## Integration with Smart Lighting Systems and IoT

The integration of Visible Light Communication with smart lighting systems and the Internet of Things (IoT) is a significant driver shaping the growth trajectory of the VLC market. VLC can seamlessly merge with existing lighting infrastructure to create intelligent lighting systems that not only illuminate spaces but also serve as data communication networks.

The synergy between VLC and smart lighting enables multi-functional capabilities within a single infrastructure. For instance, smart buildings can leverage VLC for both efficient lighting solutions and high-speed data communication. As the adoption of IoT devices continues to rise, VLC provides a complementary communication solution that can support the increasing connectivity demands of these devices.

The potential for VLC to operate in environments with electromagnetic interference restrictions, such as hospitals and aircraft, makes it an attractive choice for IoT applications in these sensitive settings. The ability of VLC to coexist with other technologies and seamlessly integrate into diverse ecosystems positions it as a driving force in the global market, especially as the world moves towards more interconnected and intelligent infrastructures.

## Key Market Challenges

### Limited Range and Line-of-Sight Constraints

One of the primary challenges facing the Global Visible Light Communication (VLC) market is the limited range and susceptibility to line-of-sight constraints. VLC relies on visible light waves for data transmission, and as a result, the communication link is established through direct line-of-sight between the transmitter (LED source) and the receiver (photosensitive device). This characteristic poses challenges in scenarios where obstacles or physical barriers may obstruct the direct line of communication.

In environments with complex structures or spaces requiring non-line-of-sight communication, such as multi-room setups or areas with frequent obstructions, VLC may face difficulties in maintaining a consistent and reliable connection. This limitation makes it challenging for VLC to compete with traditional wireless communication technologies, like Wi-Fi, which can penetrate obstacles and offer broader coverage.

Efforts are being made to address this challenge through advancements in VLC

technology, including the development of relay systems and the incorporation of intelligent algorithms to enhance signal stability. However, overcoming the line-of-sight constraint remains a significant hurdle for VLC adoption in certain applications and environments.

### Interference from Ambient Light Sources

Another significant challenge confronting the VLC market is interference from ambient light sources. Since VLC operates within the visible light spectrum, it is susceptible to interference from natural sunlight, indoor lighting, and other sources of ambient light. This interference can impact the reliability and performance of VLC systems, particularly in environments where controlling ambient light conditions is challenging.

In outdoor settings, the variability of sunlight intensity and the presence of competing light sources can hinder the effectiveness of VLC communication. In indoor spaces, the coexistence of multiple light-emitting devices, such as fluorescent lights, LEDs, and display screens, can create interference and degrade the quality of the VLC signal.

Addressing this challenge requires the development of sophisticated modulation techniques and signal processing algorithms that can distinguish the VLC signal from ambient light fluctuations. Additionally, innovations in light sensor technologies are crucial to improving the resilience of VLC systems in the presence of varying ambient light conditions.

### Standardization and Interoperability Issues

Standardization and interoperability pose notable challenges to the widespread adoption of VLC technology globally. The VLC market is still in its nascent stages, and the absence of universally accepted standards can hinder the seamless integration of VLC into existing communication infrastructures. Different manufacturers and developers may implement varying protocols, modulation schemes, and communication standards, leading to interoperability issues between VLC devices from different vendors.

To achieve the full potential of VLC and ensure its compatibility with a diverse range of applications and devices, the industry must work towards establishing common standards. Standardization efforts are essential to promote interoperability, simplify device integration, and foster a more competitive and robust VLC ecosystem.

Initiatives by industry organizations and standardization bodies are underway to address this challenge. However, achieving widespread consensus on standards and protocols remains a complex process that requires collaboration among stakeholders to create a unified framework for the deployment of VLC technology across various sectors and applications. As the market matures, resolving these standardization issues will be crucial to unlocking the full potential of VLC and facilitating its seamless integration into the broader communication landscape.

## Key Market Trends

### Integration with Li-Fi Technology and 5G Networks

A prominent trend shaping the Global Visible Light Communication (VLC) market is the increasing integration of VLC with Li-Fi (Light Fidelity) technology and 5G networks. Li-Fi, a subset of VLC, utilizes visible light to transmit data, offering high-speed wireless communication. As demand for faster and more reliable data transfer grows, the synergies between VLC, Li-Fi, and 5G networks present a compelling solution for addressing the communication needs of diverse industries and applications.

