Characteristics of Grid computing

1. **Distributed Resources:** Grid computing aggregates computing resources, such as processing power, storage, and data, from multiple locations and organizations.
2. **Virtual Organizations:** It enables the creation of virtual organizations that collaborate across administrative boundaries, sharing resources and expertise.
3. **Dynamic Scalability:** Grids can dynamically scale resources up or down based on demand, allowing efficient allocation of computing power.
4. **Resource Sharing:** Grids emphasize efficient sharing of resources, enabling users to access and utilize computing capabilities and data as needed.
5. **Heterogeneity:** Grids support diverse hardware, operating systems, and platforms, accommodating a variety of resources.
6. **Middleware and Standards:** Middleware tools and standardized protocols facilitate communication and coordination among different resources in the Grid.
7. **High-Performance Computing:** Grids harness the combined processing power of multiple resources for high-performance computing tasks.
8. **Parallel Processing:** Grid computing allows tasks to be divided and processed in parallel across distributed resources, improving efficiency.
9. **Collaborative Environment:** Grids foster collaboration among researchers, scientists, and institutions by providing shared computing infrastructure.

Characteristics of Grid computing

10. **Security and Authentication:** Grids implement robust security measures to protect data and ensure secure access to resources.
11. **Fault Tolerance:** Grids incorporate redundancy and fault-tolerant mechanisms to ensure continuous operation in the presence of failures.
12. **Global Accessibility:** Users can access Grid resources from different locations, enabling worldwide collaboration and access.
13. **Cost Efficiency:** Grid computing optimizes resource utilization, reducing the need for dedicated hardware and associated costs.
14. **Scheduling and Load Balancing:** Grids manage resource allocation and load distribution to optimize task execution.
15. **Scientific and Research Applications:** Grids are commonly used for scientific simulations, data analysis, and research-oriented tasks.
16. **Green Computing:** By efficiently using resources, Grid computing contributes to energy efficiency and environmental sustainability.
17. **Interoperability:** Grids promote interoperability by enabling different resources to work together seamlessly.

	Aspect	Edge Computing	Fog Computing	Clo[illegible]
1	Definition	Processing at the data source	Extending cloud to network edge	Centralized [illegible] storage
2	Proximity to Data Source	Very close to data source (devices)	Close to data source, not on it	Remote data centers
3	Processing	Data processing on the device	Data processed on edge nodes and cloud	Data processing in remote data centers
4	Latency	Extremely low latency	Lower latency compared to cloud	Latency depends on data center location
5	Scalability	Scalable by adding more edge devices	Scalable by deploying more fog nodes	Scalable by adding more servers
6	Resource Limitations	Limited resources due to device size	More resources than edge devices	Higher resources in data centers
7	Use Cases	IoT, real-time analytics at device level	Smart cities, connected vehicles, industrial IoT	Various applications across domains
8	Focus	Device-level processing	Balance between local and centralized processing	Centralized processing and storage
9	Data Transfer	Minimal data transfer to cloud	Some data transferred to cloud	Data transferred to/from cloud
10	Network Infrastructure	Focuses on device networks	Focuses on network infrastructure	Leverages the internet
11	Management	Often managed at device level	Managed across edge nodes and cloud	Managed centrally by cloud provider
12	Data Storage	Limited storage on devices	Storage on edge nodes and cloud	Remote data center storage
13	Security	Can offer increased device-level security	Enhanced security compared to cloud	Security measures by cloud provider
14	Cost	Lower(limited resources)	Moderate cost for infra.	Pay-as-you-go model

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1) Latency Reduction
    - Reduced latency is the primary benefit of edge and fog computing. Data does not necessarily need to be sent to the cloud for processing as some of the compute can be performed nearer the data source for time-sensitive services.
2) Improved Response Time
    - With a reduction in network latency, real-time applications will benefit from improved response time and greater overall user experience.

3) Enhanced Compliance

Data that can reside locally rather than moving to the cloud can increase compliance for specific business sectors.

4) Increased Security

Similar to compliance, if specific sensitive data does not need to move to the cloud for processing, the overall security of that data will be increased.

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5) Greater Data Privacy

Sensitive data can be processed locally and just a subset of that data sent to the cloud for additional analytics.

6) Reduced Cost Of Bandwidth

Because certain data can be processed locally without being sent to the cloud, less network bandwidth will be required. With the ever-increasing numbers of IoT devices all generating live data, this bandwidth saving could be considerable.

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7) Overall Increase In Speed and Efficiency

If you have a number of local IoT and user devices that share data, allowing local processing between them rather than utilising cloud services will increase the overall speed and efficiency of the service.

8) Less Reliance on WAN Services

Should overall access be lost to the internet or private cloud service due to a complete WAN failure, local services can continue to operate.

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9) Greater Up-time of Critical Systems

Critical systems using the edge and fog computing model will have a greater uptime as the reliance on remote cloud services for data compute, analytics and storage is reduced.

10) Enhanced Services for Remote Locations

Systems running in remote or geographically challenging locations where access to the internet or private cloud services may be slow or unreliable will benefit from edge and fog computing.