SAP HANA | PUBLIC

Rethink the Possible with SAP HANA®

THE BEST RUN SAP

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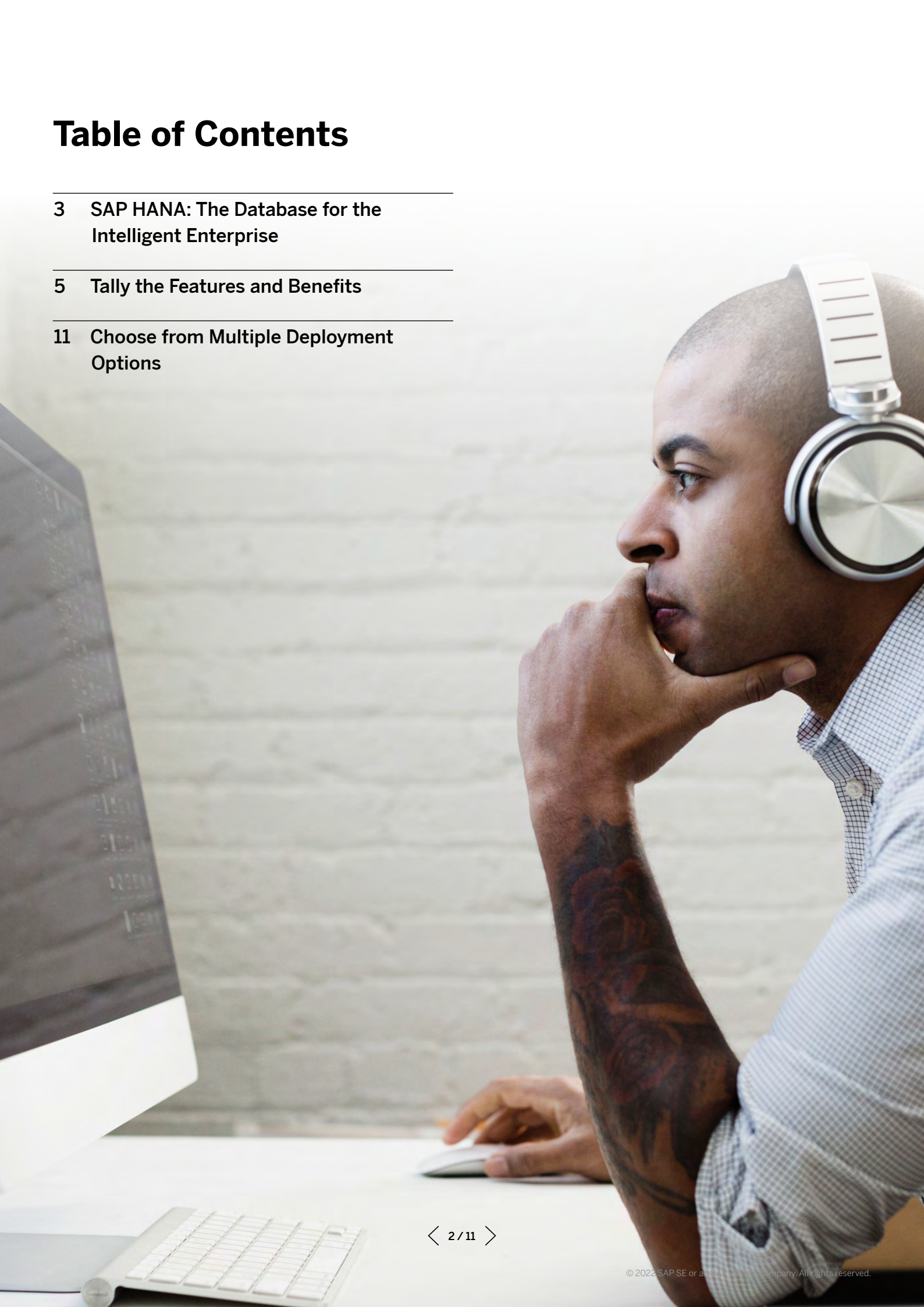


SAP HANA®: The Database for the Intelligent Enterprise

An intelligent enterprise requires a business-ready digital platform that helps you **unleash the potential of your data for better business outcomes**. SAP's leadership in enterprise applications and analytics enables organizations to apply data management technology to their data and further enhance business value.