Li-Fi enhances VLC by providing a robust framework for high-speed, secure, and energy-efficient wireless communication. As a result, Li-Fi has found applications in various sectors, including healthcare, transportation, and smart cities. The combination of VLC and Li-Fi can create efficient and versatile communication systems that leverage both visible light and radiofrequency spectrum, catering to different use cases based on their specific requirements.

The integration of VLC and Li-Fi with 5G networks introduces a comprehensive communication ecosystem. 5G networks offer high data transfer rates, low latency, and increased network capacity. By combining the strengths of VLC and Li-Fi with the capabilities of 5G, industries can deploy advanced communication systems capable of supporting the diverse and growing demands of emerging technologies, such as the Internet of Things (IoT), augmented reality, and autonomous vehicles.

This trend reflects a strategic convergence of technologies, creating a holistic communication infrastructure that addresses the need for high-speed, secure, and energy-efficient data transfer across various domains.

### Emerging Applications in Indoor Positioning and Navigation

An emerging trend in the Global Visible Light Communication market is the exploration and adoption of VLC for indoor positioning and navigation applications. As traditional positioning systems, like GPS, face challenges in providing accurate location information indoors due to signal attenuation, VLC presents itself as a promising alternative for overcoming these limitations.

VLC systems can leverage the existing lighting infrastructure to establish precise indoor positioning and navigation capabilities. By integrating VLC with sensors and smart lighting systems, businesses and industries can develop location-based services that enhance user experiences in indoor spaces such as shopping malls, airports, hospitals, and warehouses. The ability of VLC to deliver accurate location data is particularly valuable in environments where GPS signals are weak or unavailable.

This trend is gaining traction in various sectors, including retail, healthcare, and logistics, as organizations recognize the potential of VLC for optimizing operations, improving efficiency, and enhancing user engagement. Indoor positioning and navigation using VLC can lead to innovations in location-aware marketing, asset tracking, and navigation assistance for both consumers and workers within indoor environments.

As this trend continues to evolve, VLC's role in indoor positioning and navigation is likely to expand, creating new opportunities for businesses to leverage this technology for improved operational efficiency and enhanced user experiences in indoor spaces.

## Segmental Insights

## Application Insights

The Indoor Applications segment dominated the Global Visible Light Communication Market in 2023. Retail environments are increasingly adopting VLC for indoor positioning, wayfinding, and location-based services. VLC enables accurate and real-time tracking of customers' locations within stores, facilitating personalized shopping experiences through targeted promotions and navigation assistance. Retailers leverage VLC technology to enhance customer engagement, optimize product placement, and streamline inventory management within indoor spaces. In the healthcare sector, VLC finds applications in patient monitoring and asset tracking within hospitals and clinics. VLC-based communication and sensing systems facilitate the accurate tracking of medical equipment, personnel, and patients in real-time. The technology enhances the efficiency of healthcare operations, reduces the risk of errors, and contributes to the

overall improvement of patient care by ensuring the availability of critical resources when needed.

VLC is closely integrated with smart lighting systems for indoor applications, forming a symbiotic relationship. Smart lighting, enabled by VLC, not only provides energy-efficient illumination but also serves as a communication infrastructure. Indoor spaces, such as smart buildings and offices, leverage VLC for data transmission, enabling building automation, environmental monitoring, and seamless integration with Internet of Things (IoT) devices. This convergence of lighting and communication enhances the overall intelligence and efficiency of indoor environments. In educational settings, VLC contributes to interactive learning experiences. By embedding VLC technology in educational tools, such as interactive displays and projectors, educators can create engaging and interactive lessons. VLC facilitates the transmission of data between devices, allowing for collaborative learning and innovative teaching methods within indoor classrooms and educational spaces.

## Regional Insights

North America emerged as the dominating region in 2023, holding the largest market share. The concept of smart cities is gaining momentum in North America, with VLC playing a pivotal role in the integration of smart lighting and communication infrastructure. VLC enables data transmission through existing lighting networks, contributing to energy-efficient smart lighting solutions while simultaneously serving as a communication backbone for various smart city applications. This includes intelligent transportation systems, public safety, and environmental monitoring.

North America has witnessed substantial adoption of VLC technology in commercial and retail settings. Retailers leverage VLC for indoor positioning, personalized marketing, and enhancing the overall shopping experience. The region's dynamic retail landscape embraces VLC's ability to provide location-based services, such as targeted promotions and efficient customer navigation within stores, contributing to the growth of VLC in the retail sector.

