

# PC-based motion control

Automation Product Segment

Senior Manager

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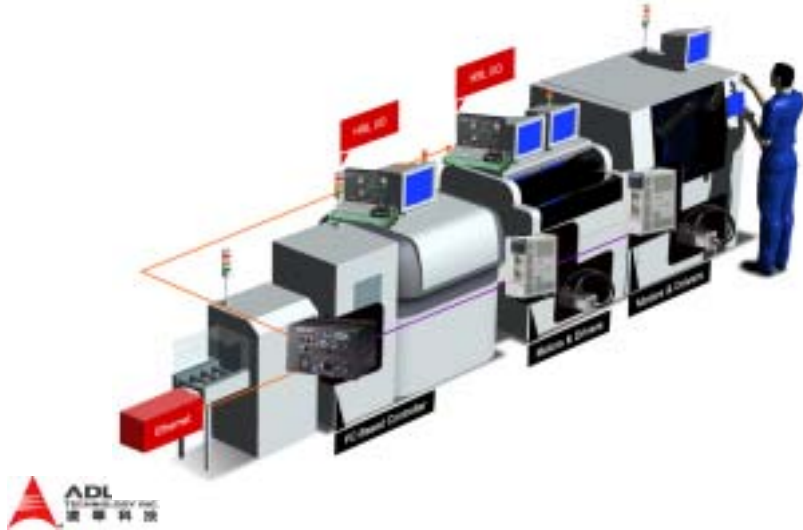


## Agenda




- Computer-Based Motion Control Overview**
- Pulse-Type Motion Control Solution
- SSCNET Motion Cards
- Other Motion Solutions



## Computer-based machinery



## MOTION in Machine Automation

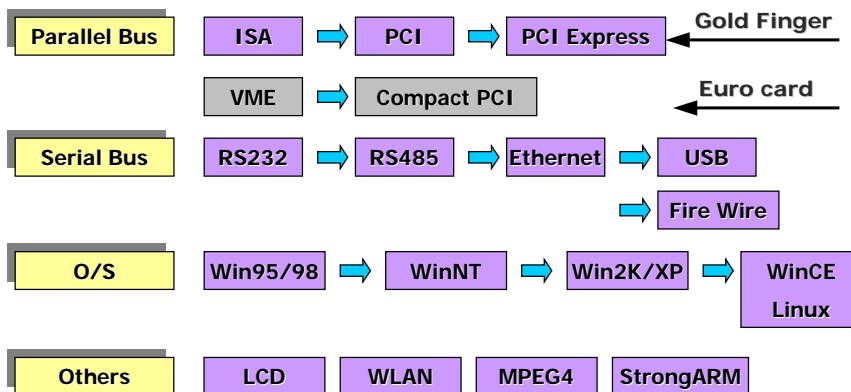
IT Machinery	Manufacturing	CNC
<ul style="list-style-type: none"> <li>■ Back End Semicon - e.g. Flip Chip Bonder...</li> <li>■ LCD, e.g. laser repair...</li> <li>■ AOI, Mounter, PCB drill</li> </ul> 	<ul style="list-style-type: none"> <li>■ Food Packaging</li> <li>■ Printing</li> <li>■ Injection</li> <li>■ Textile</li> </ul> 	<ul style="list-style-type: none"> <li>■ Lathe</li> <li>■ Milling</li> <li>■ Robot</li> </ul> 
<ul style="list-style-type: none"> <li>■ VB, VC Programming</li> <li>■ Linear Interpolation. (1~4 axis)</li> <li>■ Circular (2 axis), Helical</li> <li>■ P change, V change</li> </ul>	<ul style="list-style-type: none"> <li>■ PLC Programming - Ladder, SFC</li> <li>■ Axis Synchronous</li> <li>■ Electric gear, clutch</li> <li>■ Electric CAM</li> </ul>	<ul style="list-style-type: none"> <li>■ G/M code</li> <li>■ 3 axis circular</li> <li>■ Backlash compensation</li> <li>■ Tool compensation</li> </ul>

