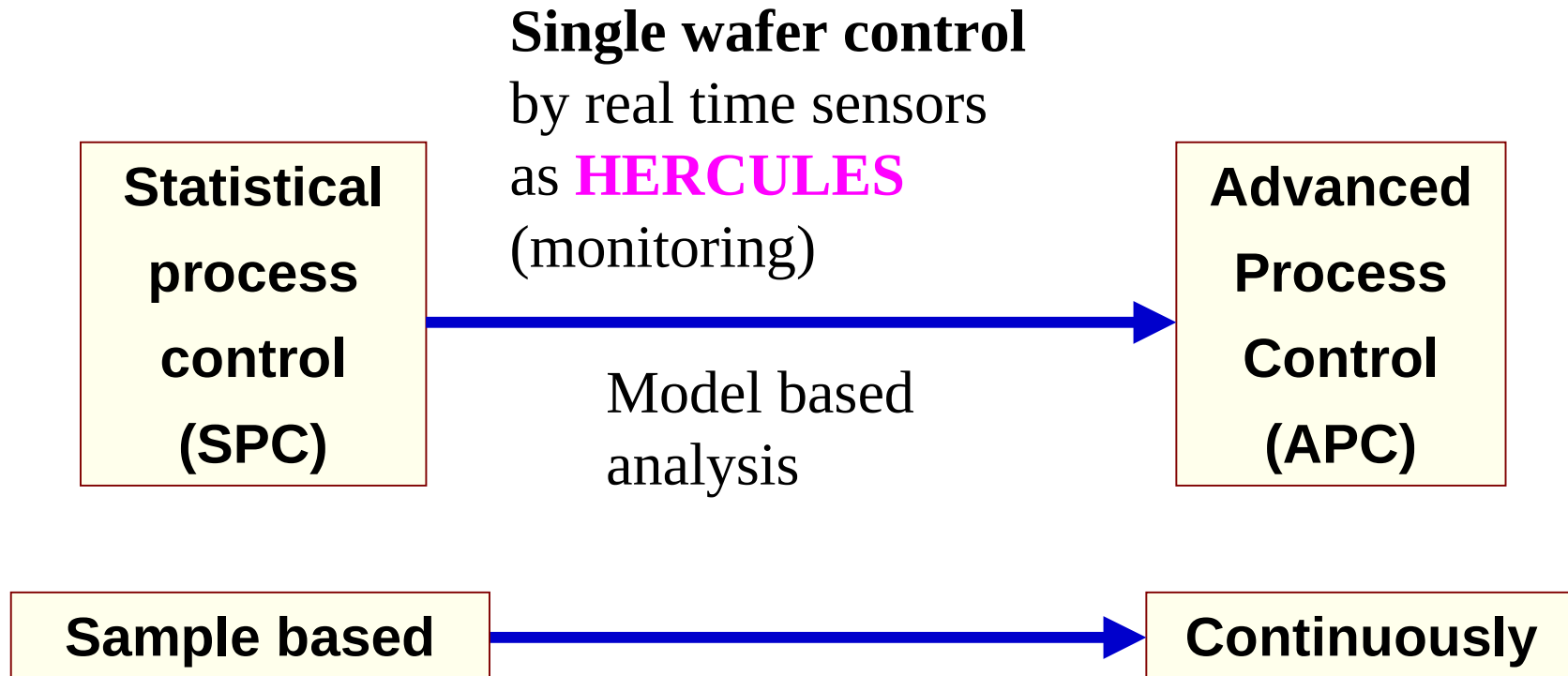


Technical and business Hercules roadmap

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From SPC to APC using Hercules/PL+



Hercules/PL+

HERCULES/PL+ provides

- internal plasma parameters
- standard & customer interfaces for fab automation
- one metrology tool for one mainframe (cluster)
- easy data handling

**Better OEE and yield - lower COO
of etch equipment**

Level 1: Process Monitoring

chamber and tool matching
process and tool failure identification
single wafer control (process and history)
optimizing cleaning conditioning procedure

improves

- mean time between clean (MTBC)
- process stability
- reducing test and monitor wafers