ADAPT WITH AGILITY, INNOVATE WITHOUT BOUNDARIES, AND SIMPLIFY FOR EFFICIENCY AT SCALE

Help your business accelerate the pace of innovation by moving to SAP HANA®, the database management foundation of SAP® Business Technology Platform. Choose the game-changing database that complies with the standards for atomicity, consistency, isolation, and durability (ACID) and combines application development with smart multi-model capabilities and flexible data integration. Remove the burden of maintaining separate legacy systems and their silos of data so you can become an intelligent enterprise in this ever-changing digital economy, where new technologies and solutions emerge every other day.

One of the most challenging roadblocks to innovation today is the sheer complexity of IT systems. SAP HANA can help you simplify your data management infrastructure. As illustrated in the **figure**, SAP HANA converges database management, application development, smart multi-model capabilities (spatial, graph, enterprise search, document store, predictive modeling, and machine learning), and data integration in-memory to process transactions in one system. You can operate in real time and accelerate business transformation by integrating core business processes with customer data, supplier data, and data from the Internet of Things.

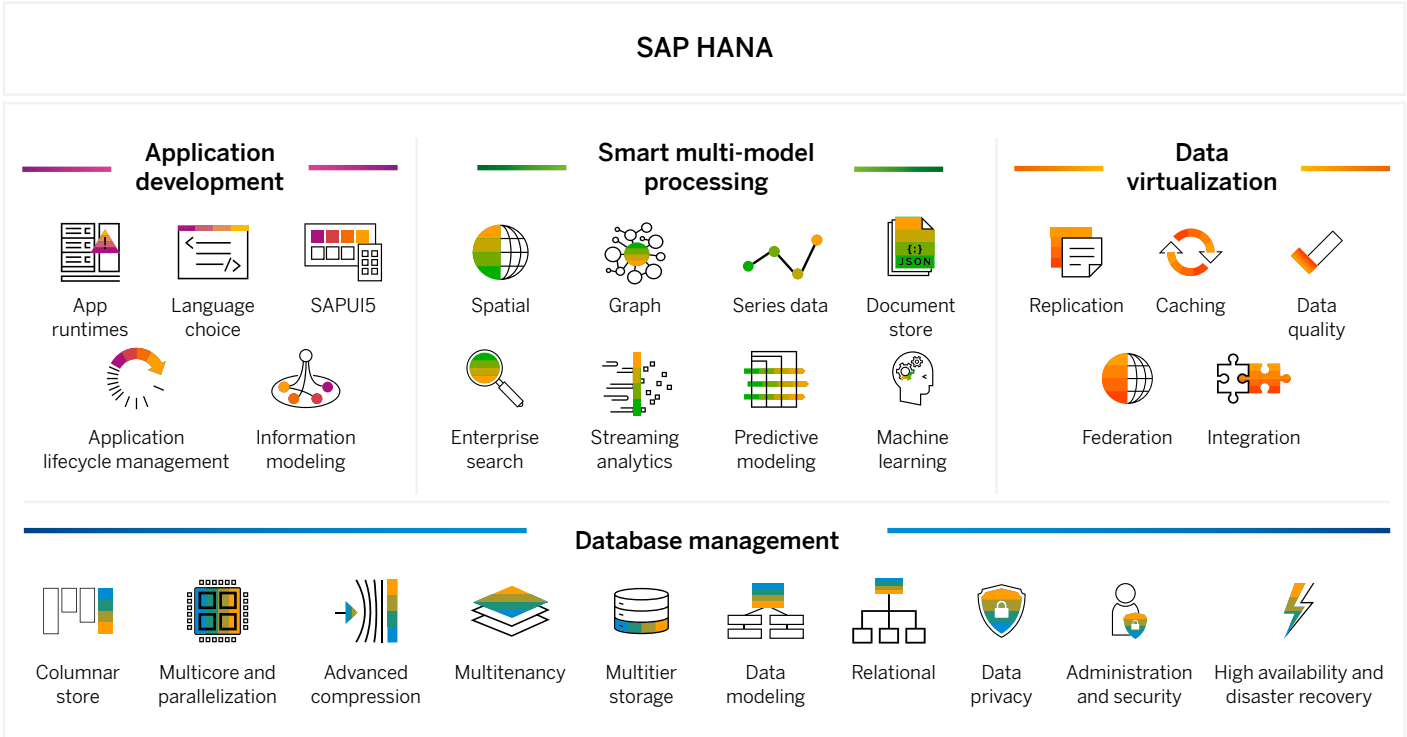
The massively parallel, in-memory paradigm underlying SAP HANA speeds information processing by a quantum leap. This architecture converges transactional and analytical workloads in a single data set in an in-memory, column-based data store. SAP HANA, in short, eliminates data redundancy, disk latency, and data movement among applications and analytical tools. And it provides advanced integration capabilities such as data federation, replication, bulk loading, transformation, cleansing, and remote data synchronization in the same architecture. It further simplifies application development and processing across data sources by providing a single virtualized view of data across your organization.

