Basen
Billions of..

BaseN Service Description:
Industrial Internet (of Things)

The BaseN Platform

Version: 0418v6

www.basen.net

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Introduction

Welcome to the BaseN service description covering our fundamental platform capabilities and core functionality. The purpose of this document is to provide a solid understanding of how our solution is architected and how it works as a common platform for wide range of different Industrial Internet and Internet of Things (IoT) areas in the most generic sense. As we with our customers already support many different specialized IoT verticals since several years, these cases are covered in other documents detailing the specifics of each particular IoT area. Ask your designated BaseN representative for how to obtain additional information about these.

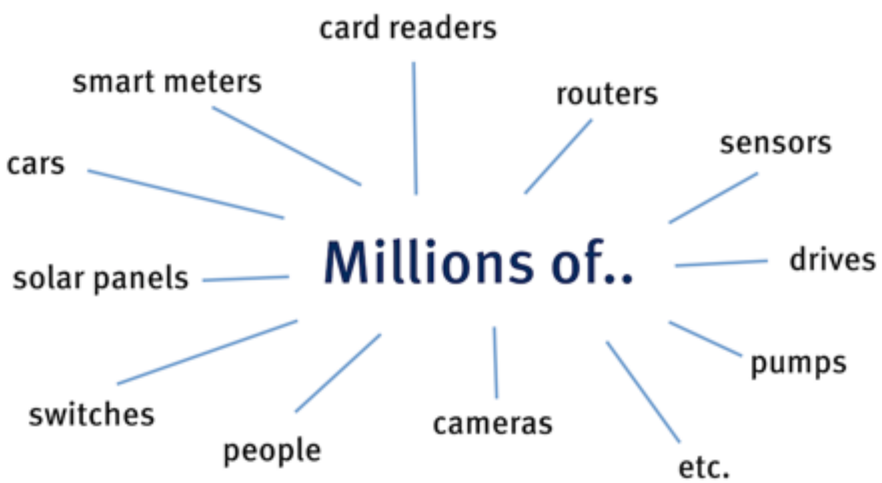
Company Overview

BaseN Corporation is a multinational corporation with fully owned subsidiaries in The Netherlands and United States. Founded in 2001, BaseN is owned and controlled by its original founders. Profitable since many years, the company has never raised venture capital by design. BaseN also has investments in companies operating regional Internet exchanges as well as ones manufacturing industrial control solutions.

In addition to its own development team, BaseN has a growing number of external developers, currently more than 200, in partner companies creating and maintaining application specific solutions on top of BaseN Platform. We foresee the amount of external developers rapidly increasing with the global introduction of the my.basen self-provisioning service.

BaseN provides both dedicated and shared services out of global data centers to customers in the United States, Finland, Belgium, India, Indonesia, Czech Republic, Sweden, South Africa, and Spain.

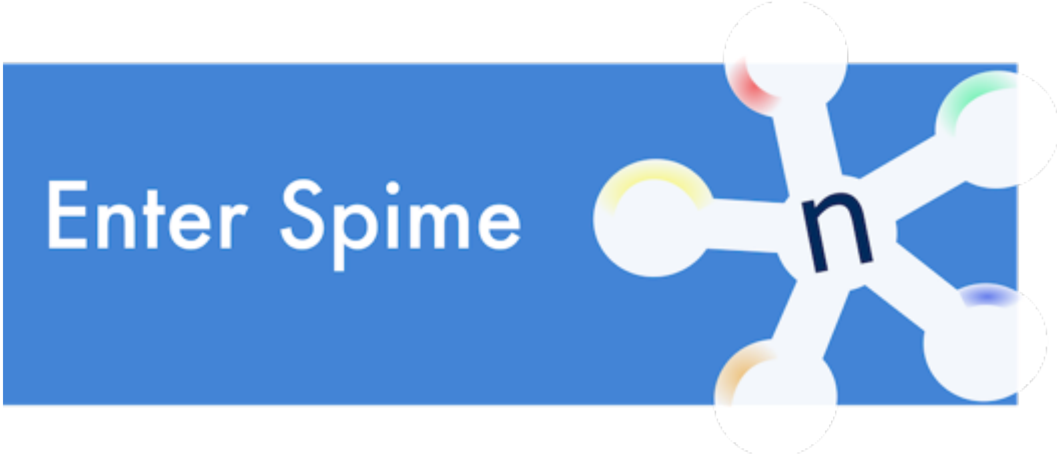
BaseN was established to provide extremely scalable and fault-tolerant network and service management systems for telecommunications operators and large multinational enterprises, and is positioning itself as the primary platform for Spimes in the Industrial Internet and Internet of Things (IoT).



The BaseN Platform

Architecture and Design Principles

BaseN is a mature Software as a Service (SaaS) and Platform as a Service (PaaS) provider, launched and in continuous development since December 2001, providing an extremely scalable, fully distributed, resilient, secure, and combined real-time monitoring and control platform for ICT, M2M, and IoT combined. BaseN provides new ways to capture, store, process, analyze, visualize, and control extreme volumes of things and data real-time, which enables next generation digital businesses to greatly improve what they do and how they do it.