The multiple chamber system

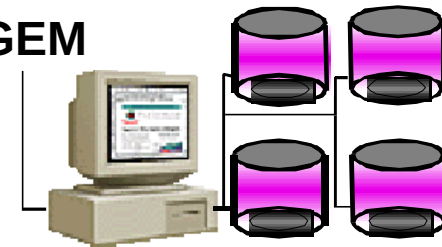
Level 2: Real time process control

real time tool failure detection
process control by independent
parameters
dynamic control of MTBC

improves additionally

- uptime (etch tool)
- MTBR, MTBF (etch tool)
- throughput of etch equipment

SEGS/GEM



Plasma process parameter ↔
Wafer, Lot, Product ID, Recipe,
Wafer and Lot History

Hercules roadmap

Improved model and algorithm,
automatic data handling,
integrated analysis functions

Parallel monitoring of four chambers,
SECS interface, lot-based logsheet,
extended analysis functions

HERCULES

Research and develop-
ment, basic research
1995

HERCULES/PL

R&D, basic research
Production line
1997

HERCULES/PL+

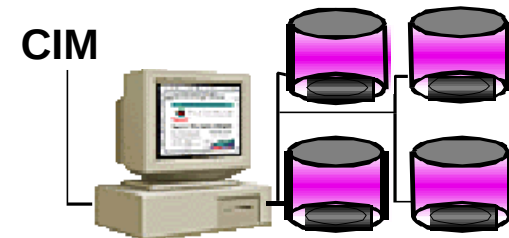
Production line,
multi chamber system
1999



Plasma parameter



Plasma process parameter
↔ Wafer



Plasma process parameter
Wafer, Lot, Product ID, Recipe,
Wafer and Lot History ↔

Data structure for process monitoring

in-line measurements

Structure data

Layer thickness

Device data



Lot ID, Product ID, Recipe

Lot parameters (sample based)

...

$CD_1, \dots, CD_N$

...

Single wafer parameters
(continuously)

...

Process_k step-wise
means and std. dev.'s

...

$n_{\text{electron},1}, \dots, n_{\text{electron},25}$

...