## PC-based advantages

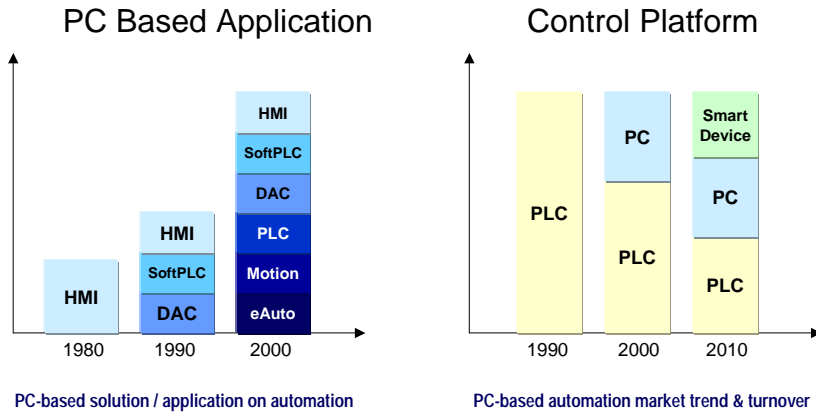
- Networking to higher control layer (TCP/IP)
- High speed CPU for advanced control algorithm
- Complex process simulation
- Extensive database manipulation
- HMI functionality
- Large memory for DAQ or vision application
- Easy to data storage application
- Open architecture for sensor extension
- Wireless access



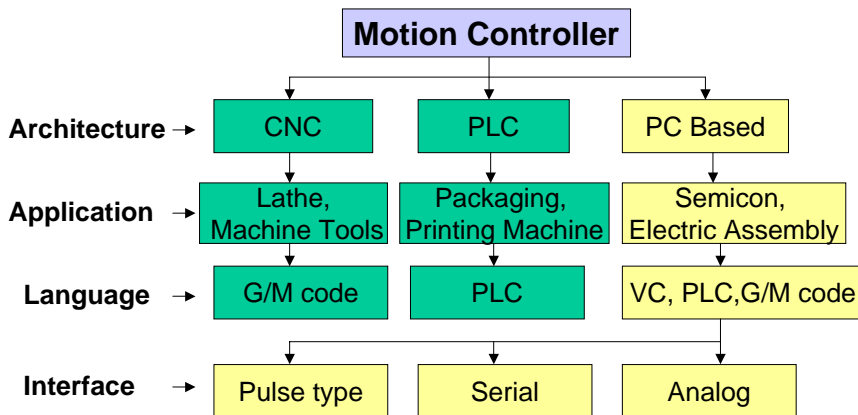
## Trend of PC based Technologies



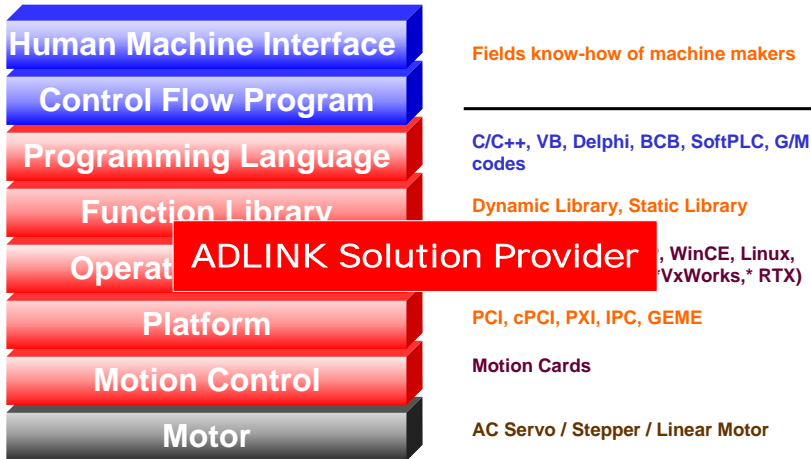
## Automation Paradigm Shift: from PLC to PC based (Siemens)