At the core of the BaseN design philosophy is the concept of Spime, a logical incarnation of any thing. Spimes record and manage the full lifecycle of their physical representations as physical hardware and support software come and go. As such an object can be considered a Spime when all of its essential programming is managed in the cloud. The Spime concept was originally crafted by the author Bruce Sterling as a neologism for a futuristic Internet of Things object (see http://en.wikipedia.org/wiki/Spime).

Spime is patented by BaseN and the next generation extension of Digital Twin: US Patent (Pending) # 20170139788 (https://patents.google.com/patent/US20170139788A1/en) A Spime is the complete logical software description and mastering reflection of a physical object, typically a device or any other entity that performs a function, or series of functions, in a digital service. The Spime is defined and conceived before the appearance of its physical counterpart. In this sense, a Spime is independent of its physical representation, which can come and go and be easily replaced.

Grounded at the core of BaseN's pioneering distributed computing platform design philosophy and architecture, Spime enables the extreme levels of fully automated adaptability, sustainability, scalability, reliability, and security. These are all so critical elements in the future digital world of connected objects, but something that conventional data process, conventional storage systems and conventional service providing systems simply cannot cope with sufficiently well.

Because the core of BaseN platform's operational nature is fully based on a Spime architecture, it lends itself to fully enabling digital services which evolve and which have the capability to change over time. This is opposed to static instances of services, such as conventional software designs that need to be manually redesigned and re-launched whenever a change is needed.

Examples of components and entities defined and managed by Spime:

- Devices and device types and versions
- Device attributes and roles and relationships
- Device communications and security protocols
- Device and component control and configuration management functions
- Accounts and account data, all user interaction data, and security

- Data storage systems and failover mechanisms
- Data and analytics processing and computation components
- Software versions and attributes
- Presentation, portal, and end-user experience technologies, graphing engines and formats
- External API types, API versions, and systems communications with external and 3rd party ecosystem components
- All components and aspects of the BaseN platform itself

Additionally, BaseN provides a solution known as “Spime Enablers”, to drastically shorten time to market for (3rd party) devices and components that have not yet been upgraded to communicate via standard means over the Internet. BaseN has a series of options for customizing, deploying, and pairing Spime Enablers with such legacy devices and components.

The BaseN Platform Operating Environment (BPOE) is a stable, optimized and hardened Linux based operating system that runs on top of bare metal hardware providing a reliable layer for the BaseN platform software to run on. The platform itself is deployed with rigorous version control, security rules and demarcation points. It also includes a high level of automation, auto-discovery and self-configuration making new or incremental installations fast and simple.

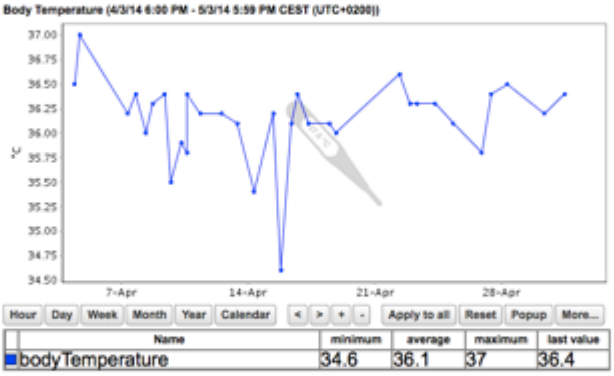
The BaseN platform is highly agnostic to which specific hardware platforms it can be installed and run on and we support a range of both virtualized and non-virtualized options. For example, our platform software currently runs on ScLinux (ScientificLinux) but we can also fit our agent software on an SD card, such as the RaspberryPI. The exact server models, versions, and configurations we run on changes fairly quickly as these keep evolving rather rapidly. Please consult your designated BaseN representative should you wish to have detailed and up to date information about these environments at any given point in time. Also note that if for example servers are used for long-term data storage, memory and disk allocations are adjusted accordingly.

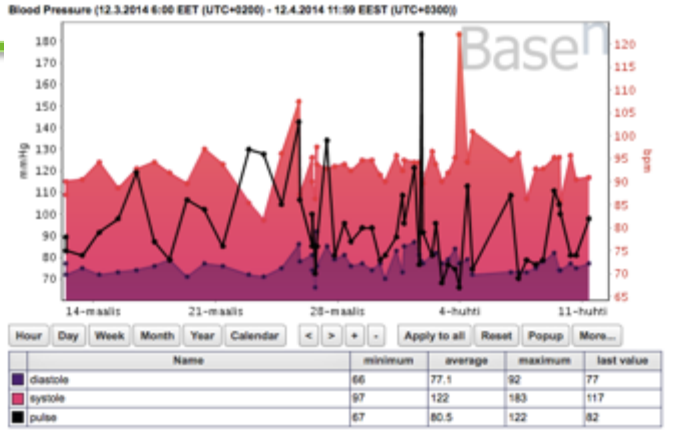
The platform is designed for multi-tenancy from the start. It provides secure Spime containers for customers for their own and their customers’ things in massive scale.

Agents or microagent units perform measurement and control functions. Agents are commodity servers (COTS) that support a large number of standardized data protocols; they are installed on or near the device layer and typically manage from hundreds to tens of thousands of devices. Microagents are based on API communications and allow a range of implementation options by embedded devices to nanocomputers monitoring smaller targets.