in-situ measurements

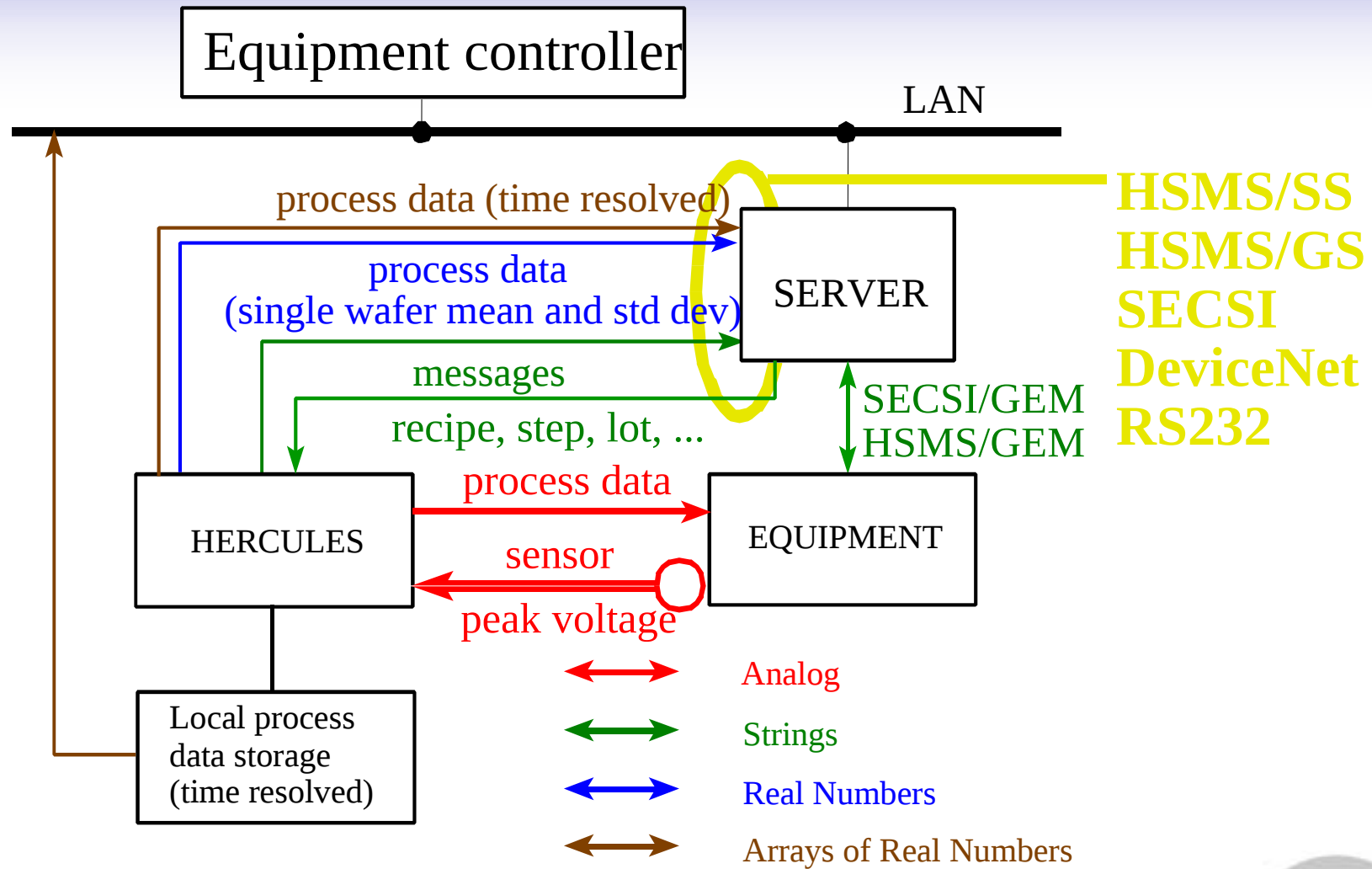
Endpoint time

Plasma parameter



Equipment coupling and data handling

Equipment coupling for process monitoring



