

Using Ada for Semiconductor Assembly Equipment

**How ITEC uses Ada95
in semiconductor
assembly equipment**

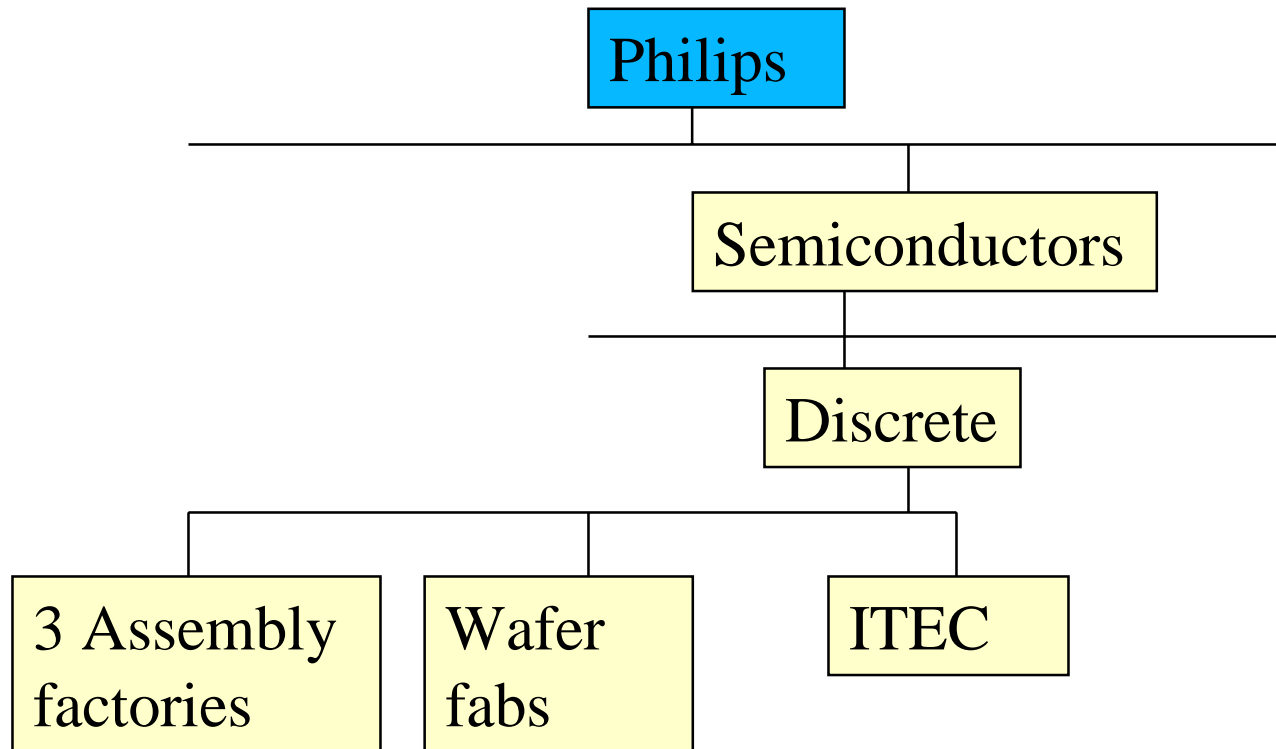
PS - XXX.XX.XX-1

Let's make things better.