## Market Segmentation



## Computer-based Motion System



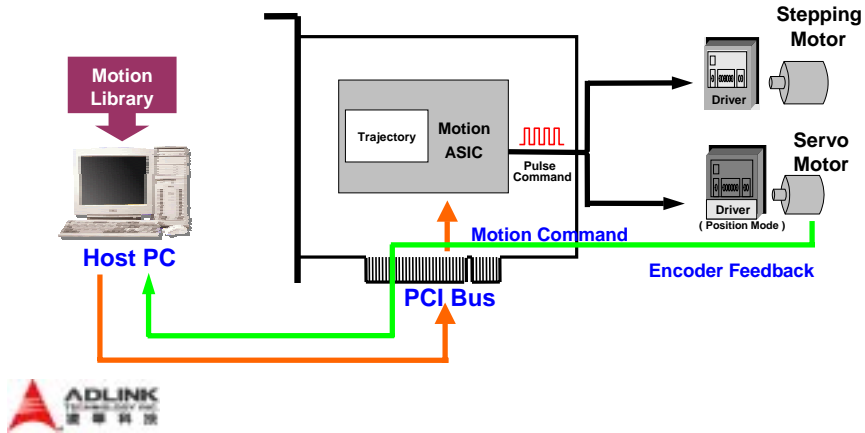
## Agenda

- Computer-Based Motion Control Overview
- Pulse-Type Motion Control Solution**
  - Architecture**
  - Functions**
  - Features**
  - Products Highlight**
  - Motion Creator**
  - Function Library Usage**
- SSCNET Motion Solution
- Other Motion Solutions

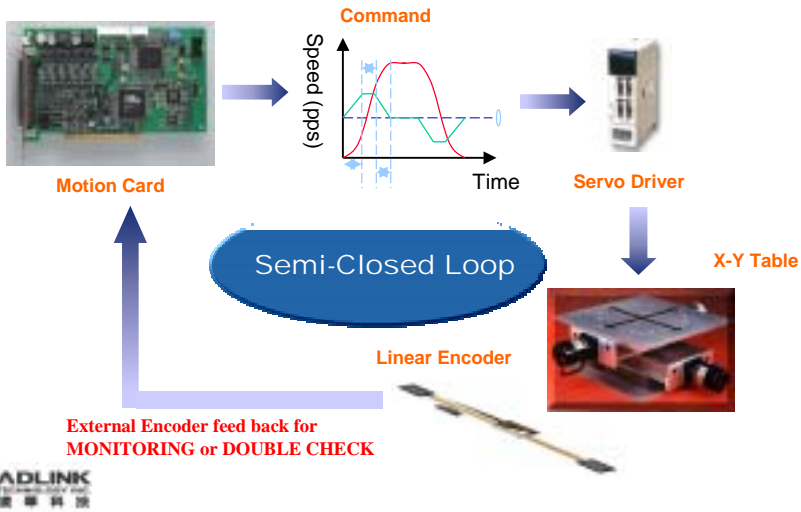


## Pulse-type Motion Control

### □ Structure of pulse-type ASIC-Based Controller



## Semi-closed Loop Control



## Functions of Pulse-type Motion Cards

- **Basic Functions:**
  - Point to Point
  - Linear Interpolation
  - Trapezoidal, S-curve velocity profile
- **Continuous Trigger**
- **Contour Motion (Continuous Interpolation)**
- **Circular Interpolation**
- **Programmable Interrupt**
- **Auto Homing**
- **On-the-fly Speed Change**



## General features

- **Command output options: DIR/OUT, CW/CCW (6 types)**
- **S-curve, T-curve velocity profile**
- **Absolute move, Relative move**
- **Speed Override (Change speed on the fly)**
- **Encoder interface (AB phase, CW/CCW)**
- **Mechanical Interface (EL, ORG, SD)**
- **Servo Drive Interface (INP, ALM, ERC...)**
- **Interrupt Events**