Equipment coupling and data handling

Hercules in Asia

Evaluation and purchases

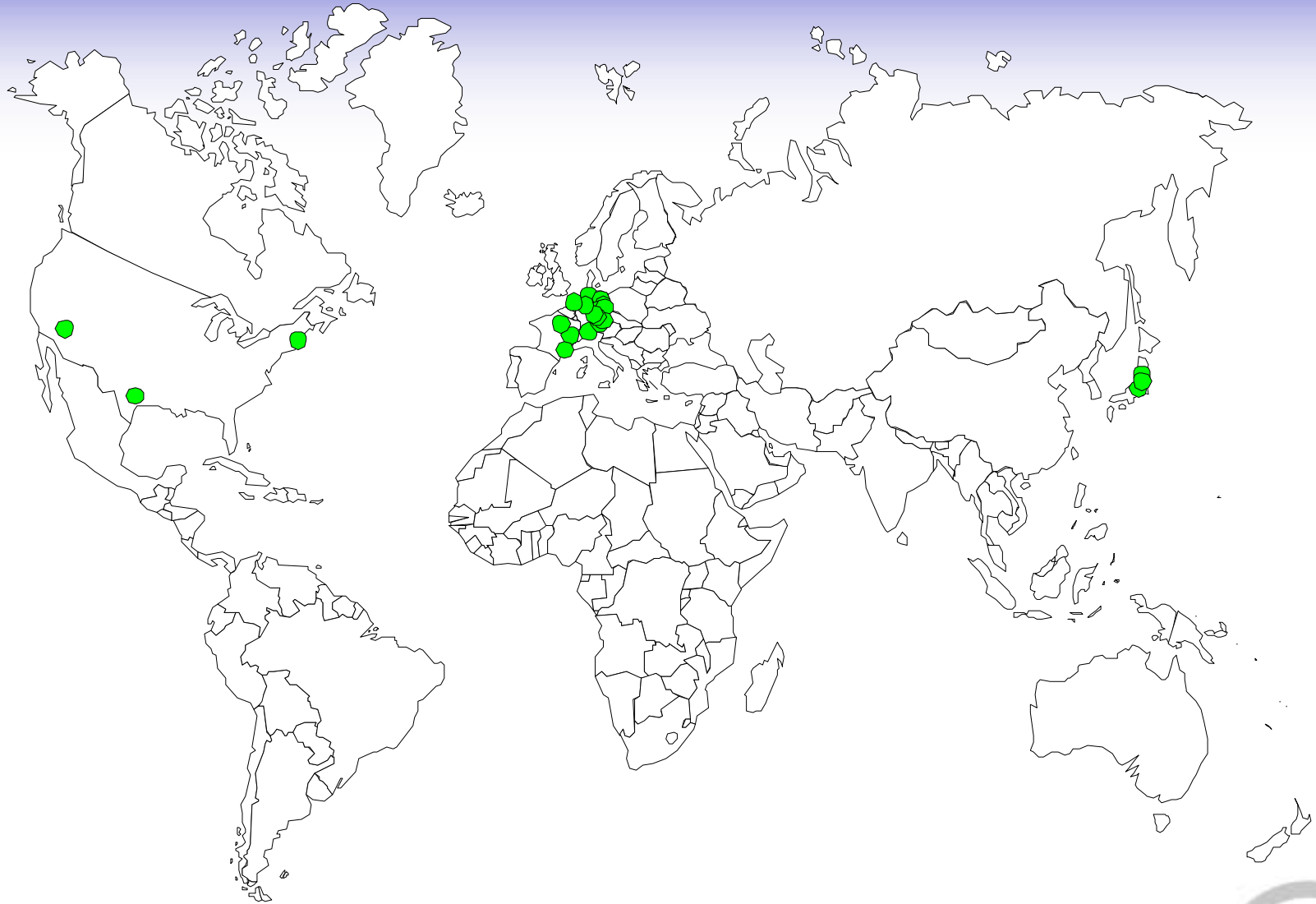


Successful evaluation in:

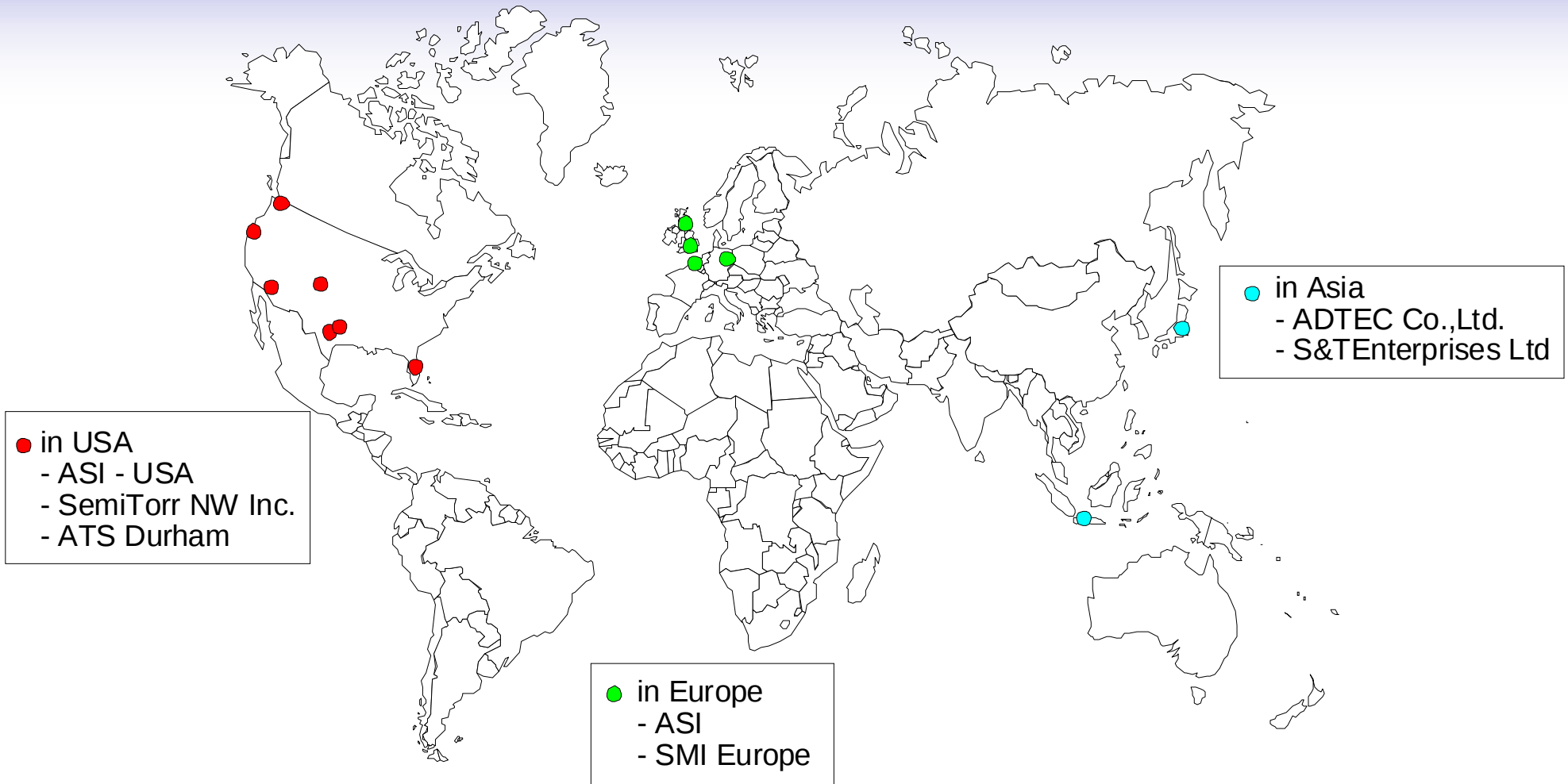
! Japan

- TEL (Tokyo)
- Toyo-University
- Hiroshima-University
- Hitachi (Ibaraki)