The healthcare sector in North America incorporates VLC for applications such as indoor navigation, asset tracking, and patient monitoring. VLC systems help optimize hospital operations, ensuring the efficient utilization of resources, accurate tracking of medical equipment, and enhanced patient care. The region's emphasis on healthcare innovation and technology adoption further propels the integration of VLC in healthcare facilities.

North American corporate environments are increasingly adopting VLC for building automation and smart office solutions. VLC's integration with smart lighting systems allows for energy-efficient illumination, while also serving as a communication infrastructure for data transmission. This convergence enhances building automation, facilitating seamless integration with IoT devices and improving overall workplace efficiency.

Government initiatives in North America, such as smart city projects and investments in technological advancements, provide a conducive environment for the growth of VLC. Funding support for research and development projects in communication technologies, including VLC, stimulates innovation and fosters the deployment of VLC solutions across different sectors.

The North American entertainment and hospitality industries leverage VLC for enhancing customer experiences. In entertainment venues, such as theme parks and gaming centers, VLC contributes to interactive and immersive experiences. In the hospitality sector, VLC is employed for indoor navigation, location-based services, and personalized guest experiences.

The North American segment of the Global Visible Light Communication Market is characterized by its leadership in technological innovation, the integration of VLC in various sectors, and the support of government initiatives. The region's commitment to smart technologies and research-driven advancements positions it as a key contributor to the ongoing growth and development of the VLC market.

### Key Market Players

Koninklijke Philips N.V.

Acquity Brands, Inc.

Toshiba Corp.

Panasonic Corp.

Purelifi Ltd.

Signify Holding B.V.



Nitto Denko Corp.

Qualcomm Inc.

Samsung Electronics Co. Ltd.

NEC Corp.

### Report Scope:

In this report, the Global Visible Light Communication Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Visible Light Communication Market, By Component:

Image Sensor

Visible Light Diode

Visible Light Communication Market, By Application:

Location Based Service

Indoor Applications

Outdoor Applications

Visible Light Communication Market, By End-User:

Transportation

Automotive

Defense

Healthcare

Others

Visible Light Communication Market, By Region:

North America

United States

Canada

Mexico

Europe

France

United Kingdom

Italy

Germany

Spain

Netherlands

Belgium

Asia-Pacific

China

India

Japan

Australia

South Korea

Thailand

Malaysia

South America

Brazil

Argentina

Colombia

Chile

Middle East & Africa

South Africa

Saudi Arabia

UAE

Turkey

## Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Visible Light Communication Market.

## Available Customizations:

Global Visible Light Communication Market report with the given market data, TechSci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

## Company Information

*Visible Light Communication Market - Global Industry Size, Share, Trends, Opportunity, and Forecast Segmented...*

Detailed analysis and profiling of additional market players (up to five).

## Contents

### **1. SERVICES OVERVIEW**

- 1.1. Market Definition
- 1.2. Scope of the Market
  - 1.2.1. Markets Covered
  - 1.2.2. Years Considered for Study
  - 1.2.3. Key Market Segmentations

### **2. RESEARCH METHODOLOGY**

- 2.1. Objective of the Study
- 2.2. Baseline Methodology
- 2.3. Formulation of the Scope
- 2.4. Assumptions and Limitations
- 2.5. Sources of Research
  - 2.5.1. Secondary Research
  - 2.5.2. Primary Research
- 2.6. Approach for the Market Study
  - 2.6.1. The Bottom-Up Approach
  - 2.6.2. The Top-Down Approach
- 2.7. Methodology Followed for Calculation of Market Size & Market Shares
- 2.8. Forecasting Methodology
  - 2.8.1. Data Triangulation & Validation

### **3. EXECUTIVE SUMMARY**

### **4. IMPACT OF COVID-19 ON GLOBAL VISIBLE LIGHT COMMUNICATION MARKET**

### **5. VOICE OF CUSTOMER**

### **6. GLOBAL VISIBLE LIGHT COMMUNICATION MARKET OVERVIEW**

### **7. GLOBAL VISIBLE LIGHT COMMUNICATION MARKET OUTLOOK**

- 7.1. Market Size & Forecast
  - 7.1.1. By Value
- 7.2. Market Share & Forecast

- 7.2.1.By Component (Image Sensor and Visible Light Diode)
- 7.2.2.By Application (Location Based Service, Indoor Applications and Outdoor Applications)
- 7.2.3.By End-User (Transportation, Automotive, Defense, Healthcare and Others)
- 7.2.4.By Region (North America, Europe, South America, Middle East & Africa, Asia-Pacific)
- 7.3. By Company (2023)
- 7.4. Market Map

