

CUSTOM DESIGNS  
**MOTION AND POSITIONING**

**REPEATABILITY**  
SUBNANOMETER  
VACUUM

RELIABLE  
**PILINE**  
**Q-MOTION®**

**PI**

MOTION CONTROL  
PIGLIDE  
**AIR BEARING**

**THE BEST SOLUTIONS**  
ENGINEERED SYSTEMS

FACTS AND PRODUCTS  
FROM THE LEADER  
IN PRECISION POSITIONING

**REPEATABILITY**  
PHOTONICS ALIGNMENT

**LINEAR MOTOR**  
HIGH DYNAMICS  
PIMAG®

# The PI Group

A Strong Partner for Industry and Research



PI (Physik Instrumente) has been one of the leading players in the global market for precision positioning technology for many years. The technological diversity of the PI Group is unique all over the world. PI develops, manufactures, and qualifies all its core technologies itself. PI is therefore not dependent on components available on the market to offer its customers the most advanced solutions.

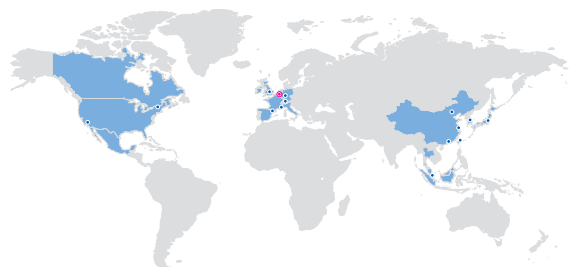
The complete control over vertically linked manufacturing processes allows flexible reaction to market developments and new requirements.

Modern organizational forms such as the fractal production model guarantee efficient production for batch sizes of 1, small series, and also OEM products in large quantities. By acquiring the majority shares in ACS Motion Control, a worldwide leading developer and manufacturer of modular motion controllers for multi-axis drive systems, PI can also offer solutions from one single source to meet the industry's increasing demands on precision and throughput.

The foremost priority for PI is to be a reliable and highly qualified partner for the customer.

## Core Technologies

- In-house manufacturing of piezo components and piezo actuators
- Magnetic direct drives: linear motors and voice coils
- Air bearings, magnetic and flexure guides
- Comprehensive range of piezo motor technologies
- Nanometrology sensors
- Parallel-kinematic systems for positioning in six axes (Hexapods)
- Motion control technology
- Software



# Focus on Markets

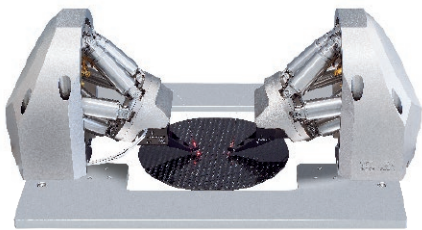
## Where Demands for Highest Precision and Dynamic Motion meet Engineering Creativity

With the broad portfolio of technologies and capabilities, PI is able to serve a wide variety of markets that share a common objective: They strive for the best positioning accuracy to achieve optimum efficiency at a reasonable economic effort.

With PI as a partner, the motion solution is not only geared to the needs of the customer but provides the technological step ahead and gives a considerable competitive edge.

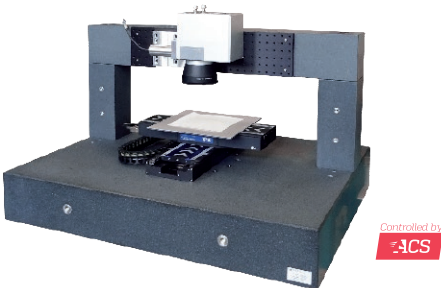
### Market and application examples

- Semiconductor production and inspection
- Industrial manufacturing with high accuracy demands, e.g., in micro-production
- Industrial quality assurance, optical metrology, e.g., for surface inspection
- Microscopy and life sciences, medical technology
- Motion simulation and image stabilization
- Micromanipulation, optical alignment, optomechanics
- Silicon photonics (SiP) packaging and testing
- Automation of handheld or portable devices
- Basic research, scientific instrumentation
- Astronomy, aerospace research



### Fast Multi-Channel Photonics Alignment Solutions

PI's solutions for fast multi-channel alignment allow fast coupling optimization between photonic and other optical devices and assemblies, operating across multiple degrees-of-freedom, inputs and outputs, elements and channels. Importantly, these optimizations can often be performed in parallel. Thus, significant process savings can be achieved, e.g., in the production, characterization, test and inspection of multi-channel Silicon Photonics (SiP) devices, LIDAR sensors, smartphone camera assemblies and emerging quantum optical devices.