Locations of Hercules evaluation

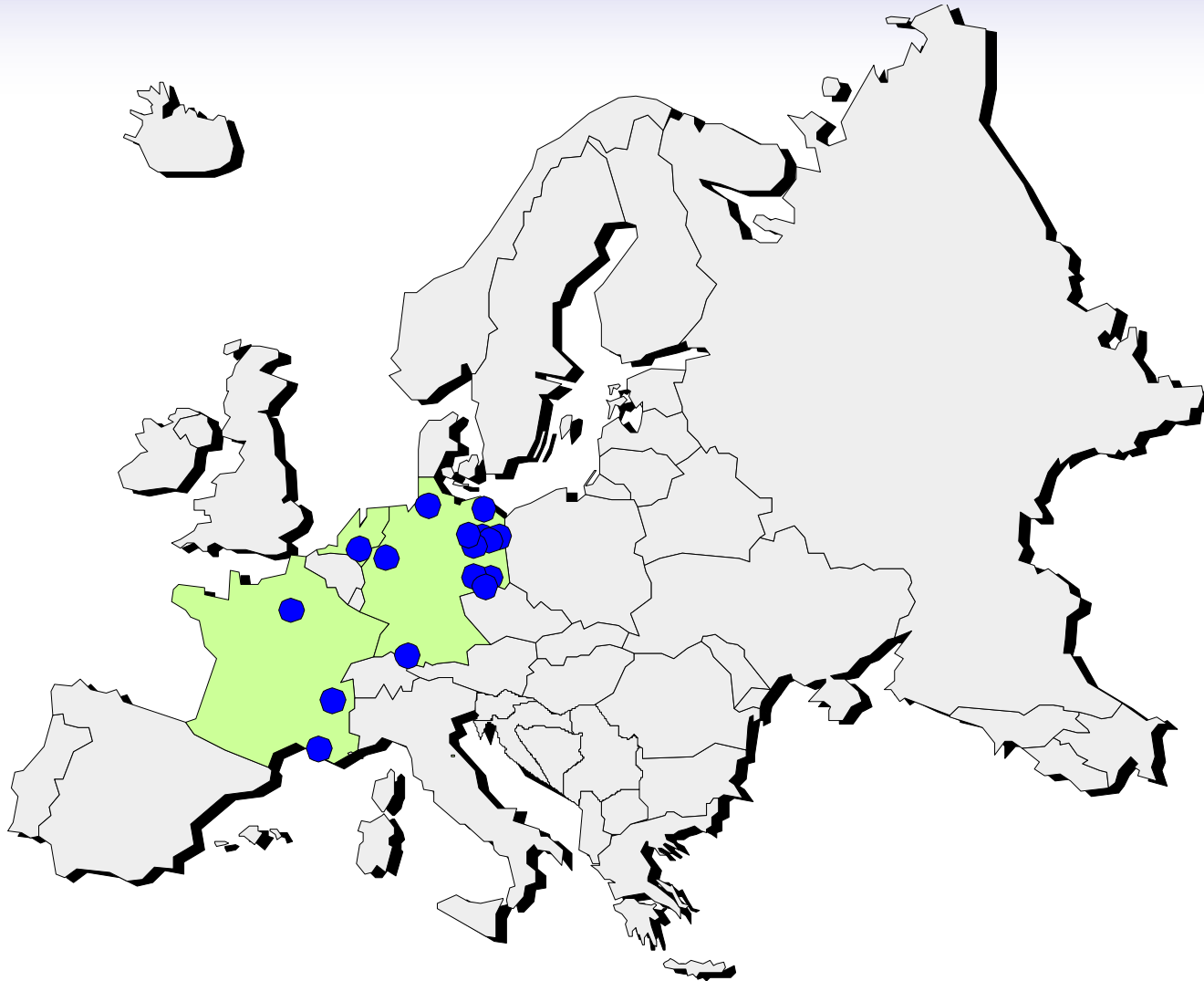


Distribution and Support of Hercules



Hercules in Europe

Evaluation and Purchases



Successful evaluation in:

! Germany

- Siemens AG
(Dresden, Regensburg, München)
- AMD (Dresden)
- Philips (Hamburg)
- Gillette (Berlin)
- FhG (Berlin, Dresden)
- Greifswald University
- Essen University
- IHP Frankfurt/Oder

! France

- IBM (Essonnes)
- ST Microelectronics
(Marseille, Grenoble)

! The Netherlands

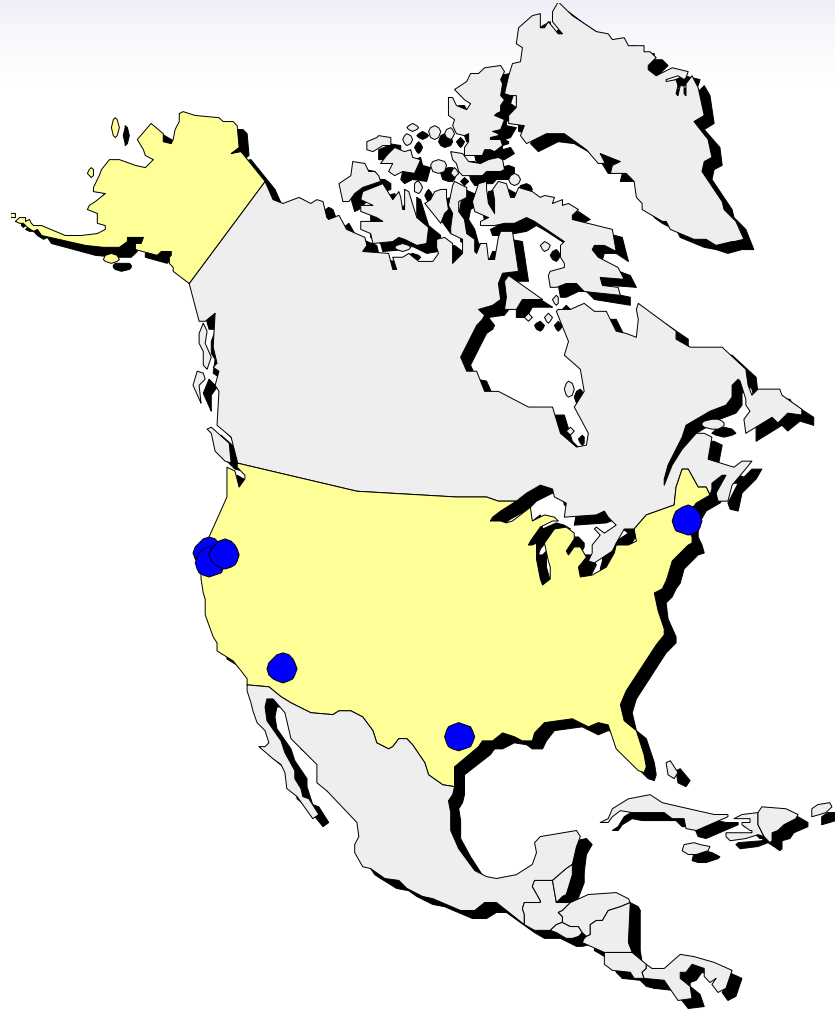
- Philips (Eindhoven)
- Eindhoven University

! Liechtenstein

- Balzers

Hercules in Northamerica

Evaluation and purchases



Successful evaluation in:

- ! California
 - ETEC (Hayward)
 - KOMAG (San Jose)
 - Novellus (San Jose)
- ! Arizona
 - TEL (Phoenix)
- ! Texas
 - Motorola (Austin)
- ! Massachusetts
 - IBM/TEL (Boston/Fishkill)