The core of the platform consists of data reception and storage components optimized for scalability, high volume and replication. All components can be added or removed on the fly, allowing both reception capability and storage period to be expanded as required.

The services layer that refines the data to produce exported signals, visualizations, configuration logic, and user interfaces, is similarly based on a dynamic service scheme and expands to meet the needs. The platform standard user interface is web based. An adapter based authentication and multi-layer access scheme allows for granular per user or group visibility into data. The user interface, the measurement and export logic are programmable, and the external API permits specialized interfaces (e.g. systems integration or tablet/phone apps) that can for example access measurements, store data or control remote equipment.





In addition to being able to visualize data collected within the BaseN platform on a very granular level, BaseN also provides several alternatives of open and easy to use northbound APIs (including REST and JDBC) for obtaining not only fault and performance management data but also the raw measurements for external use, and customers may utilize all the rich analysis capabilities of BaseN platform in addition to their own. Customers may also subscribe (listen) to certain channels and choose to receive data in real time for those channels as it arrives from devices.

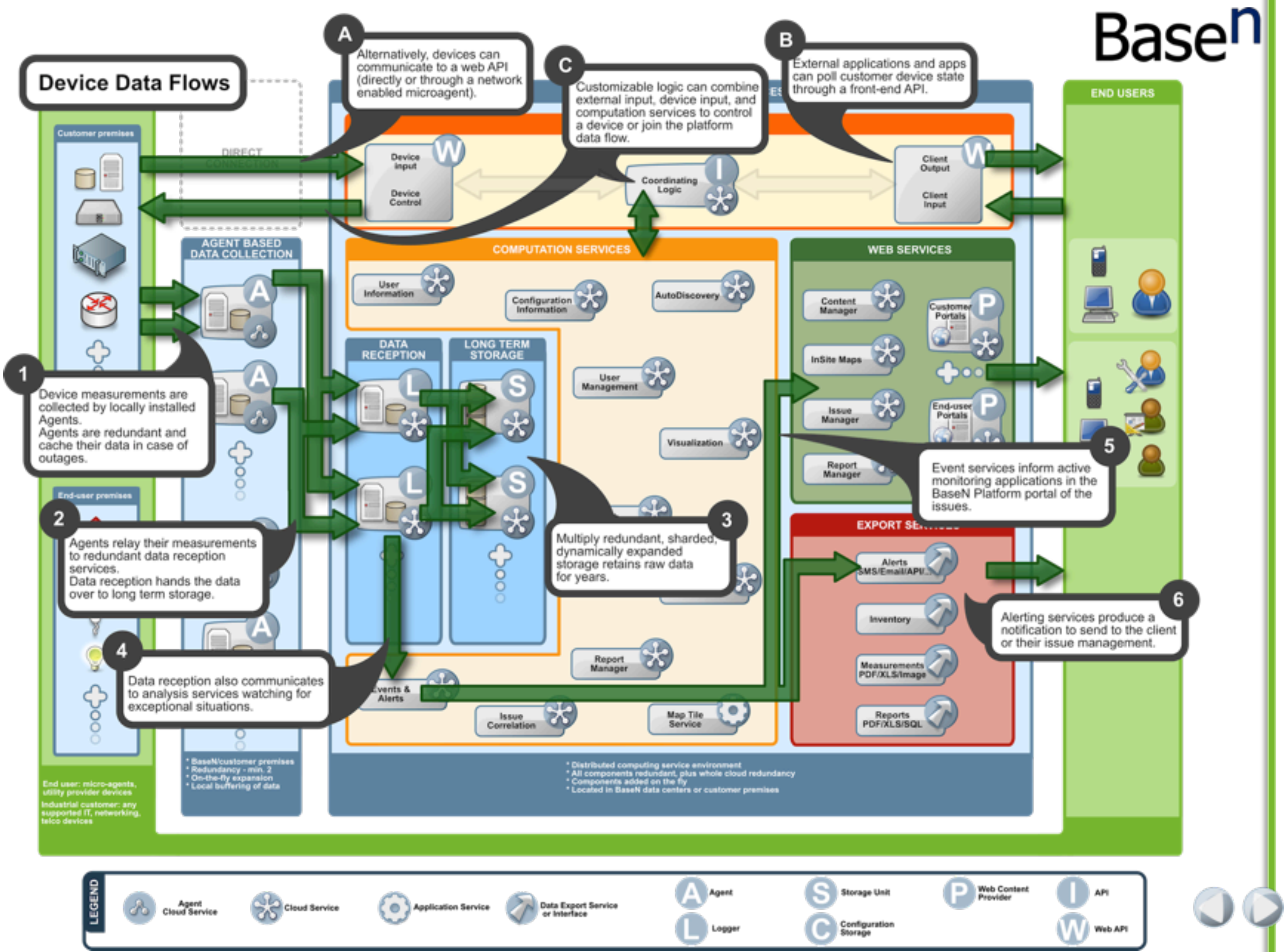
The BaseN platform also provides a container framework, boasting millions of full-fledged virtual computers capable of executing complex programs, Spimes, in various programming languages. These Spimes have access to all historical data and combined parallel processing power of the BaseN platform and can execute a multitude of fine tuned control functions in IoT environments.