Perform transaction and analytical processing in-memory and make data immediately available from **a single system**.

SAP HANA is for your existing applications – legacy software, third-party software, and SAP® software – and is optimized for building and deploying next-generation, real-time applications; machine learning applications; and predictive analytics. You can perform business operations and data analysis in minutes rather than hours, untangle your data center operations by integrating data into a single source, and lay the groundwork for reimagining business models.

SAP HANA is optimized for the latest persistent-memory technology from Intel. Furthermore, it provides several data-tiering options and is available through various deployment models in the cloud and on premise, so you can choose the deployment that best fits your business needs without compromising flexibility and cost. SAP HANA democratizes in-memory computing so you stand ready to expand and diversify your business with minimal IT growing pains.

Figure: Building Next-Generation Applications with SAP HANA



Tally the Features and Benefits

The following tables summarize the features of SAP HANA that contribute to making it unique in the industry.

Database

Feature	Description
In-memory, columnar, massively parallel database processing	SAP HANA permits transactional and analytical workloads using a single instance of the data on a single platform. It stores data in high-speed memory, organizes it in columns, and partitions and distributes it among multiple servers. This delivers faster queries more efficiently than aggregate data while avoiding costly full-table scans, materialized views, and analytic indexes.
Full ACID compliance	SAP HANA helps ensure compliance with requirements for atomicity, consistency, isolation, and durability (ACID) standards. A two-phase commit protocol protects atomicity, while multiversion concurrency control and distributed transactions help guarantee consistency. A built-in transaction manager safeguards isolation, and the logger provides durability by writing commit-log entries to persistent storage.
Multitenancy	SAP HANA allows multiple tenant databases to run in one system, sharing the same memory and processors. Each tenant database is fully isolated, with its own database users, catalog, repository, data files, and log files for maximum security and control. You can move or copy tenants to other systems. Your high-availability and disaster-recovery settings apply for all tenants. Backup and recovery are supported at the tenant level or the system level.
Multitier storage	SAP HANA offers various software solutions to manage multitemperature data (hot, warm, and cold) with an improved price-performance ratio. It also helps easily manage data through its lifecycle and the various available storage tiers. SAP HANA native storage extension is a built-in capability to store warm data in persistent storage, in both scale-up and scale-out configurations, such as a solid-state drive. Tables, columns, and partitions can be paged to disk, and administrators receive automated recommendations based on actual usage for data that could be moved to warm storage. Data is intelligently moved back into memory if queried by users. The data lake component of SAP HANA Cloud enables massive scaling to petabytes of storage and offers easier access through standard SAP HANA Cloud database clients. Data storage in the data lake can also be used by SAP HANA on premise or in the cloud to expand the storage footprint in the cloud.
Persistent memory support	With Intel® Optane□ persistent memory, you can process larger volumes of data in real time with increased memory capacity while reducing total cost of ownership through lower data management and storage costs. Business continuity is improved and downtime is reduced through minimized time to load data at the startup of SAP HANA, as data is persistent in main memory, enabling near-DRAM performance in a more affordable way. Learn more.