## Advanced Features

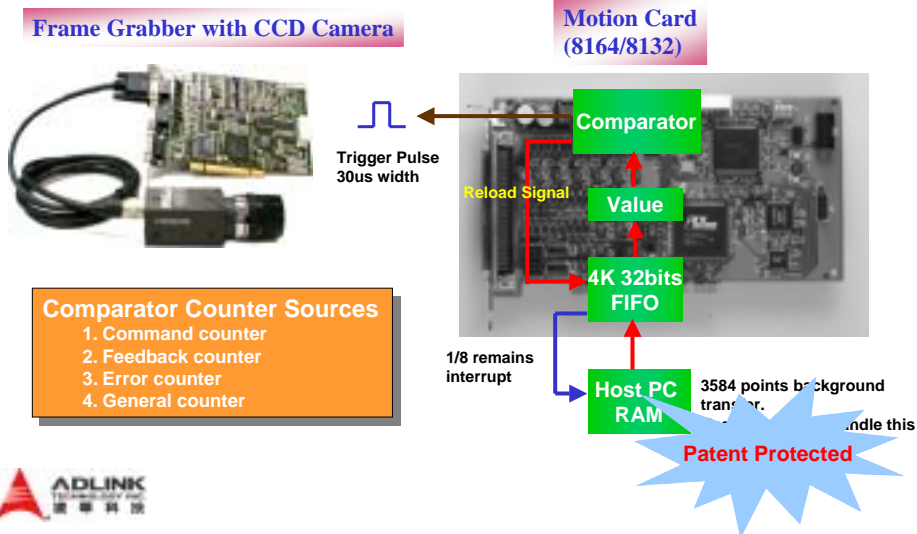
- multiple axes motion control card
- Pulse Output up to 6.5 MHz.
- Circular interpolation
- Linear interpolation of 2-4 axes
- multiple Home return modes
- Position compare and trigger output
- Continuous motion (Contour)
- Position change on-the-fly
- Speed change on-the-fly
- Position Latch input
- Automatic Backlash Compensation



Software supports maximum up to 12 cards operation



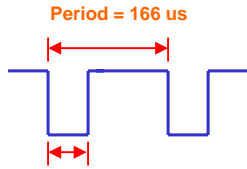
## Continuous Trigger(1/2)



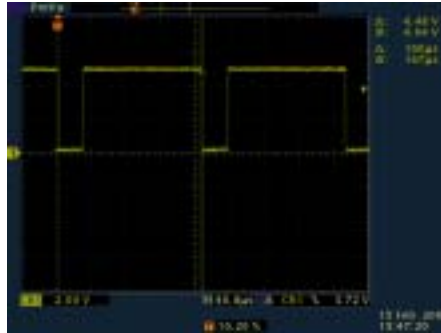


## Continuous Trigger (2/2)

### Oscilloscope on Trigger Pulse



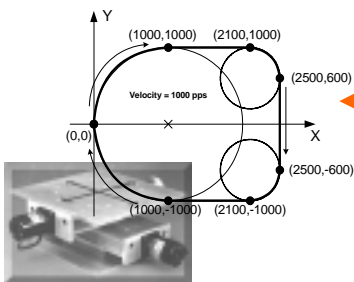
Default trigger pulse width is 30 us.



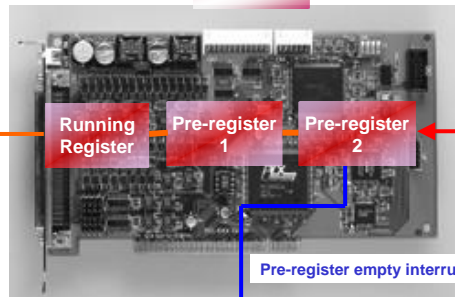
## Continuous Contouring

Three hardware command registers in each axis for command preloading.

### Target System



### PCI-8164



Host Program

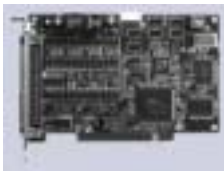
Next Command Loading



# Products Highlight



## Pulse Motion card/system



PCI-8132/34



GEME  
With  
MPC-8164



cPCI-8168



PCI-8164



HSL-4XMO



## Motion Control Solutions

Motion Control Cards

Pulse-Type Motion Control

PCI-8132

PCI-8134

PCI-8164

cPCI-8168

MPC-8164

HSL-4XMO

Servo Motor : Mitsubishi, Panasonic, SanyoDenki...  
Stepper Motor : Oriental, MyCom, Parker...