Each Spime created and maintained in BaseN platform has full version control and rollback capabilities, including complete audit trail.

The BaseN platform is capable of control functions such as distributed software upgrades, complex end-to-end network configuration, power consumption control based on time of use pricing and for predefining heating cycles, managing AC and fans based on in-room CO2 levels, engine optimization through adjustment of car settings based on weather data, automated worksite gate management, healthcare crew dispatch based on real-time patient data, just to name a few examples.

BaseN microagent protocols have also been developed for automatic distribution of computing and storage resources, enabling seamless operation of Spimes both in local, millisecond-grade agents as well as in a centralized BaseN data centers with thousands of CPUs. The Spime master objects, however, always reside in BaseN platform and are automatically delegated to local microagent devices when needed.

BaseN's framework for control functions supports completely “headless” devices as well as highly sophisticated devices with local intelligence alike, and will be fully supported in the my.basen self-provisioning service.


Device Data Flows
BaseN
END USERS
Customer premises
End-user premises
DIRECT CONNECTION
AGENT BASED DATA COLLECTION
COMPUTATION SERVICES
WEB SERVICES
EXPORT SERVICES
DATA RECEPTION
LONG TERM STORAGE
Device Input
Device Control
Coordinating Logic
Client Output
Client Input
User Information
Configuration Information
AutoDiscovery
User Management
Visualization
Report Manager
Issue Correlation
Map Tile Service
Events & Alerts
Content Manager
InSite Maps
Issue Manager
Report Manager
Customer Portals
End-user Portals
Alerts SMS/Email/API/...
Inventory
Measurements PDF/XLS/Image
Reports PDF/XLS/SQL
A Alternatively, devices can communicate to a web API (directly or through a network enabled microagent).
B External applications and apps can poll customer device state through a front-end API.
C Customizable logic can combine external input, device input, and computation services to control a device or join the platform data flow.
1 Device measurements are collected by locally installed Agents. Agents are redundant and cache their data in case of outages.
2 Agents relay their measurements to redundant data reception services. Data reception hands the data over to long term storage.
3 Multiply redundant, sharded, dynamically expanded storage retains raw data for years.
4 Data reception also communicates to analysis services watching for exceptional situations.
5 Event services inform active monitoring applications in the BaseN Platform portal of the issues.
6 Alerting services produce a notification to send to the client or their issue management.
End user: micro-agents, utility provider devices
Industrial customer: any supported IT, networking, telco devices
* BaseN/customer premises
* Redundancy - min. 2
* On-the-fly expansion
* Local buffering of data
* Distributed computing service environment
* All components redundant, plus whole cloud redundancy
* Components added on the fly
* Located in BaseN data centers or customer premises
LEGEND
Agent Cloud Service
Cloud Service
Application Service
Data Export Service or Interface
Agent
Logger
Storage Unit
Configuration Storage
Web Content Provider
API
Web API

Device Connectivity and Communications

The BaseN platform supports over 100 different communications protocols for managing various devices. Our preference is to use standards based, open protocols to exchange data with devices. Protocols suitable for telemetry and control of field devices could be e.g. CoAP (Internet Engineering Task Force (IETF), Standards Track for IoT) or Message Queuing Telemetry Transport (MQTT, OASIS). The Platform also presents these standardized interfaces also to developers enabling them to develop the connectivity portion – device/function proprietary measurement to transport – themselves. In addition, BaseN and its partner companies are able to assist with integrated hardware and software design related to the connectivity portion (such as interfacing GPIO/SPI/UART bus on a microcontroller with a 2G/3G/4G System-on-Chip).

BaseN normally suggests using standardizing the communications protocol utilized between its platform field devices to the Internet Protocol (IP) version 4/6, and the primary device connection method to be an encrypted connection over the Internet. This significantly lowers the cost of connectivity, as the Internet is ubiquitous in most countries. However, for high security implementations fully closed BaseN platform environments can be built.

Additional means of connectivity are also readily available, such as:

- Mobile broadband (machine to machine, M2M) via private Mobile Network Operator interconnection bypassing the Internet completely
- Tunneling inside an IPSec Virtual Private Network (VPN)
- MPLS VPN service to plant with guaranteed Quality of Service
- Satellite connectivity via Very Small Aperture Terminal (VSAT)

The end goal is to have the BaseN platform reachable by the field devices through any reasonable means wherever they may be located. It already hosts several thousands of templates for different types of device connectivity and communication paired with specific monitoring and control function scenarios, and templates are continuously being added or expanded on.

The BaseN platform is fully compliant with both Internet Protocol versions 6 and 4. While the connectivity between devices and the platform typically is bidirectional, it is always the equipment on the customer side that initiates the connection. All connections should be long-lived, if at all possible, to reduce connection setup overhead and latency. Data received from field devices can be stored and processed in at least two different data centers for geographical redundancy.

Communication from devices themselves can typically be secured by standardized encryption protocols such as Transport Layer Security (TLS), in the case of HTTPS, or with Datagram Transport Layer Security (DTLS), in the case of CoAP (Constrained Application Protocol), that prevent eavesdropping. BaseN also supports other methods such as AES with pre-shared key, which can be used to encrypt communications between very low resource microcontrollers and the platform instead of full-blown TLS.