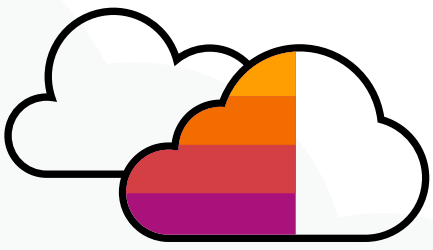
Feature	Description
Data modeling and stored procedures	SAP HANA offers a native language called SQLScript that lets you build stored procedures and use advanced capabilities to create complex logic that runs inside the database. It includes a business function library with built-in, parameter-driven financial functions. In addition, it includes a framework that lets you build custom algorithms and run them securely inside the database. Core data services and calculation views further simplify and accelerate the creation of database logic.
Administration	SAP HANA provides comprehensive administration tools to support various levels of administrative capabilities from any device and location. You can use these tools for various platform lifecycle, performance, and landscape management operations and automation, such as start, stop, restart, back up, and recover. You can perform offline diagnostics, automate updates, customize and orchestrate SAP HANA environments, and analyze, simulate, and optimize workloads. SAP HANA cockpit is a modern, user-friendly Web administration tool based on the SAP Fiori® user experience (UX) that supports multiple instances of SAP HANA in your system landscape. SAP HANA cockpit includes advisors that provide recommendations based on actual operating conditions for system optimization, data distribution, and data tiering. Furthermore, there are tools to analyze SQL execution plans and CPU and memory use over time to pinpoint problems. The SAP HANA hardware and cloud measurement tool helps you analyze, confirm, and optimize your hardware and cloud infrastructure.
Security	Embedded technology for real-time data anonymization lets you squeeze maximum value from your data while supporting compliance with increasingly strict data protection regulations. Robust authentication, user management, and authorization protocols help ensure that users access only the data they have permission to see and handle. Extended Lightweight Directory Access Protocol (LDAP) integration enables automated user provisioning and native LDAP authentication. Combined with sophisticated encryption for data, both at rest and in motion, these techniques give SAP HANA solid security against cyberattacks and unauthorized data access. The local secure store for SAP HANA supports extended key management using external key servers available through the SAP Data Custodian key management service. Dynamic data masking for tables and views lets you display only what each user is authorized to see, while data access can be recorded in the standard auditing framework. And since complex security authorizations can be shared easily between native SAP HANA applications and extensions and SAP business applications, developers can create innovative applications on SAP HANA covered by the same 360-degree security strategy. Learn more about data security and data anonymization.

Feature	Description
High availability and disaster recovery	SAP HANA supports high availability and disaster recovery to meet a broad range of service levels through an array of techniques such as backup; storage mirroring; synchronous, asynchronous, and multitarget system replication; hot standby; auto restart; invisible takeover; and auto failover. It supports standbys at campus, metropolitan, cloud-backup, and remote locations for maximum availability and cost efficiency. Several third-party backup and recovery tools are certified to work with SAP HANA as well, so you have your choice of approaches. The SAP HANA, active/active read-enabled option allows IT organizations to leverage secondary systems to offload read-intensive workloads for additional load balancing, local read access to data, and better hardware utilization.
Scaling up and out	SAP HANA supports multiple terabytes of data in a single server and scales further by implementing a shared-nothing architecture across multiple servers in a cluster. You can distribute large tables across these servers automatically, based on round-robin, hash, or range-partitioning rules.

Smart Multi-Model Capability and Advanced Analytics

Feature	Description
Smart multi-model capability	SAP HANA is a multi-model database that can store, process, and analyze multiple data types in a single, scalable solution. Intelligent technologies such as natural-language processing, text mining, and machine learning let you augment and improve business processes with data-driven insights. Learn more.
Spatial processing	Add spatial intelligence to your business data to gain deeper insights, identify new opportunities, and discover root causes of complex issues, using the high-performance, native geospatial data processing in SAP HANA. Business intelligence and analytics tools can directly leverage this performance to execute rapid calculations, get precise answers to queries about proximity, distance, and location, and create detailed, geographically relevant insights. SAP HANA provides native storage for 2D, 3D, and 4D vector data types and offers more than 100 in-memory geospatial functions and predicates that integrate into SQL. This allows you to rapidly create and deploy powerful analytic tools. The unified modeling environment also supports other multi-model data types, such as graph, JavaScript Open Notation (JSON), machine learning, and search functionality. SAP HANA supports many open standards, such as Open Geospatial Consortium Simple Feature Access, ISO SQL multimedia (ISO SQL/MM), and geospatial JSON (GeoJSON), so you can exchange spatial information with third-party spatial solutions to develop enterprise-wide location intelligence. Live spatial intelligence in SAP HANA enables organizations to create location-aware business applications faster and adopt advanced spatial capabilities, helping eliminate the barriers to accessing geospatial data. Learn more.