## **8. NORTH AMERICA VISIBLE LIGHT COMMUNICATION MARKET OUTLOOK**

- 8.1. Market Size & Forecast
  - 8.1.1.By Value
- 8.2. Market Share & Forecast
  - 8.2.1.By Component
  - 8.2.2.By Application
  - 8.2.3.By End-User
  - 8.2.4.By Country
- 8.3. North America: Country Analysis
  - 8.3.1.United States Visible Light Communication Market Outlook
    - 8.3.1.1. Market Size & Forecast
      - 8.3.1.1.1. By Value
    - 8.3.1.2. Market Share & Forecast
      - 8.3.1.2.1. By Component
      - 8.3.1.2.2. By Application
      - 8.3.1.2.3. By End-User
  - 8.3.2.Canada Visible Light Communication Market Outlook
    - 8.3.2.1. Market Size & Forecast
      - 8.3.2.1.1. By Value
    - 8.3.2.2. Market Share & Forecast
      - 8.3.2.2.1. By Component
      - 8.3.2.2.2. By Application
      - 8.3.2.2.3. By End-User
  - 8.3.3.Mexico Visible Light Communication Market Outlook
    - 8.3.3.1. Market Size & Forecast
      - 8.3.3.1.1. By Value
    - 8.3.3.2. Market Share & Forecast
      - 8.3.3.2.1. By Component
      - 8.3.3.2.2. By Application

8.3.3.2.3. By End-User

## **9. EUROPE VISIBLE LIGHT COMMUNICATION MARKET OUTLOOK**

9.1. Market Size & Forecast

9.1.1. By Value

9.2. Market Share & Forecast

9.2.1. By Component

9.2.2. By Application

9.2.3. By End-User

9.2.4. By Country

9.3. Europe: Country Analysis

9.3.1. Germany Visible Light Communication Market Outlook

9.3.1.1. Market Size & Forecast

9.3.1.1.1. By Value

9.3.1.2. Market Share & Forecast

9.3.1.2.1. By Component

9.3.1.2.2. By Application

9.3.1.2.3. By End-User

9.3.2. France Visible Light Communication Market Outlook

9.3.2.1. Market Size & Forecast

9.3.2.1.1. By Value

9.3.2.2. Market Share & Forecast

9.3.2.2.1. By Component

9.3.2.2.2. By Application

9.3.2.2.3. By End-User

9.3.3. United Kingdom Visible Light Communication Market Outlook

9.3.3.1. Market Size & Forecast

9.3.3.1.1. By Value

9.3.3.2. Market Share & Forecast

9.3.3.2.1. By Component

9.3.3.2.2. By Application

9.3.3.2.3. By End-User

9.3.4. Italy Visible Light Communication Market Outlook

9.3.4.1. Market Size & Forecast

9.3.4.1.1. By Value

9.3.4.2. Market Share & Forecast

9.3.4.2.1. By Component

9.3.4.2.2. By Application

- 9.3.4.2.3. By End-User
- 9.3.5. Spain Visible Light Communication Market Outlook
  - 9.3.5.1. Market Size & Forecast
    - 9.3.5.1.1. By Value
  - 9.3.5.2. Market Share & Forecast
    - 9.3.5.2.1. By Component
    - 9.3.5.2.2. By Application
    - 9.3.5.2.3. By End-User
- 9.3.6. Netherlands Visible Light Communication Market Outlook
  - 9.3.6.1. Market Size & Forecast
    - 9.3.6.1.1. By Value
  - 9.3.6.2. Market Share & Forecast
    - 9.3.6.2.1. By Component
    - 9.3.6.2.2. By Application
    - 9.3.6.2.3. By End-User
- 9.3.7. Belgium Visible Light Communication Market Outlook
  - 9.3.7.1. Market Size & Forecast
    - 9.3.7.1.1. By Value
  - 9.3.7.2. Market Share & Forecast
    - 9.3.7.2.1. By Component
    - 9.3.7.2.2. By Application
    - 9.3.7.2.3. By End-User

## **10. SOUTH AMERICA VISIBLE LIGHT COMMUNICATION MARKET OUTLOOK**

- 10.1. Market Size & Forecast
  - 10.1.1. By Value
- 10.2. Market Share & Forecast
  - 10.2.1. By Component
  - 10.2.2. By Application
  - 10.2.3. By End-User
  - 10.2.4. By Country
- 10.3. South America: Country Analysis
  - 10.3.1. Brazil Visible Light Communication Market Outlook
    - 10.3.1.1. Market Size & Forecast
      - 10.3.1.1.1. By Value
    - 10.3.1.2. Market Share & Forecast
      - 10.3.1.2.1. By Component
      - 10.3.1.2.2. By Application