## Pulse-type Motion Control Comparisons

	PCI-8132	PCI-8134	PCI-8164	PXI-8164	cPCI-8168
Bus Type	PCI	PCI	PCI	PXI (3U)	cPCI (6U)
No. of Axes	2	4	4	4	8
Max. Output Freq.	2.4Mhz	2.4Mhz	6.55Mhz	6.55Mhz	6.55Mhz
Linear Interpolation	2 axes	2 axes	Any of 2 Axes	Any of 2 Axes	Any of 2 Axes
Circular Interpolation	N/A	N/A	Any of 2 Axes	Any of 2 Axes	Any of 2 Axes
Position Compare	2 CH	N/A	4 CH	4 CH	4 CH
Max. Continuous Trigger Output/Freq.	2CH / 1Khz	N/A	2CH / 30Khz	2CH / 30Khz	2CH / 30Khz
Contour Motion	N/A	N/A	Yes	Yes	Yes
General IO	16 DI / 16 DO	N/A	6 TTL DO	4DI/4DO	8 DI / 8 DO / 4 AI / 4 AO
Remote I/O	N/A	N/A	N/A	N/A	PCI-7852 built-in
Interlock Function	N/A	N/A	N/A	N/A	N/A



# Utility - MotionCreator™

## Advantages

1. Free Software
2. System Setup
3. Parameters Management
4. Hardware Debugging
5. Software Debugging



# Function Library Usage

Easy-understanding velocity profile based function calls

	Trapezoidal	S-Curve
Absolute	start_ta_move	start_sa_move
Relative	start_tr_move	start_sr_move

Ex1 Absolute Trapezoidal : start\_ta\_move

*start\_ta\_move( axis, position, start velocity, max. velocity, acc time, dec time )*

Ex2 Relative S-curve : start\_sr\_move

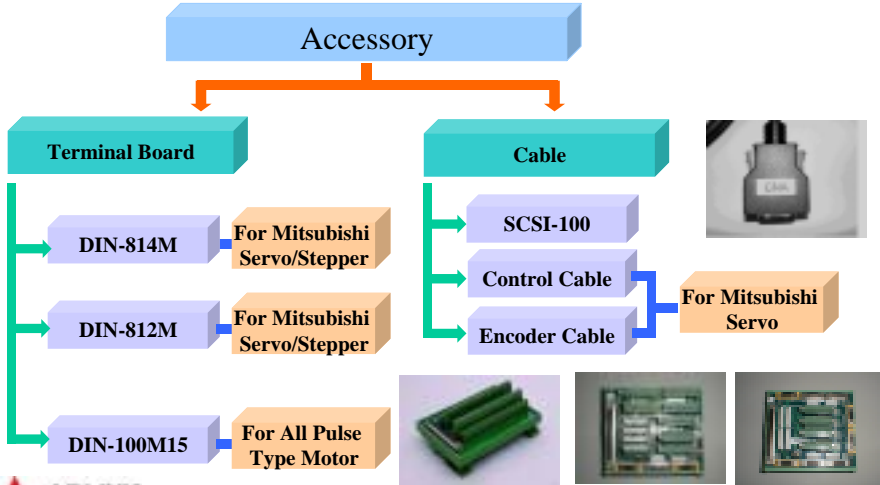
*start\_sr\_move( axis, distance, s\_vel, m\_vel, acc time, dec time, svacc, svdec )*

Ex3 2-axis linear T-curve : start\_sr\_move\_xy

*start\_tr\_move\_xy( axis, distanceX, DistanceY, s\_vel, m\_vel, acc time, dec time )*



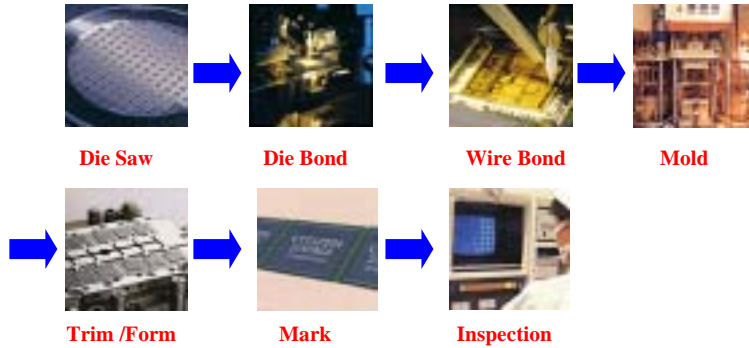
# Accessory



# Applications

## Semicon Backend Manufacturing

- IC packaging
- IC Testing



<http://www.semilink.com.tw/>



## Semicon Backend Manufacturing

- Ball Mounter (BGA)
- Under-Fill (Flip-Chip)
- Cutter (MLCC, MLCI process)
- Multi-Chips Tray Test Handler
- LED Mapping Sorter
- Burn In Loader-Unloader for Tray
- AOI (BGA)
- Marking & Inspection
- Inspection of Leads, Package
- Tape & Reel
- ...



