Case Study 6: HPC Optimized Instances

1. Overview of Recommended Instances

High-Performance Computing (HPC) instances are designed for workloads that require **massive parallel processing, high-speed networking, and extreme computational power**. These workloads typically involve **scientific research, engineering simulations, and large-scale mathematical modelling**.

- **Hpc6id**: Optimized for distributed computing, offering high **memory bandwidth**, **low-latency networking**, and **high-speed Elastic Fabric Adapter (EFA)** support.
- **Hpc7g**: Powered by AWS Graviton3 processors, providing a **cost-effective and energy-efficient** alternative for HPC workloads.
- **C6gn**: Compute-optimized instance with **AWS Graviton2 processors**, best suited for **network-intensive HPC tasks** that require strong compute power but moderate memory bandwidth.

2. Characteristics of Instance Series

Instance Series	Key Characteristics
Hpc6id	Intel-based, optimized for distributed computing with high-speed EFA networking, offering low latency and high performance.
Hpc7g	ARM-based (AWS Graviton3), cost-effective, energy-efficient, suitable for cloud-native HPC applications.
C6gn	Compute-optimized with AWS Graviton2, best for high-performance networking and compute-heavy workloads.

3. Why These Instances Are Suitable

Scenario A: Climate Simulations (Meteorology Department)

Climate modelling involves running **complex weather simulations**, requiring **parallel computing**, **high-speed interconnects**, and **low-latency networking** to process large datasets.

- **Hpc6id** is highly suitable as it provides **high memory bandwidth** and **fast EFA networking**, ensuring quick data exchange between computing nodes.
- **Hpc7g** offers a **cost-effective and energy-efficient alternative**, making it a great option for research institutions with long-term simulation needs.

Scenario B: Computational Fluid Dynamics (CFD) Simulations for Automotive Design

Aerodynamic analysis requires solving **complex fluid equations** that demand **high CPU power and optimized networking**.

- **Hpc6id** is an ideal choice as it is **Intel-based** and offers **low-latency networking**, which is crucial for large-scale CFD simulations.
- **C6gn** provides a **network-optimized solution**, making it suitable for workloads that require **fast inter-node communication but do not demand extreme memory bandwidth**.

4. Comparison of Instance Series

Feature	Hpc6id	Hpc7g	C6gn
CPU Type	Intel	Graviton3	Graviton2
High-Speed Networking (EFA)	Excellent	Excellent	Good
Memory Bandwidth	Excellent	Good	Moderate
Cost Efficiency	Moderate	Excellent	Good
Parallel Computing Performance	Excellent	Good	Moderate
Energy Efficiency	Moderate	Excellent	Good
Best for CFD Simulations	Excellent	Moderate	Good
Best for Climate Modelling	Excellent	Good	Moderate

5. Selection Based on Use Case

Use Case	Hpc6id	Hpc7g	C6gn
Climate Simulations (Weather Modeling)	Highly Recommended	Suitable	Not Ideal
Computational Fluid Dynamics (CFD)	Highly Recommended	Moderate	Suitable
Energy Efficiency	Moderate	Highly Recommended	Suitable
High-Speed Interconnect (EFA)	Highly Recommended	Highly Recommended	Suitable
Cost-Sensitive HPC Workloads	Moderate	Highly Recommended	Suitable

6. Key Considerations Supporting the Business Case

1. Scalability and Parallel Processing

- HPC workloads often require thousands of virtual CPUs (vCPUs) running in parallel. **Hpc6id and Hpc7g** are optimized for such **distributed computing tasks**, while **C6gn** offers a balance of network and compute performance.

2. Networking and Data Transfer

- Many scientific applications rely on **high-speed interconnects** to share data across multiple instances. **Elastic Fabric Adapter (EFA)** support in **Hpc6id and Hpc7g** allows for **low-latency, high-bandwidth communication**.

3. Cost Efficiency and Power Consumption

- **Hpc7g**, powered by **AWS Graviton3**, provides **significant cost savings** and **energy efficiency**, making it a strong choice for organizations looking to reduce their **cloud infrastructure costs**.

4. Optimization for Specific Workloads

- **Hpc6id is ideal for workloads requiring high CPU and memory performance**, making it perfect for **weather simulations and CFD applications**.
- **Hpc7g offers better power efficiency**, making it **suitable for long-running simulations** that do not require extreme CPU performance.
- **C6gn is best for compute-heavy tasks where fast networking is a priority**, but memory requirements are lower.

7. Conclusion

- **For climate simulations and weather modelling**, **Hpc6id is the best choice** due to its **high memory bandwidth, Intel-based processing, and EFA support**.
- **For CFD simulations**, **Hpc6id** is the most optimal, but **C6gn** provides a **budget-friendly alternative** with strong networking capabilities.
- **For organizations focused on cost-efficiency and sustainability**, **Hpc7g offers a power-efficient and cost-effective solution** using AWS Graviton3.
- **Selecting the right instance depends on the balance of performance, cost, and scalability needed for the specific HPC workload**.

This case study highlights the importance of selecting the right **HPC-optimized instances** to ensure **high performance, efficient scaling, and cost savings** while handling compute-heavy scientific and engineering applications.