PHILIPS

ITEC within Philips

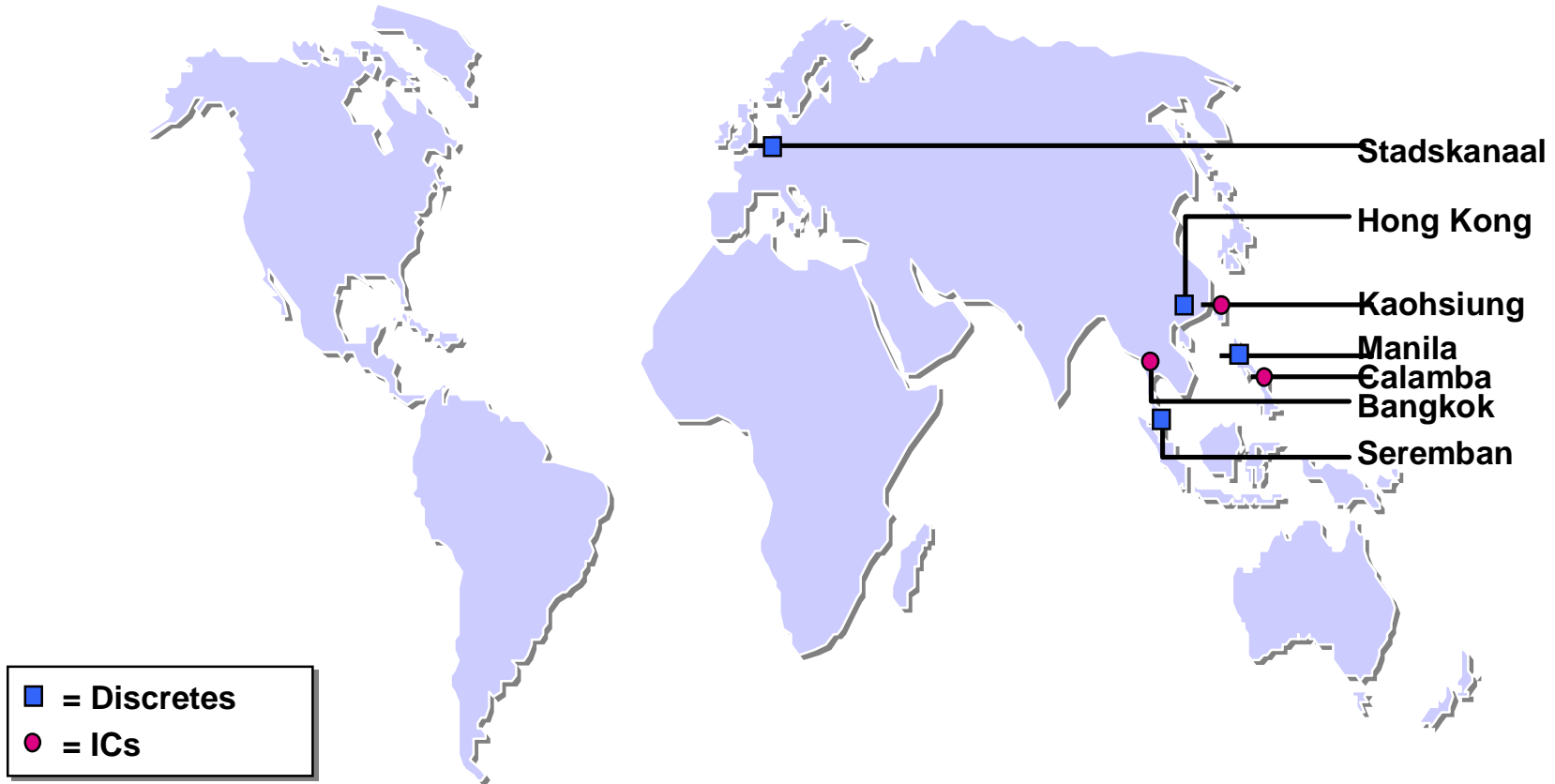


Let's make things better.



PHILIPS

Assembly facilities, our customers



Let's make things better.



PHILIPS

BIM line setup

BIM: Break through In Manufacturing

Endless
leadframe



Adat

Phicom

Mould

Plate

Test,
mark,
tape

Let's make things better.



PHILIPS

ITEC equipment

- **Adat: Die attach machine, takes die from wafer and solders it on leadframe**
- **Phicom: Wire bond machine, bonds gold and aluminum wires from die to leadframe**
- **Multiplunger: Mould products in plastic**
- **Parset: Tests devices to meet electrical specification**
- **Quad: Machine to cut and bend leads, laser mark, test and tape products.**

Let's make things better.



PHILIPS

Started with Ada95 5 years ago

Assembly machines use RTL/2 on 68k, tester used pascal on VAXeln
Converted code to Ada95 automatically

Reasons to start with Ada 95:

- Old code can be converted to Ada95 code
- Ada95 good programing environment compared with pascal
- GNAT available, based on gcc, lots of tools available

Let's make things better.