## Other Applications

- LCD Backend Manufacturing
  - COG (Chip On Glass)
  - Laser Repair
  - Macro (inspection)
  - Load/Unloader
  - Handler
  - ...
- PCB Drill
- PCB Inspection
- ...



## Cutter

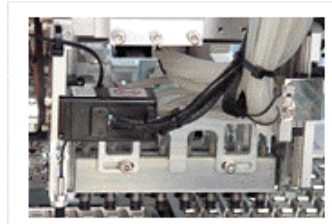
Area	Taiwan
Products used	<ul style="list-style-type: none"><li>■ IPC</li><li>■ PCI-8132 Solution</li><li>■ AC Servo</li><li>■ Steppers</li><li>■ Vision alignment system</li></ul>





## Multi-Chips Tray Test Handler

Area	Taiwan
Products used	<ul style="list-style-type: none"> <li>■ IPC</li> <li>■ PCI-8164 Solution</li> <li>■ AC Servo</li> <li>■ Steppers</li> <li>■ Over 100 points HSL remote I/O modules</li> </ul>



## LED Mapping Sorter

Area	Taiwan
Products used	<ul style="list-style-type: none"> <li>■ IPC</li> <li>■ PCI-8164 solution</li> <li>■ AC Servo</li> <li>■ Steppers</li> <li>■ Over 100 points HSL remote I/O modules.</li> <li>■ Vision inspection system</li> </ul>



## Burn In Loader-Unloader for Tray

Area	Taiwan
Products used	<ul style="list-style-type: none"><li>■ IPC</li><li>■ PCI-8134 solution</li><li>■ AC Servo</li><li>■ Steppers</li><li>■ Over 200 points HSL remote I/O modules.</li></ul>



## AOI (Automated Optical Inspection)

Area	Taiwan
Products used	<ul style="list-style-type: none"><li>■ IPC</li><li>■ PCI-8132 solution</li><li>■ AC Servo</li><li>■ Steppers</li><li>■ Vision alignment system</li></ul>



## System Requirements

- High performance
- Complete functions
- Field proven reliability
- Easy to use, develop and trouble shoot
- Good products quality
- Accessory (Terminal board...)
- Supports & Services