- 10.3.1.2.3. By End-User
- 10.3.2. Colombia Visible Light Communication Market Outlook
  - 10.3.2.1. Market Size & Forecast
    - 10.3.2.1.1. By Value
  - 10.3.2.2. Market Share & Forecast
    - 10.3.2.2.1. By Component
    - 10.3.2.2.2. By Application
    - 10.3.2.2.3. By End-User
- 10.3.3. Argentina Visible Light Communication Market Outlook
  - 10.3.3.1. Market Size & Forecast
    - 10.3.3.1.1. By Value
  - 10.3.3.2. Market Share & Forecast
    - 10.3.3.2.1. By Component
    - 10.3.3.2.2. By Application
    - 10.3.3.2.3. By End-User
- 10.3.4. Chile Visible Light Communication Market Outlook
  - 10.3.4.1. Market Size & Forecast
    - 10.3.4.1.1. By Value
  - 10.3.4.2. Market Share & Forecast
    - 10.3.4.2.1. By Component
    - 10.3.4.2.2. By Application
    - 10.3.4.2.3. By End-User

## **11. MIDDLE EAST & AFRICA VISIBLE LIGHT COMMUNICATION MARKET OUTLOOK**

- 11.1. Market Size & Forecast
  - 11.1.1. By Value
- 11.2. Market Share & Forecast
  - 11.2.1. By Component
  - 11.2.2. By Application
  - 11.2.3. By End-User
  - 11.2.4. By Country
- 11.3. Middle East & Africa: Country Analysis
  - 11.3.1. Saudi Arabia Visible Light Communication Market Outlook
    - 11.3.1.1. Market Size & Forecast
      - 11.3.1.1.1. By Value
    - 11.3.1.2. Market Share & Forecast
      - 11.3.1.2.1. By Component

- 11.3.1.2.2. By Application
- 11.3.1.2.3. By End-User
- 11.3.2. UAE Visible Light Communication Market Outlook
  - 11.3.2.1. Market Size & Forecast
    - 11.3.2.1.1. By Value
  - 11.3.2.2. Market Share & Forecast
    - 11.3.2.2.1. By Component
    - 11.3.2.2.2. By Application
    - 11.3.2.2.3. By End-User
- 11.3.3. South Africa Visible Light Communication Market Outlook
  - 11.3.3.1. Market Size & Forecast
    - 11.3.3.1.1. By Value
  - 11.3.3.2. Market Share & Forecast
    - 11.3.3.2.1. By Component
    - 11.3.3.2.2. By Application
    - 11.3.3.2.3. By End-User
- 11.3.4. Turkey Visible Light Communication Market Outlook
  - 11.3.4.1. Market Size & Forecast
    - 11.3.4.1.1. By Value
  - 11.3.4.2. Market Share & Forecast
    - 11.3.4.2.1. By Component
    - 11.3.4.2.2. By Application
    - 11.3.4.2.3. By End-User

## **12. ASIA-PACIFIC VISIBLE LIGHT COMMUNICATION MARKET OUTLOOK**

- 12.1. Market Size & Forecast
  - 12.1.1. By Value
- 12.2. Market Share & Forecast
  - 12.2.1. By Component
  - 12.2.2. By Application
  - 12.2.3. By End-User
  - 12.2.4. By Country
- 12.3. Asia-Pacific: Country Analysis
  - 12.3.1. China Visible Light Communication Market Outlook
    - 12.3.1.1. Market Size & Forecast
      - 12.3.1.1.1. By Value
    - 12.3.1.2. Market Share & Forecast
      - 12.3.1.2.1. By Component