### Industrial Automation

Positioning and motion tasks in industrial automation such as those in assembly, electronics manufacturing, laser material processing, or in additive manufacturing, demand robust and reliable solutions. Submicrometer accuracy, position reproducibility, high dynamics, and throughput are essential.

In addition, the motion components or subsystems must be easily integrated into machines and production lines by communicating via high-performance standard industrial networks. EtherCAT®-based ACS motion control and drive modules enable PI to offer high-performance solutions.



### Microscopy and Life Sciences

Superresolution microscopy systems in biomedical and in materials research need nanometer-precision and fast specimen positioning as well as reliable focus adjustment. Piezo systems are exact to the nanometer and offer settling times in the millisecond range, combined with the highest stability and repeatability.

In medical technology, high reliability, simple integration through variable designs and low energy consumption play a decisive role. PI meets these demands with piezoceramic components that can be used as actuators, sensors or ultrasonic transducers. Hexapods ensure micrometer-accurate positioning during surgery.

# Motion Components for Integration

## Product Overview Single-Axis Motion Solutions

### DIRECT DRIVE COMPONENTS

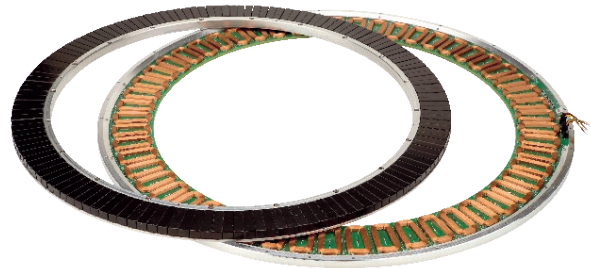
Variable designs, optionally with position feedback, UHV versions, high dynamic range, high resolution



PICMA® multilayer piezo actuator



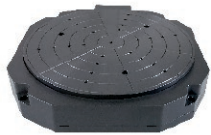
Voice coil OEM actuator



Scalable linear motors and torque motors

### STAGES, SCANNERS AND ACTUATORS

Drive technologies include piezo motors, piezo actuators, DC and stepper motors, PIMag® voice coil



High-precision positioning stages with travel ranges up to 1 m; linear motors, DC/BLDC or stepper motors; mechanical or air bearings; incremental or absolute position encoders. Linear, rotation, lifting and goniometer stages.



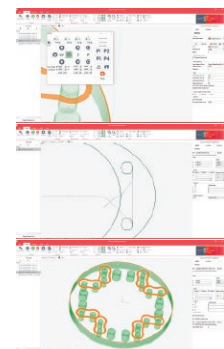
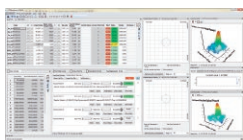
Linear actuator with piezomotor for high resolution and drift-free long-term positioning



Piezo scanners and microscope lens focusers for nanometer precision and millisecond settling time

### MOTION CONTROLLERS AND SOFTWARE

Motion control hardware and software; sophisticated control concepts; EtherCAT connectivity; industrial ACS motion controllers and drive modules, application-specific software



# Multi-Axis Precision Positioning

## Product Overview Stacked and Integrated Subsystems

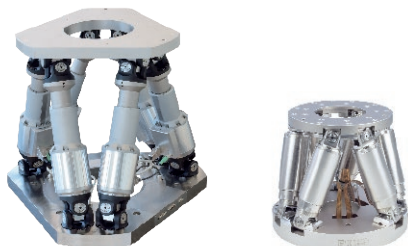
### STACKED AND PARALLEL-KINEMATIC MINIATURE STAGES

Miniaturized versions based on stacked piezo motor stages, and parallel-kinematic piezo scanners for XY, XYZ and ThetaX/ThetaY tip-tilt platforms



### PARALLEL-KINEMATIC HEXAPOD ROBOTS

Precise positioning in six axes of motion with uniform dynamics, high stiffness, good payload-to-operating weight-ratio, fixed virtual pivot point