Based on significant experience in implementing proprietary protocols, BaseN does not generally foresee any issues with implementing various customer specific protocols on the platform side, as long as protocol descriptions are available.

Scalability

BaseN's grid architecture enables the adding and removal of capacity on the fly for each service provided by the platform. It utilizes all computing resources available on all physical servers and distributes any user requested or algorithm generated function dynamically to best available resources.

The BaseN platform has been designed to operate in a distributed, multi-site environment that is able to grow seamlessly over time. It is able to discover, utilize and blacklist resources on the fly – a fact that makes it very tolerant to faults such as network partitioning events, data center power failures or even natural disasters. Services prefer to utilize resources local to the site first but may utilize resources at any other data center, too.

The basic compute resource in the grid architecture is a Compute Unit (CU). Each server participating in the grid has as many CUs as it has logical CPUs. The number of CUs is dynamically tuned according to server load caused by other processes. CUs are utilized by core platform services such as algorithm initiated tasks, drawing graphs, rendering pages, data query calculations and calculations that use BaseN's mathematical filter expressions. Requests that require processing of large quantities of data are divided into as many CU tasks as possible resulting in significant speed increases due to parallelization.

The core of the platform consists of data reception and storage components optimized for scalability, high volume and for replication. On commodity hardware a standard 2 rack unit (RU) storage node is able to process and store over one million measurements per second. Storage nodes can be added on the fly, allowing both reception capability and storage period to be expanded as required. The storage nodes utilize BaseN's own measurement storage, developed in-house, that is optimized especially for time-series data. The measurement storage utilizes queuing and journaling to ensure reliable and efficient storage. It also provides lossless compression, which delivers compression ratios between 40:1 and 100:1. Adding more storage is as simple as installing new nodes and letting them join the platform grid automatically.

The BaseN platform's measurement storage utilizes Consistent Hashing to decide on which storage node to place received data. Consistent hashing is a way of distributing data using a hashing algorithm to determine its location. The algorithm uses a customer identifier and a unique measurement identifier to place the data on a storage node. In addition, any received data is stored redundantly on two or more storage nodes typically in two physically separate locations.

Information Security

As described previously the BaseN platform runs on top of a hardened, BaseN customized Linux distribution that only runs services essential for operation of the platform in order to minimize attack surfaces. Each server has also a firewall that is controlled by the platform application control process that allows for communication between platform servers and disallows the rest. The operating system and the platform are distributed as signed packages and there is a full inventory log of the pieces of software installed on each and every server. The servers access only BaseN's software repositories for updates.

BaseN strongly recommends using only encrypted communication between field devices and the platform (southbound), and between the platform and users/servers (northbound). Such protocols rely on TLS or DTLS, certificates based on X.509v3 Public Key Infrastructure.

By default the BaseN platform uses an internal user database but is able to use one or more Lightweight Directory Access Protocol (or Active Directory) servers to authenticate and authorize individual users or groups of users. It also keeps detailed logs of all login attempts whether successful or not. Several Single Sign-on (SSO) solutions for federated access management (FAM) are supported.

The platform is able to detect, mitigate and rate-limit misconfigured or malicious device/service clients via device specific, group specific or equipment category specific limits (example: each RFID aggregation device is allowed to send no more than 15 measurements/second, all RFID devices at a particular site are not allowed to exceed 500 measurements/second).

Complete change management records are kept for each and every change made by customers to command data, measurements and reports. The BaseN platform also provides an interface to view such changes in full detail. All modifications to the configurations on the platform are fully logged allowing for rollback to any point in history per measurement or device.

For field devices, each device should internally be identified by preferably a tamper proof identifier such as Universally Unique Identifier (UUID) or contain a private and public key pair in the form of a X.509 certificate that is signed by a trusted Certificate Authority. It is not sufficient to use an interface's MAC address as the unique identifier for a device.

BaseN Deployment Options and the Notion of Scopes

Based on 16 years of experience with sometimes very different customer deployment requirements, BaseN has developed support for several options for how its platform can be deployed and operate. Customers can be serviced from BaseN-run public clouds, private dedicated clouds, and through hybrids of these. In addition, BaseN supports so called Global, Regional and Local scopes. This enables full flexibility of data, algorithms, analytics and execution environments based on various business, policy, and regulatory requirements.

In a public cloud setup multiple BaseN customers are typically serviced from the same BaseN platform instance, however with data always strictly partitioned based on customer identity and ownership.

In a private dedicated cloud setup, one full instance of the BaseN platform is installed and operated inside one or more of particular customer's datacenters and inside that customer's network, servicing only that customer.