PHILIPS

Platform Windows NT

Why Windows NT:

- **Advanced system services**
- **Cheap, runs on cheap hardware**
- **Integrates well in office environment**
- **Realtime properties good enough**
- **Advanced GUI**

Let's make things better.



PHILIPS

Selection of Ada95

+++ positive

- **Conversion from rtl/2, pascal possible**
- **Very good from engineering point of view**
- **Finally good compiler (GNAT)**

--- negative

- **Nobody uses it (in Philips), everybody does C**
- **One must know C anyway**

Let's make things better.



PHILIPS

Typical Equipment control

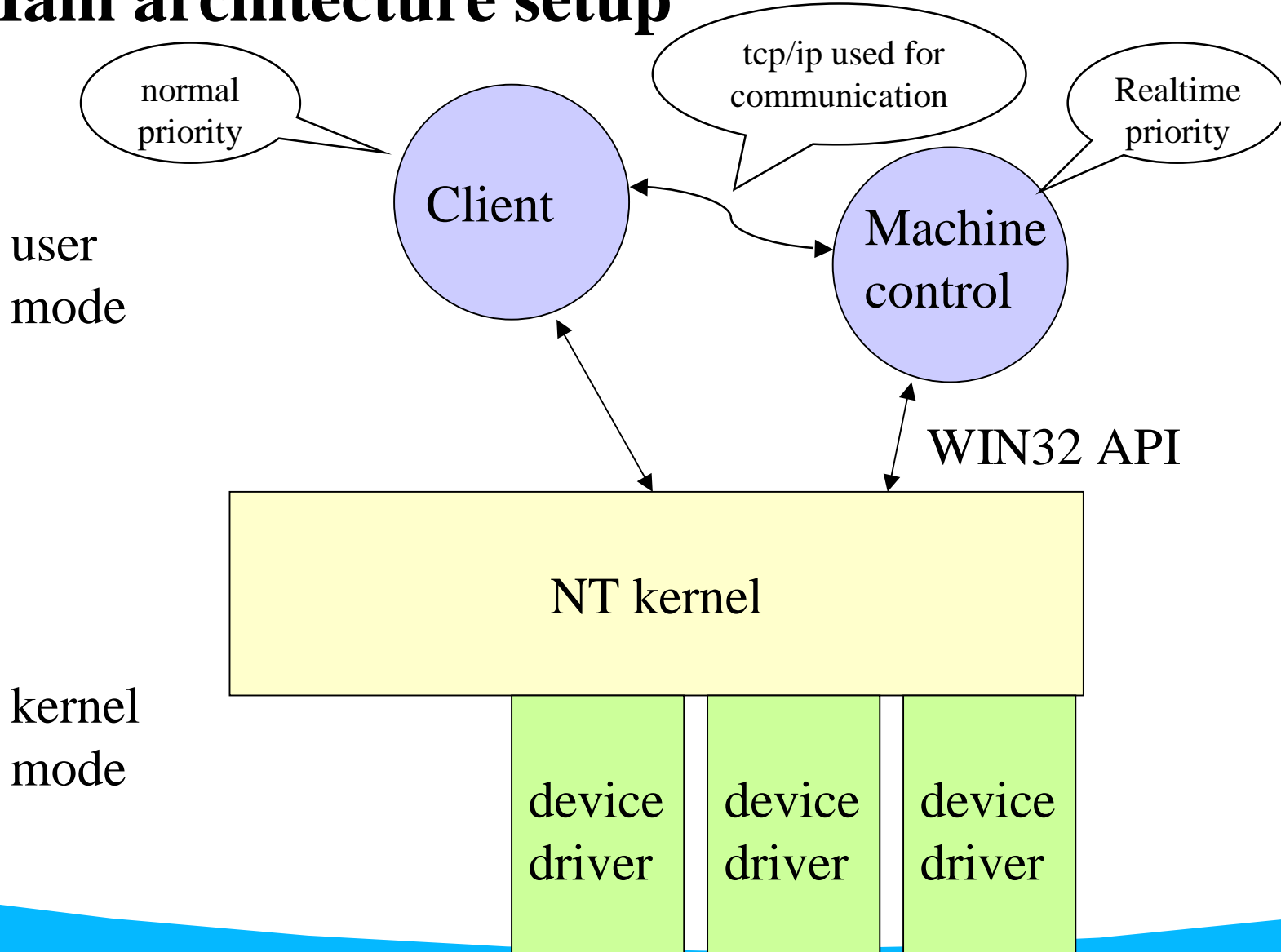
- **High end motion controllers using fast DSP's (9kHz cycle).**
- **Vision function: using frame grabber to get the image, then process it on the pc**
- **Machine control multithreaded (typical 30-50 threads)**
- **Integration with Shop Floor Control system**
- **Support of many variants**
- **Response time to external events <1ms**
- **Setup as client/server**
 - **Server performs the control**
 - **Client interacts with user**