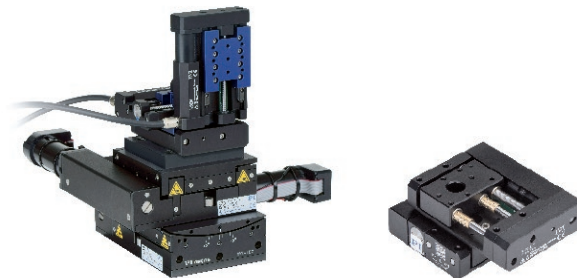


High-load hexapod for 1000 kg loads

Compact design for micro-assembly tasks or integration

### STACKED SYSTEMS CONFIGURED FROM STANDARD PRODUCTS

Flexible, fast to adapt to custom application, cost-efficient solution



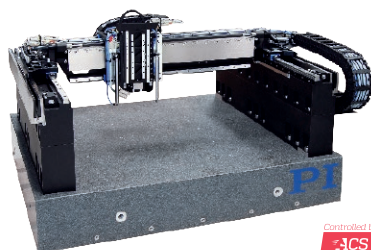
5-axis system for fiber alignment

XY stacked systems can be mounted without adapter plate

### INTEGRATED SUBSYSTEMS FOR AUTOMATION

Precision solutions enhance throughput and reliability

Gantries with industrial motion controllers



XY Stages with screw or direct drive, mechanical or air bearing, incremental or absolute encoders, optional aperture

# The PI Group Milestones

## A Success Story

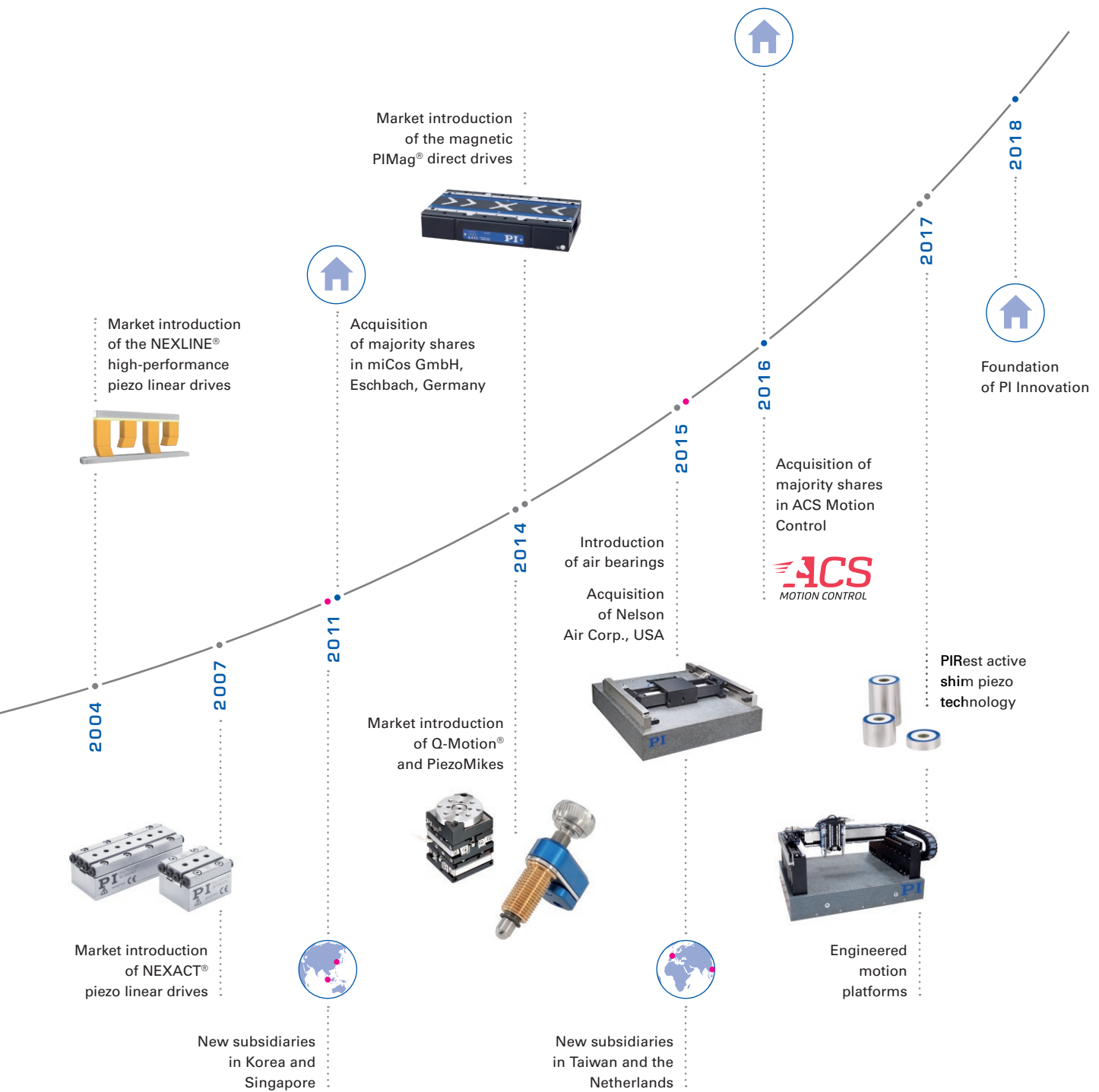
PI has been developing and manufacturing standard and OEM products with piezo or motor drives for more than 40 years. Continuous development of innovative drive concepts, products, and system solutions and more than 200 technology patents distin-