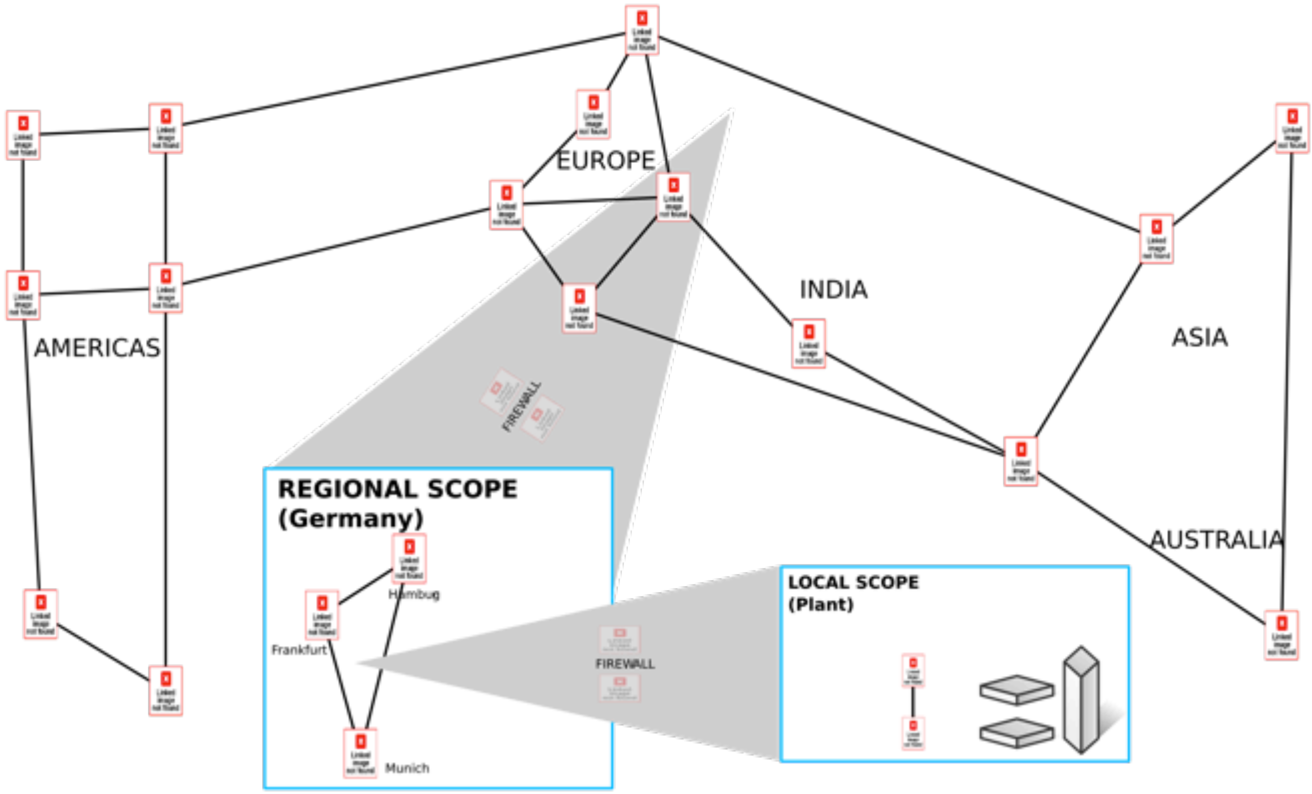
In a hybrid cloud setup the first tier in the BaseN architecture, the agents, are deployed inside the customer's network while the rest of the BaseN platform operates from a public cloud setup. In either case the BaseN platform is provided and managed as a service (SaaS), and connections between domains are typically established with a high level of encryption.

Global scope includes devices and applications provided to global markets. Resources and services are provisioned from BaseN's many data centers strategically located next to major telecommunications interconnection points, all connected over a high-speed network.

In Regional scope services are provisioned and provided within an administrative area, such as a country, due to data security, privacy and related regulation and legislation.

Local scope defines millisecond grade monitoring and control of devices and services. In practice this means that an instance of the BaseN platform is built and operated within the facility the device(s) reside in due to constraints set by the speed of light.

GLOBAL SCOPE



All the scopes share the same basic components; whether they're Global, Regional or Local, they are constructed using the same engineering principles and using the same commonly available off-the-shelf hardware (COTS).

In global and regional scopes all the platforms are operated by BaseN and backed with our existing partnerships with major global service providers and operators.

In the deployment phase, BaseN is responsible for the complete architecture, design, hardware, colocation, telecommunication services acquisition and global project management. BaseN's founders and employees, several of whom have founded Internet Service Providers or carriers, have significant experience with constructing mission critical networks, data centers and services.

In the operating phase, BaseN is responsible for day-to-day operations, capacity planning and maintenance in the global and regional scopes, and in local scope on case-to-case basis. BaseN operates the platform, replacing faulty hardware and fixing issues with the software on continuous basis, with minimal service interruptions. Hardware lifecycles are managed continuously with upgrades and decommissioning of outdated and energy inefficient components.

BaseN's Pricing Model

Pricing for a default deployment scenario of the BaseN platform service is based on an upfront, and with the customer agreed to, calculation of the committed transactions per second the BaseN platform data collectors are required to be able to handle. This in addition to a base fee amounts to a Monthly Recurring Charge (MRC). BaseN's ability to process these data flows is expressed and priced in committed transactions per second.

Under this pricing mechanism, the customer only incurs cost when committed measurements and controls have been configured into the BaseN platform. In BaseN terminology a transaction is an atomic measurement or control function.