Let's make things better.



PHILIPS

Main architecture setup



Let's make things better.



PHILIPS

Interface with hardware & interrupts

Wrote special device driver for NT

- **Allows user mode program to access physical memory**
- **Allows synchronization with interrupts**
- **User process can execute routine in kernel mode**

Response times: Interrupt to thread

- **average 40 microsecond**
- **maximum 1 millisecond**

Let's make things better.



PHILIPS

GUI clients

- **Visual ITEC (Build with CLAW)**
- **Scope (build with CLAW)**
- **Curve tracer (build with gnatcom, gwindows)**

Let's make things better.



PHILIPS

Visual ITEC used as GUI interface (1)

In design mode:

**Allows to define screen layout. Select objects from application into screen.
Can make buttons that give commands to applications. Buttons can also
invoke other screens.**

In execute mode:

User makes use of screens defined.

Advantage: Application developer can focus on core of application.

Let's make things better.



PHILIPS

Visual ITEC used as GUI interface (2)

Object types for Visual itec:

- Text objects
- Chart objects
- Life video objects
- Wafermap objects (gives view of wafer with die processed)

Visual itec characteristics:

- Inquires server periodically to get its information
- Can run anywhere because of tcp/ip connection
- Can combine information from different servers in one form

Let's make things better.



PHILIPS

Visual ITEC used as GUI interface (3)

The screenshot shows the Visual ITEC software interface. At the top, the title bar reads "Visual ITEC (C:\Itec\Release\Image\phicom_automatic.vif)". Below this, the "PHICOM" logo is displayed along with "Software version: V2.301 14-SEP-2000 07:05:18.00", "Process program:", and "Temperature: 300". The "itec" logo is in the top right corner.

On the left side, there are labels for "Work station", "State", and "Sfc link". A central panel contains a table of parameters:

Wire number	1
Product number	1
Bond single product	TRUE
Pattern recognition only	FALSE
UPM	37
Batch counter	3903
Shift counter	3903
Skip counter	0

To the right of this table is a grayscale image of a wire bond. A red rectangular box highlights a specific area on the bond. Below the image, the coordinates "X: 8191.2 Y: -5291.8 Z: 323.7" are displayed.

At the bottom, there is a row of function keys labeled F1 through F12. Below these keys is a row of buttons with the following labels: "Start / Stop", "Make 'new ball'", "Correct tooloffset", "Toggle wireclamp", "Form exit", "Top menu", and "Continue". The date and time "15-SEP-2000 10:04" are shown in the bottom right corner of the interface.

Let's make things better.