guish the company history today. In addition to four locations in Germany, the PI Group is represented internationally by fifteen sales and service subsidiaries. PI is a privately owned company with healthy growth and more than 1000 employees worldwide.



Market introduction of the PICMA® multilayer piezo actuators





# Expert Consulting



Time for qualified technical consultation is crucial for the success of high-tech projects

The PI Group can respond precisely to what customers want: Specific requirements can often only be satisfied by customized solutions – solutions that can be found by unconventional and creative thinking. Together with the customers, PI plans and realizes individual solutions for the most varied applications and integration levels. And that means that PI's customers can always be sure that they will get the best solution every time.

Customers directly benefit from:

### **Highly Qualified Consultancy Through Trained Specialists**

Individual advice often is key to solve a complex problem. PI sales engineers are ready to come on site with all the time necessary for a solid understanding of the topic. Or they will gladly meet at the PI head office. All PI sales engineers have a background in natural sciences or engineering, and have up to 20 years of experience in optical, micro- or nanopositioning technology.

### **International Support**

PI subsidiaries and distributors in many countries across the world guarantee global support – a decisive advantage, especially for globally operating customers. PI has its own sales and service offices in all important markets. Moreover, the company maintains testing devices for nanometrology on three continents. PI Shanghai and PI USA have additional development and manufacturing resources that allow rapid local reaction to custom-engineered specifications.



# Customization from 1-off to Series

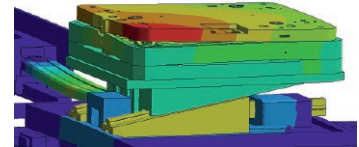
The unique technological breadth of the PI Group allows to develop positioning solutions with innovative drive technologies for high-tech applications worldwide. PI covers the whole motion range from finger-tip sized nanopositioners to large-scale stages with long travel ranges, through their plethora of different drive and guiding systems.

## OEM Users Benefit From Maximum Flexibility

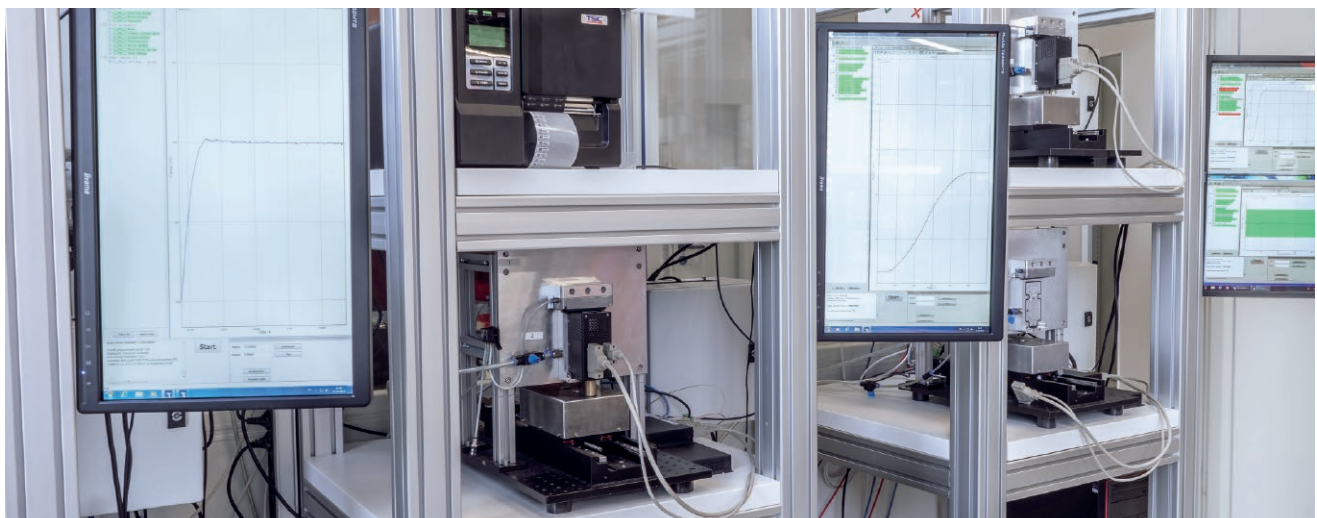
PI serves both the research and industrial markets. The complete control over the design and manufacturing process provides our customers with significant competitive advantages. Optimized processes allow PI to deliver customized products in quantities up to several 100,000 units per year at low cost and right on time. The range of OEM products offered by the PI Group varies widely, ranging from “bare” actuators and sensors to highly integrated parallel-kinematic positioning systems. Evaluation of preproduction run samples, test procedures, production processes and quality management are all included in the development process.