Calculating and Controlling Committed transactions per second:

Measurements: A measurement is a single, atomic value stored on the BaseN platform. Using RFID tags as an example, if devices are logging a list of tags, the corresponding antenna and signal strength, the ID of each tag, the antenna on which it was read, and the signal strength of the tag response are all considered equal and independent measurements.

Committed transactions: The total number of measurements and controls that have been configured in the BaseN platform to be the maximum number of transactions to be transmitted in any given second.

Based on number of committed transactions, BaseN's Monthly Recurring Charges (MRC) are available in different tier levels, with tier increments being defined in groups of several thousands of transaction units. Ask your designated BaseN representative to receive detailed information about our pricing tiers.

In addition to MRC based on the selected pricing tier(s) corresponding to the committed transactions per second required, BaseN services also consist of One Time Charges (OTC) usually associated with the start of a new implementation project.

Throttling and controlling data flows:

The BaseN platform provides configurable throttles for device, system and customer and customer sub-division levels in order to ensure billing consistency during traffic peaks or other contingencies. These throttles limit the maximum measurements per second particular devices may transmit, returning a pre-defined error code to the device instructing the device to temporarily pause transmitting data to the BaseN platform ('back off') and to re-transmit the data after a set period of time.

BaseN is committed to its customers' success. Should you have particular needs regarding pricing that deviates from our default approach, please consult your designated BaseN representative, as we can work to adapt our pricing within the realms of what is fair and what makes sense.

BaseN's Project Approach

BaseN uses Project Management Institute's Project Management Professional (PMP) as the required certification grade for its project managers. All internal and external projects are executed using PMI's PMBOK as a guideline.

BaseN utilizes Agile methodology both in its internal software development cycle as well as in customer integration projects. Agile is an iterative and incremental development model, where requirements and solutions evolve through collaboration between the customer and BaseN's self-organizing, cross-functional teams. It promotes adaptive planning, evolutionary development and delivery, a time-boxed iterative approach, and encourages rapid and flexible response to change. As a conceptual framework it promotes foreseen tight iterations throughout the development cycle. BaseN has been using two-week iterations both internally and externally with great success.

A challenge that applies to most of customers is that typically BaseN integrates into an environment where the communications protocols are already in place. In practice this means that BaseN will need to implement the existing protocols correctly. Since this is very common we have developed a large collection of development tools that enable rapid and flexible development of new protocols into our platform. BaseN refreshes the software release more than 20 times per year for most of its customers.

For deployment of infrastructure BaseN will utilize the traditional project management approach, consisting of initiation, planning/design, execution and construction, monitoring/controlling and completion phases.

BaseN continues to participate in numerous mission-critical projects with together with Project Management Offices of several multinational corporations.








BaseN's Operations and Support

BaseN provides qualified engineering support, development resources and 24x7 troubleshooting to its customers. This is also count for northbound (towards external systems) and southbound (towards field devices) interfaces.

BaseN's follow-the-sun Service Operations Center (SOC) model, staffed with experts, handles operation and monitoring of network, platforms and services allowing for uninterrupted 24x7 operation and takes ownership of fault management activities. The SOC works in close cooperation with partner Tier 1 and 2 support centers and serves as contact point for all escalations.

For larger customers a dedicated global service desk is typically put in place, with first and second level support personnel having full situational awareness views of the global and regional environments, its performance, availability, traffic load and security status.

Second level support is capable of supporting the ongoing customer projects and can be dynamically sized to meet the requirements of numerous projects in parallel. The principle is that a customer request arriving at the first level can either be solved immediately or moved to a second level engineer within minutes.

BaseN Qualified Engineers (BQE) predominantly working in the BaseN Service Operations Center provides third level of engineering and operational support.

BaseN actively monitors the service desk performance through ticket response and time-to-solve times, in addition to utilizing automatic customer feedback forms for every ticket raised.

All levels of service are reachable globally by a real-time web interface, telephone, email, and instant messaging.

BaseN also performs periodic failover tests of BPOE redundancy throughout its environment, by shifting loads between datacenters and thus simulating loss of connectivity or unexpected hardware failures. Timing of these tests is naturally agreed upon with customers and results are shared. Should the tests indicate a non-performing hardware vendor, telecom or colocation supplier, BaseN will immediately launch an evaluation project to remedy the situation by either changing the provider or service type.

BPOE capacity planning sessions are typically held together with customers at least twice a year, in order for BaseN to pre-empt hardware and telecom capacity needs well in advance. BaseN may also provide sub-capacity planning sessions for customer projects if the required capacity proves difficult to define accurately upfront.

BaseN's Service Level Agreements (SLAs)

BaseN provides comprehensive Service Level Agreements that apply to both the Platform service, including underlying infrastructure, and Service Desk functions.