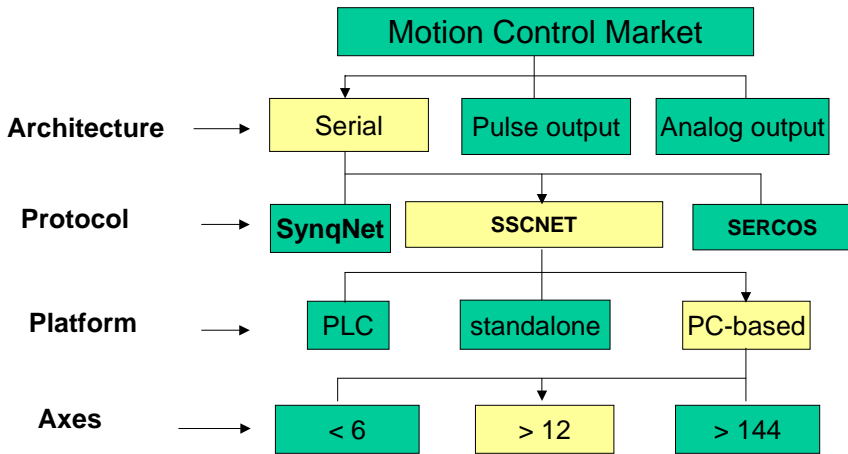


## Agenda

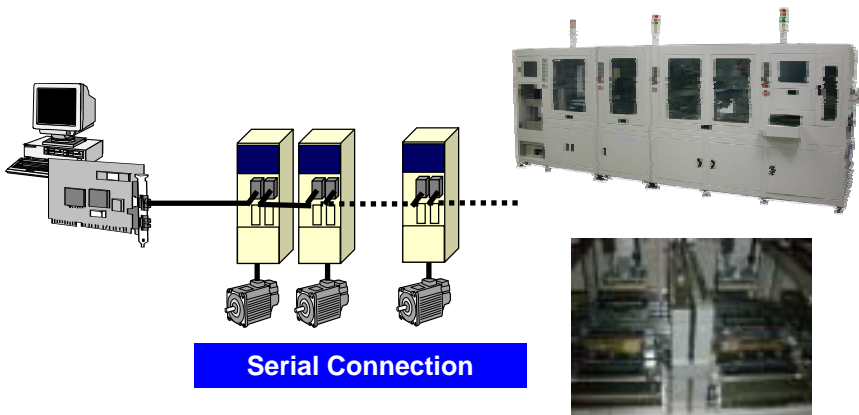
- Computer-Based Motion Control
- Pulse-Type Motion Control Solution
- SSCNET Motion Solution**
  - Architecture**
  - Advantages**
  - Solutions**
- Other Motion Solutions



## Marketing Segmentation



## Servo System Control Network (SSCNET)



## SSCNET

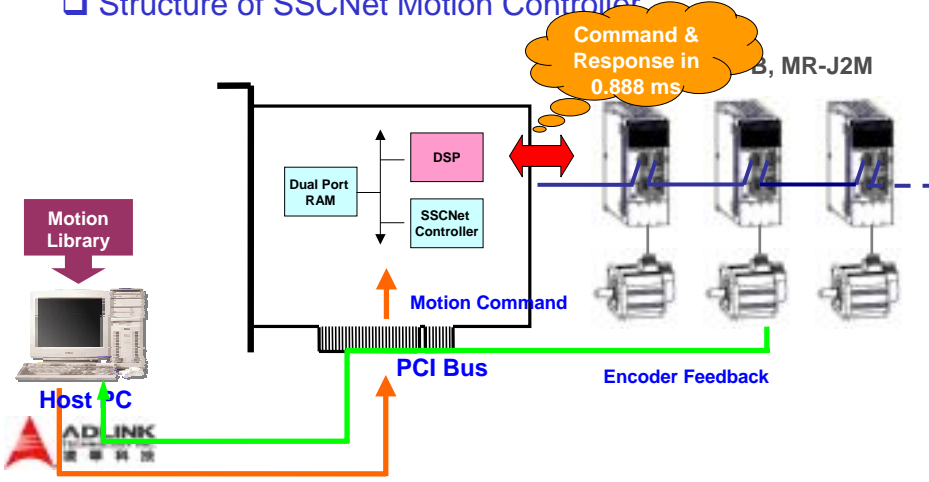
- ❑ Servo Control Network by Mitsubishi Electric
- ❑ One Sentence for Describing SSCNET

**Totally synchronized control** for multiple servo axes by plug & play and **easy wiring**



## SSCNET Architecture

- ❑ Structure of SSCNet Motion Controller



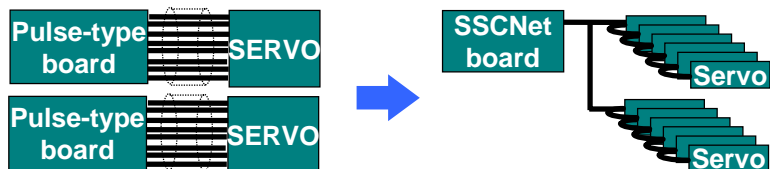
## SSCNET Advantages

- Save Wiring
- Easy Setup & Maintenance
- Higher Command Resolution and Speed
- Advanced Synchronization for Interpolation
- Stable Communication Signal



## Easy Wiring

- Reduction of Integration time
- Cost saving
- Reduction of wiring mistakes
- Standard cables as Option
- Maximum Transmission Length: **30 meters**