## OEM Services

- Global account management: Close proximity to the customer thanks to international presence
- Risk assessment from design to delivery
- Depending on the task: From the drive to the turnkey system
- Copy exactly policy
- Preparation of internal and external certification
- Production of series in the shortest time
- Sustainable spare parts service
- Manufacturing and testing capacities from functional samples to mass production



Maximum performance of precision systems is achieved through extensive design and analysis expertise, using equipment built in-house with proprietary techniques. See here the modal analysis of a complex multi-axis system that includes linear guide elements as well as mixed piezo drive technologies like PICMA® multilayer actuators and PiezoWalk® walking drives, and PIMag® magnetic drives



Standardized performance control with full documentation of individual measurement charts

# Production Capabilities



PI's flexibility in serial production allows for fast adaptation of both processes and quantities

A modern production management and an integrated management system allow PI to guarantee the high quality of its products, processes, and services. The continual improvement of organization and processes is an integral part of the corporate culture. KAIZEN workshops and an active innovation management are important elements for achieving this.

The production processes for the standard range are made flexible by the fractal production structure and it is therefore possible to manufacture even large series with full process control. Active, system-based requirements management makes it possible to dispense with comprehensive storage facilities.

## **Vertical Production Range and Production Capacity**

The product spectrum ranging from the two-ton hexapod to the 10-gram nanopositioner requires PI to have the equipment and technologies at its disposal that allow the systems to be manufactured, assembled, and qualified.

- 13,000 m<sup>2</sup> of overall production space
- 5,000 m<sup>2</sup> for cleanrooms
- Air-conditioned and vibration-proof measuring conditions
- Vacuum chambers for startup and residual gas analysis
- Measuring technology with traceable, calibrated measuring equipment
- Monitoring of piezo actuator technology from material composition to final inspection
- In-house manufacturing of positioning sensors
- Production hall with measuring technology for heavy loads
- Fractal production organization

# Global Service and After-Sales

## Start-Up, User Training and Life Long Support

PI is dedicated to supporting its customers right from the initial consultation through to when a customer has purchased a PI system. Beyond that, PI's services division is committed to ensuring that every aspect of owning a PI system is catered for.

## Global Coverage

Supported by 4 Global Service Hubs in Asia, China, Europe and USA, with field product specialists working from these hubs, PI is able to support all technologies and customer applications via this global services team.

## Contracted Services

Customers subscribing to Contractual Support Services will receive commitment from PI to achieving agreed Service Levels. These include responding to the customer's first contact and providing remote technical support, through to response times for a PI expert to be on site, either to repair or replace a defective unit.

## Extended Warranty

Most customer applications require PI's systems to be operational beyond the standard warranty period. Extending the warranty for additional year(s), is simply extending the customer's peace of mind and PI's commitment that the product will not fail due to poor workmanship or faulty materials. Should a customer's system then fail due to these conditions, PI will cover the costs to repair or replace it.



On-site training is key to optimize and maximize the potential of new PI systems

## PI's Standard On-Site Services

- Set up and Commissioning – On-site support to un-box, set-up and commission the PI system
- Training Program – User training on software and programming, through to optimization of system performance
- Maintenance Systems Health Check – Preventative maintenance to prolong the life of the motion device
- Support – Ongoing remote and on-site support to maximize system uptime and provide maintenance for the whole life of any system



## Headquarters

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## Subsidiaries

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### FRANCE

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www.pi-japan.jp

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www.pi-china.cn

### SOUTHEAST ASIA

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Singapore LLP**  
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www.pi-singapore.sg  
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www.pimicos.es

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