PHILIPS

Scope debugging tool

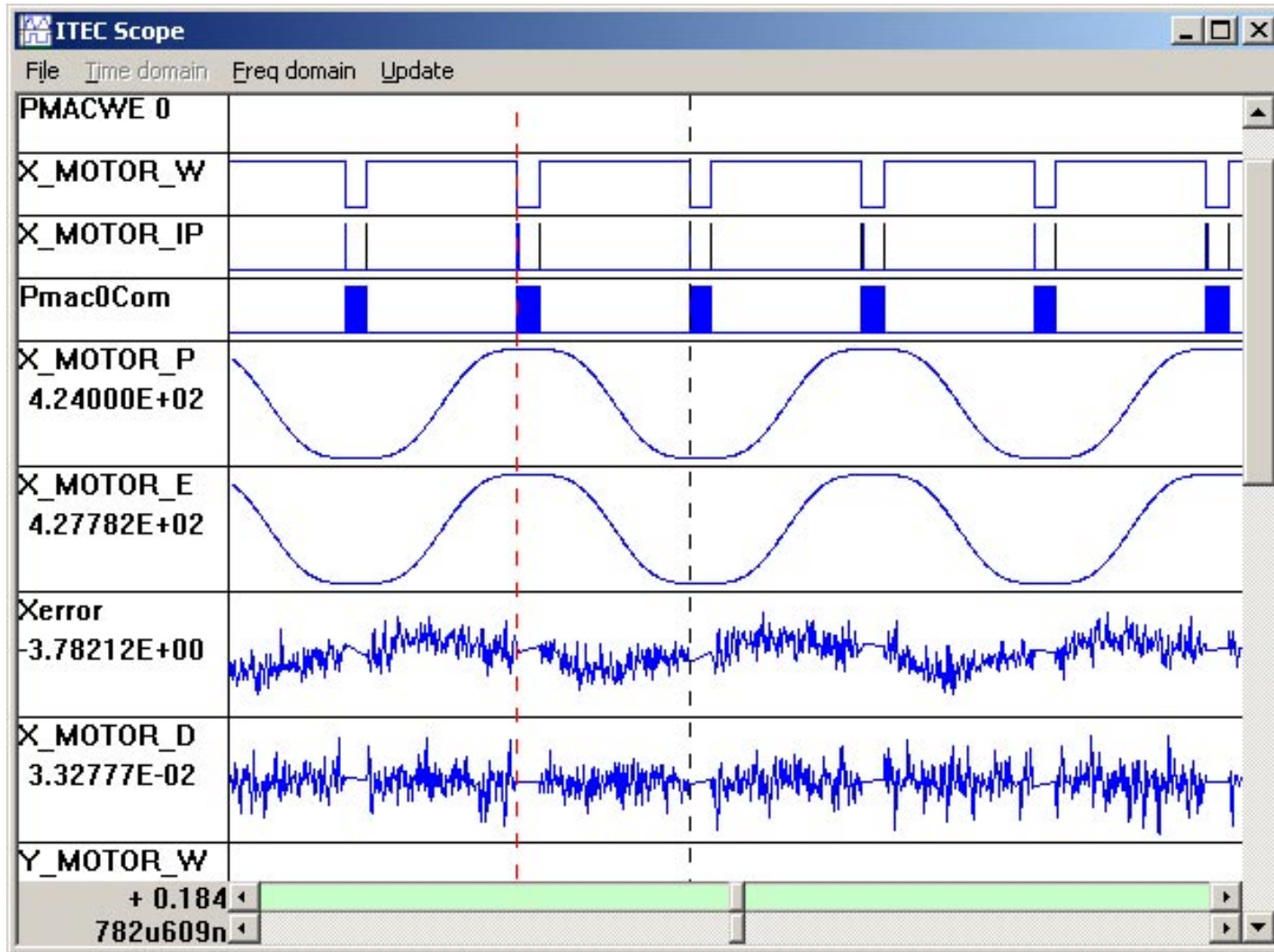
Scope architecture

- In our application we use circular buffers to store events with there time. Such an object is called a probe.
- Application can put time stamps with boolean in them
- Application can put floating point value with time in them.
- To get timestamps, we use rdtsc of pentium
- Setting a timestamp is very fast $\ll 1\mu s$
- Application has low priority server that allows client access to data
- Client displays data graphically

Let's make things better.



PHILIPS



Let's make things better.



PHILIPS

Conclusions

- **Ada95 is very good programming language**
- **Ada95 tasking features makes machine control much simpler**
- **Ada95 gives stable applications because of its build in protection mechanisms**
- **Ada95 made for proper software engineering**
- **Ada specs gives developer good idea of package content. When properly setup increases reuse of packages.**
- **In the beginning NT support was just enough. Getting better each year: stable gnat compiler, gnatcom, gwindows**

Let's make things better.



PHILIPS