Feature	Description
Graph	Analyze complex relationships in your business data and processes to boost performance and business understanding with graph processing in SAP HANA. This feature allows you to store and analyze highly connected data and relationships among business entities. The built-in graph algorithms and functions leverage the power of SAP HANA in-memory technology. Storing and querying graph data is supported through SQL and openCypher, a well-known query language for graph databases used for pattern-matching queries. Data scientists can leverage graph functions more easily through the Python interface.
Predictive modeling and machine learning	Augment and improve business processes with data-driven insights from embedded and external machine learning. With the predictive analysis library in SAP HANA, you can use more than 100 classic and trending ensemble algorithms for key machine learning scenarios, such as classification, regression, cluster, time series, text mining, and recommendation systems, as well as for data preprocessing and statistics through unified interfaces. SAP HANA offers automated in-database machine learning for developers and business analysts. You can also integrate SAP HANA with the TensorFlow external machine learning framework and R environments for specific statistical functions.
Document store	SAP HANA supports native storage for JSON documents. With the document store, you can confidently store and manage complex business data in its native structure with flexible and simplified integration options. It allows for schema flexibility and supports nested objects and arrays so data can be stored without defining a schema up front. The document store is also implemented as optimized data storage that allows you to leverage the full power of SAP HANA in-memory technology without converting data to relational tables. The standard interface is SQL. As a result, you can integrate JSON documents and use it with other applications running on SAP HANA. The document store is natively integrated with the data structures of common programming languages, such as Python.
Enterprise search	Enhance business applications with customized search capabilities across your enterprise data sources and solutions. With enterprise search in SAP HANA, you can build powerful search tools for your applications that span various data sources. Search models can be designed in a free-style manner with no predefined search pattern, and the results can be navigated to and accessed directly using the search feature. In addition, result rankings can be customized for each search model based on data views and without data replication. Developers have access to a software development kit that offers reusable components for the search engine, service, and UI. Search models and services in SAP HANA can be exposed to applications using OData and SQL.



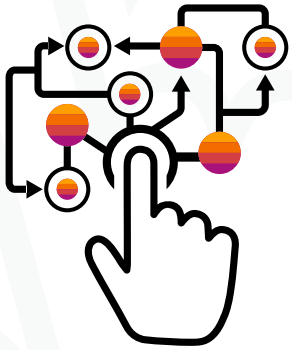
SAP HANA democratizes in-memory computing and offers a broad range of **multi-cloud deployment options** across public and private clouds.

Application Development

Feature	Description
SAP HANA extended application services	This offering is a built-in application server that helps you develop services, such as REST and OData as well as Web-based applications that can run on premise, in the cloud, and on mobile devices for efficient processing of large amounts of data. The extended application services engine is independently scalable from the database server to meet demanding requirements of applications. In addition to supporting multiple programming languages, including Java, JavaScript (Node.js), and Python, it also allows you to bring your own language and reuse existing code or function libraries, enabling a high degree of efficiency and making it ideal for building applications based on a microservices architecture. An advanced extended-services cockpit makes all these activities available through a modern UI. With SAP HANA, you can choose among various open-source development tools, such as Git, GitHub, and Apache Maven.
Clients	SAP HANA provides many client libraries for accessing SAP HANA from other application platforms. It includes standard ODBC/JDBC drivers; ADO.NET and .Net Core support; and native libraries for Python, Go, Node.js, Ruby, and Hibernate support. SAP offers native Python and R machine learning APIs to leverage SAP HANA and its built-in machine learning libraries directly from common Python and R environments. For both environments, machine learning clients with even more complete function coverage and visualizations are also available.
Responsive Web applications	SAP HANA includes an HTML5 and JavaScript framework (SAPUI5) based on the SAP Fiori UX that lets you develop responsive Web applications. These applications run on any device and adapt automatically to screen size, delivering a consistent look and feel across touch points.
Application lifecycle management	Integrated application lifecycle management helps you build and package applications, transport them from development to test to production, and deploy and upgrade them.
Application development tools	To develop applications with SAP HANA, you can use lightweight, Web-based development tools. SAP Web IDE for SAP HANA is a browser-based development environment for data modeling, application development, database administration, and security management. And, if you prefer the ABAP® programming language, the development environment in ABAP includes optimized features that help you build extensions to SAP applications on SAP HANA with a minimal learning curve. You can also use SAP PowerDesigner® software to model data for building enterprise architecture.