- 12.3.1.2.2. By Application
- 12.3.1.2.3. By End-User
- 12.3.2. India Visible Light Communication Market Outlook
  - 12.3.2.1. Market Size & Forecast
    - 12.3.2.1.1. By Value
  - 12.3.2.2. Market Share & Forecast
    - 12.3.2.2.1. By Component
    - 12.3.2.2.2. By Application
    - 12.3.2.2.3. By End-User
- 12.3.3. Japan Visible Light Communication Market Outlook
  - 12.3.3.1. Market Size & Forecast
    - 12.3.3.1.1. By Value
  - 12.3.3.2. Market Share & Forecast
    - 12.3.3.2.1. By Component
    - 12.3.3.2.2. By Application
    - 12.3.3.2.3. By End-User
- 12.3.4. South Korea Visible Light Communication Market Outlook
  - 12.3.4.1. Market Size & Forecast
    - 12.3.4.1.1. By Value
  - 12.3.4.2. Market Share & Forecast
    - 12.3.4.2.1. By Component
    - 12.3.4.2.2. By Application
    - 12.3.4.2.3. By End-User
- 12.3.5. Australia Visible Light Communication Market Outlook
  - 12.3.5.1. Market Size & Forecast
    - 12.3.5.1.1. By Value
  - 12.3.5.2. Market Share & Forecast
    - 12.3.5.2.1. By Component
    - 12.3.5.2.2. By Application
    - 12.3.5.2.3. By End-User
- 12.3.6. Thailand Visible Light Communication Market Outlook
  - 12.3.6.1. Market Size & Forecast
    - 12.3.6.1.1. By Value
  - 12.3.6.2. Market Share & Forecast
    - 12.3.6.2.1. By Component
    - 12.3.6.2.2. By Application
    - 12.3.6.2.3. By End-User
- 12.3.7. Malaysia Visible Light Communication Market Outlook
  - 12.3.7.1. Market Size & Forecast

- 12.3.7.1.1. By Value
- 12.3.7.2. Market Share & Forecast
  - 12.3.7.2.1. By Component
  - 12.3.7.2.2. By Application
  - 12.3.7.2.3. By End-User

## **13. MARKET DYNAMICS**

- 13.1. Drivers
- 13.2. Challenges

## **14. MARKET TRENDS AND DEVELOPMENTS**

## **15. COMPANY PROFILES**

- 15.1. Koninklijke Philips N.V.
  - 15.1.1. Business Overview
  - 15.1.2. Key Revenue and Financials
  - 15.1.3. Recent Developments
  - 15.1.4. Key Personnel/Key Contact Person
  - 15.1.5. Key Product/Services Offered
- 15.2. Acquity Brands, Inc.
  - 15.2.1. Business Overview
  - 15.2.2. Key Revenue and Financials
  - 15.2.3. Recent Developments
  - 15.2.4. Key Personnel/Key Contact Person
  - 15.2.5. Key Product/Services Offered
- 15.3. Toshiba Corp.
  - 15.3.1. Business Overview
  - 15.3.2. Key Revenue and Financials
  - 15.3.3. Recent Developments
  - 15.3.4. Key Personnel/Key Contact Person
  - 15.3.5. Key Product/Services Offered
- 15.4. Panasonic Corp.
  - 15.4.1. Business Overview
  - 15.4.2. Key Revenue and Financials
  - 15.4.3. Recent Developments
  - 15.4.4. Key Personnel/Key Contact Person
  - 15.4.5. Key Product/Services Offered

## 15.5. Purelifi Ltd.

15.5.1. Business Overview

15.5.2. Key Revenue and Financials

15.5.3. Recent Developments

15.5.4. Key Personnel/Key Contact Person

15.5.5. Key Product/Services Offered

## 15.6. Signify Holding B.V.

15.6.1. Business Overview

15.6.2. Key Revenue and Financials

15.6.3. Recent Developments

15.6.4. Key Personnel/Key Contact Person

15.6.5. Key Product/Services Offered

## 15.7. Nitto Denko Corp.

15.7.1. Business Overview

15.7.2. Key Revenue and Financials

15.7.3. Recent Developments

15.7.4. Key Personnel/Key Contact Person

15.7.5. Key Product/Services Offered

## 15.8. Qualcomm Inc.

15.8.1. Business Overview

15.8.2. Key Revenue and Financials

15.8.3. Recent Developments

15.8.4. Key Personnel/Key Contact Person

15.8.5. Key Product/Services Offered

## 15.9. Samsung Electronics Co. Ltd.

15.9.1. Business Overview

15.9.2. Key Revenue and Financials

15.9.3. Recent Developments

15.9.4. Key Personnel/Key Contact Person

15.9.5. Key Product/Services Offered

## 15.10. NEC Corp.

15.10.1. Business Overview

15.10.2. Key Revenue and Financials

15.10.3. Recent Developments

15.10.4. Key Personnel/Key Contact Person

15.10.5. Key Product/Services Offered

## **16. STRATEGIC RECOMMENDATIONS**

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