

Big Data in Smart Cities

Using Data-Driven Technologies
for Smarter Urban Living

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What Is a Smart City?

A **smart city** uses digital technologies and data analysis to improve:

- Quality of life for citizens
- Efficiency of urban services
- Environmental sustainability
- Decision-making by city authorities

Smart cities rely heavily on **Big Data collected in real time.**



Why Big Data Is Essential

Modern cities generate massive amounts of data every second.

Big Data enables:

- Real-time monitoring of city operations
- Predictive analytics for future planning
- Automated and optimized public services
- Faster and more accurate decisions

Without Big Data, smart cities cannot scale efficiently.

Sources of Big Data in Smart Cities

Smart cities collect data from multiple sources, including:

- IoT sensors (traffic, pollution, weather)
- Traffic cameras and GPS systems
- Smart meters for water, gas, and electricity
- Mobile devices and applications
- Social media and citizen platforms

These sources generate **continuous and diverse data streams**.



Big Data Characteristics

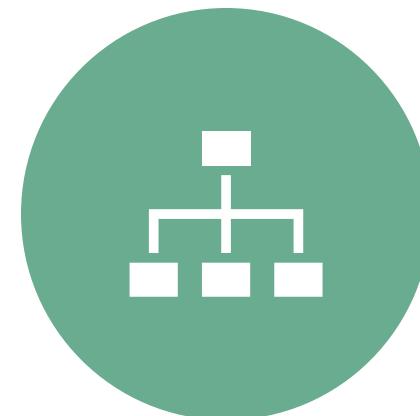
Smart city data is defined by the 3Vs of Big Data:



VOLUME – EXTREMELY LARGE DATASETS FROM MILLIONS OF DEVICES



VELOCITY – DATA GENERATED AND PROCESSED IN REAL TIME

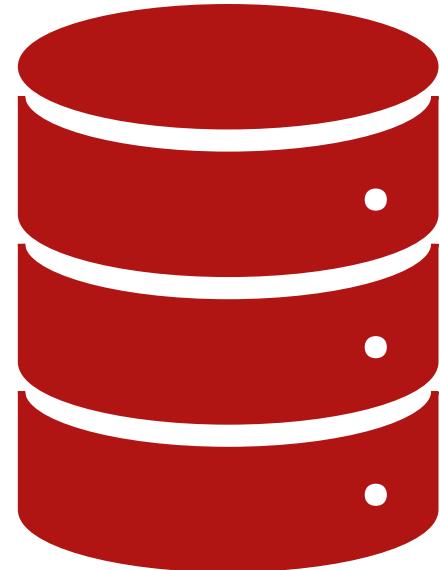


VARIETY – STRUCTURED, SEMI-STRUCTURED, AND UNSTRUCTURED DATA

Big Data Technologies Used

- ▶ **Hadoop** – distributed storage of massive datasets
- ▶ **Apache Spark** – fast, in-memory data processing
- ▶ **Apache Kafka** – real-time data streaming
- ▶ **Cloud platforms** – scalable storage and computing resources

These tools enable reliable and scalable data processing.



Algorithms Used in Smart Cities



CLUSTERING ALGORITHMS –
IDENTIFYING TRAFFIC OR
USAGE PATTERNS



TIME-SERIES FORECASTING –
PREDICTING ENERGY
DEMAND OR TRAFFIC FLOW



**MACHINE LEARNING
MODELS –** CLASSIFICATION
AND PREDICTION TASKS



ANOMALY DETECTION –
DETECTING FAULTS OR
UNUSUAL BEHAVIOR

Use Case: Smart Traffic Management

Big Data improves traffic systems by:



Monitoring traffic flow in real time



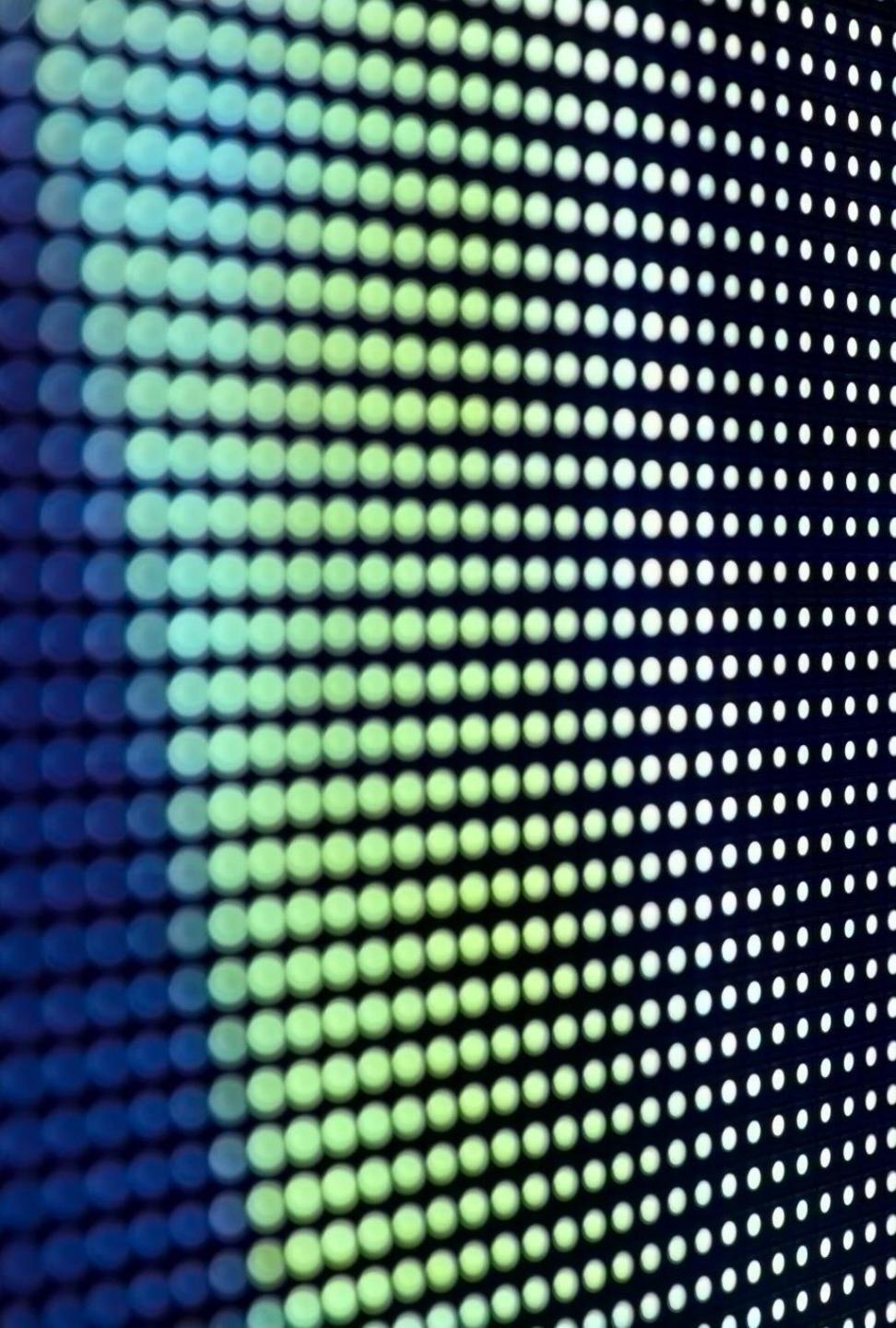
Predicting congestion before it occurs



Optimizing traffic-light timing



Reducing travel time and fuel
consumption

A vertical column of abstract background graphics on the left side of the slide. It consists of numerous small, circular dots arranged in a grid-like pattern. The dots are primarily white, but they are set against a dark background and are surrounded by a gradient of colors, including shades of blue, green, and yellow, creating a bokeh effect.

Use Case: Smart Energy Management

- ▶ Monitor consumption patterns
- ▶ Predict peak energy demand
- ▶ Optimize energy distribution
- ▶ Reduce waste and operational costs

Smart energy management supports sustainable urban development.

Challenges in Smart Cities

Despite its benefits, Big Data introduces challenges:

- Data privacy and citizen surveillance concerns
- Cybersecurity risks
- High infrastructure and maintenance costs
- Integration of data from different sources

Addressing these challenges is essential for long-term success.



CHALLENGES

Conclusion

Big Data is the foundation of smart cities. By combining advanced technologies and intelligent algorithms, cities can:

- Operate more efficiently
- Become more sustainable
- Respond better to citizens' needs

Smart cities represent the future of urban living.

Thank you!