Data Management

Feature	Description
Data virtualization, federation, and integration	Data federation using smart data access lets you access information transparently from many remote data sources without moving data from remote sources to SAP HANA. SAP HANA provides built-in adapters to help you access data from a wide array of sources and a software development kit (SDK) to build custom adapters. SAP HANA supports comprehensive features to handle data integration scenarios. These include real-time data replication as well as bulk-load processing, data transformation, cleansing services, and data enrichment services. Adapters are available for loading data from several databases, cloud sources, and Apache Hadoop, along with a custom SDK for building your own adapters. SAP HANA includes functionality to enrich geospatial data and algorithms to cleanse personal names, titles, phone numbers, firm names, and e-mail and street addresses. SAP HANA provides multiple options to analyze Apache Hadoop data, including the SAP Data Intelligence solution, the SAP Data Intelligence service, an Apache Spark adapter, and Apache Hive. You can access data in the Hadoop distributed file system and access MapReduce functions as data sources in SQL using user-defined virtual functions.
Hybrid extensions with SAP HANA Cloud	Hybrid scenarios allow you to leverage your on-premise software investment while still taking advantage of the flexibility of the cloud. Use SAP HANA Cloud as a single gateway to data. Augment on-premise data sets through access to such remote targets as Amazon Athena and Google BigQuery. Load large data sets from cloud object stores, such as Microsoft Azure Blob Storage, Azure Data Lake Storage Gen2, or Amazon S3, for extended, large-scale analysis with SQL support. Replicate data from SAP HANA to SAP HANA Cloud more easily and in real time. Enable massive scaling to petabytes of storage with the data lake for SAP HANA Cloud and leverage data storage on premise or in the cloud.
Data quality	Standardize, identify, cleanse, and correct duplicate records, enrich address data with geocode intelligence, and manage other data quality issues across domains and sources in one user interface.



Become an **intelligent enterprise**
in a data-driven economy.

Choose from Multiple Deployment Options

SAP HANA scales up and out to support many deployment scenarios and is available for use in public and private cloud environments. For on-premise installations, SAP HANA supports performance-optimized deployment on hardware appliances from SAP partners, with an option to build custom hardware based on a tailored data-center model, or to choose a hyperconverged infrastructure (HCI) environment. A tailored data-center model lets you use existing hardware and infrastructure components, such as storage and network devices and processors, for your deployment of SAP HANA. You can find more about certified and supported hardware here.

For companies that have embarked on a software-defined data-center strategy, SAP HANA supports virtualization software and hardware logical partitioning.

In the cloud, SAP HANA is available in a database-as-a-service model known as SAP HANA Cloud, which is a comprehensive infrastructure combined with managed services; or through either SAP HANA Enterprise Cloud, which is a private cloud service managed by SAP, or public cloud service providers such as Amazon Web Services, Google Cloud Platform, IBM Cloud, and Microsoft Azure. In any deployment you choose, SAP stands behind privacy, security, and availability. For details on the various deployment options of SAP HANA, see the Landscape Definition Guide for SAP HANA.

To jump-start innovation, sign up for your free trial of SAP HANA Cloud, either as a stand-alone service or included in the free tier model of SAP Business Technology Platform (SAP BTP). Alternatively, the express edition of SAP HANA offers a streamlined version of SAP HANA that is available free of charge in a basic configuration. It can be installed on your laptop or desktop computer (Windows PC or Apple Macintosh), on Linux-based servers, or on a virtual machine. Alternatively, you can deploy it on various popular cloud platforms. For more information, visit us online.

SAP HANA provides comprehensive **smart multi-model and advanced analytic processing** on data in real time, be it local or virtually connected.

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