Parameter	Availability of Data Collection and Web Services for Devices	Availability of Customer Web Portal	Ability of Platform to Provide Notifications and Reports	Credit
Target level	>=99,99%	>=99,8 %	>=99,99%	0
SLA 1	Greater than 99.95%, but less than 99.99%	Greater than 99.5% but less than 99.8%	Greater than 99.95%, but less than 99.99%	10% of monthly charge (MRC)
SLA 2	Greater than 99.90%, but less than 99.95%	Greater than 99.0%, but less than 99,5	Greater than 99.90%, but less than 99.95%	20% of monthly charge (MRC)
SLA 3	Less than 99.90%	Less than 99.0%	Less than 99.90%	30% of monthly charge (MRC)

Table 1: BaseN Platform standard SLA

Service availability is calculated per month. Both current and historical service status and availability is available for viewing at any time. A month with 30 days has 720 hours and non-availability for it would be as follows:

1% Non-availability 7,2 h outage
0,5% Non-availability 3,6 h outage
0,1% Non-availability 0,72 h, 43min outage
0,05% Non-availability 0,36 h, 22min outage

The BaseN Platform measures all of its components from hardware to operating system to the services themselves and alerts the Service Desk on any detected anomalies. In addition to BPOE internal measurements, the global and regional platforms monitor each other in order to ensure measurement objectivity under high load conditions.

Hardware monitoring covers such things such as memory faults, disk (pre-) failure indicators and chassis temperature. From the operating system monitors CPU & memory utilization, disk space, processes. Finally the Platform ensures its services on each server are properly up and running. BaseN also tracks each device measurement and can alert on a "no data received" condition.

In addition to Platform SLA, the Service Desk SLA includes the following predefined criteria.

Error classification	Response time	Resolution time
Emergency	30 minutes	2 hours
Major	4 hours	12 hours
Medium	1 business day	5 business days
Minor	5 business days	28 business days

Table 2: Service Desk SLA response and resolution times

Exceeding response or resolution times will be considered a breach of SLA and will result in MRC service credits.

Summary of the BaseN Advantage

The key takeaways for why BaseN is ideally suited for IoT operations and next generation digitization:

Spime approach

Grounded at the core of BaseN's pioneering distributed computing platform design philosophy and architecture, Spime enables extreme levels of fully automated adaptability, sustainability, scalability, reliability, and security, and lends itself to fully enabling digital services which evolve and have the capability to flexibly change over time.

Unprecedented scalability

IoT often requires systems to process data from millions or even 10s of millions of devices and objects in real-time, something our fully distributed architecture handles with ease.

Fully owned Intellectual Property Rights (IPR)

BaseN platform does not use any third party commercial licenses. This enables unprecedented commercial scalability for billions of things.

Fault tolerance, security, and no down-times

IoT communications are often mission-critical and because of our fully resilient and secure architecture we can warrant that data is never lost, missed, or misused.

An extensible platform with extensive support for IoT already

Starting off in network fault and performance management, we quickly added monitoring of meters, sensors, RFIDs, and we keep adding support for new devices and objects weekly.

Deep real-time analysis that let you focus on what matters

A 5 million alarm-storm is not useful information unless you are also notified about the root cause(s), and with fully customizable thresholds we are able to let you combine any relevant data types into alarms and events in any combination.

Removes the headache, complexity, and risk with IoT

Our SaaS offering removes the need for large upfront investments in hardware, software licenses, and administration, and we have multiple deployment options: as a public cloud or as a fully private cloud secured inside your data center and network.

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Examples of BaseN IoT Solutions

As mentioned in the beginning of this document, detailed descriptions covering the several particular IoT vertical areas BaseN has been involved in since several years are covered in other documentation, but provided here is highly summarized view of some of them:

- Construction site access control and contract workers location tracking through Ethernet-based RFID/NFC readers, providing real-time resource management as well as historical reporting.
- Retail warehouse inventory tracking, with automatic order creation based on thresholds of volume of goods managed real-time through RFID or bar code tags.
- End-to-End performance monitoring and fault identification with pin-point root cause analysis and SLA tracking for large carrier grade IP/ICT service provider networks, including LTE/4G/5G operators
- Automotive/Connected Car: Collecting data from the vehicle about its current condition, including GPS data about position, speed acceleration, etc., and enriching data with third party information, such as security, for leasing companies, insurance companies and other fleet management related organizations.
- Real-time collection, storage, analysis of information from large volumes of various security monitoring equipment, including alarm loops, radio based systems, cameras, etc., with rule-based triggering of relevant actions based on detection of issue type.
- Monitoring and control of heat pumps and other building equipment in large construction projects, with support of a large variety of equipment vendors and their different types of systems.
- Real-time monitoring and control of refrigerator and freezer temperatures in large retail stores, as part of full cold chain management systems.
- Remote monitoring of patient blood pressure, heart rate, and glucose levels, with real-time and historical trend data reporting and threshold-based alerts being provided to multiple eHealth stakeholders, such as doctors, nurses, emergency care teams, etc.
- Smart Grid and Smart Home monitoring of Smart Meters, electricity sensors and smart appliances, EV charging, residential solar panels, hot and cold water metering, district heating, external and in-home temperatures, with support for load disaggregation, home energy control, and fault and performance monitoring of the IP/ICT fabric itself.
- Remote monitoring, fault and performance analysis of solar inverters in photovoltaic (PV) power plants, from small to medium-sized PV systems in commercial and industrial building up to megawatt sized large power plants.
- Smart and automated management of energy consumption, connected objects, and critical utility assets based on geofence parameters when at home, when at work, and when on the go, including real-time monitoring of EV battery charging levels and identification of available EV parking and charging locations.
- Other solutions include gamma ray radiation analysis, monitoring of airport weather sensors, and monitoring of gas burners in large gas production companies.