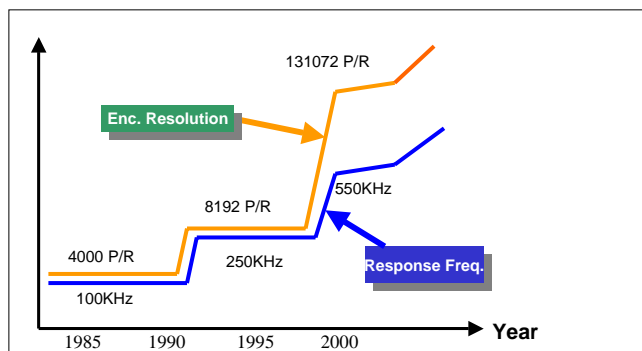
## Easy Setup & Maintain

- ❑ **Simpler wiring, less debug time.**
- ❑ **Less debug time, fast maintenance.**
- ❑ **Easy to manage servo parameters**



## Higher Command Resolution & Speed

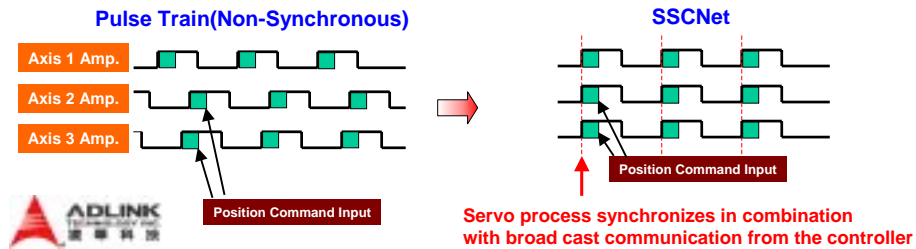
- ❑ **Limitation of command frequency**
  - **Pulse train : 500K ~ 1Mpps**
  - **SSCNet : No limit**





## Advanced Synchronized Interpolation

- ❑ Traditionally, servo motor is an independent system. It has the nature not to work synchronously.
- ❑ A synchronous mechanism exists in SSCNet communication. It can make sure the **absolute synchronization** for interpolation motion and move-all command.



## Stable Communication Signal

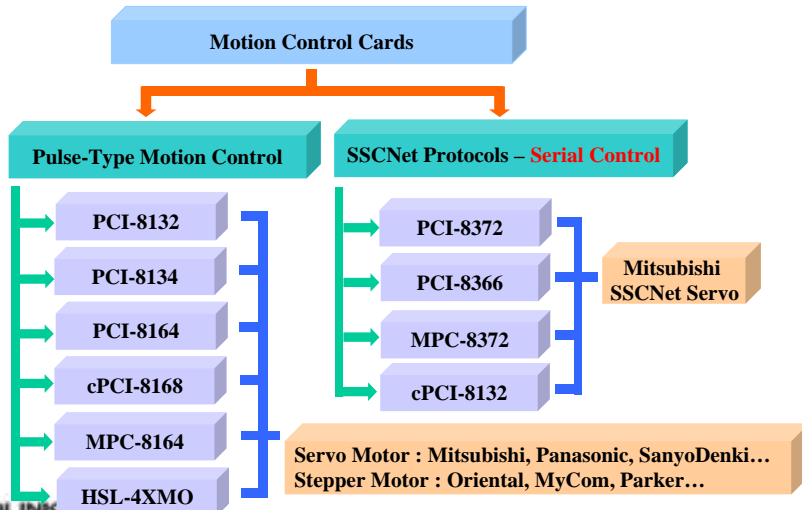
- ❑ Traditionally, pulse-type driver has disadvantages of signal decay and drift. For this reason, users have to consider **the length of controller cable** in the design of system.
- ❑ SSCNet serial communication has CRC (Cyclic Redundancy Check) mechanism, and the maximum cable length is 30 meter. Consequently, it owns excellence in **signal stability** and **transmission length**.

## SSCNET Solutions

- ❑ Cards:
  - ❑ PCI-8372 12 axes (PCI bus)
  - ❑ PCI-8366 6 axes (PCI bus)
  - ❑ cPCI-8312 12 axes (cPCI-6U)
- ❑ System: GEME with MPC-8372



## Machine Control Solution



## Utility - MotionCreator™

The screenshot displays the MotionCreator software interface. On the left, there are two tables for 'Axis List' and 'Axis Param'. The 'Axis List' table has columns for 'Axis No.', 'Type', 'Axis No.', 'Status', and 'ID'. The 'Axis Param' table has columns for 'Axis No.', 'Position', 'Vel. Lim', 'Accel. Lim', and 'Priority'. The main area shows a block diagram of a motion control system with components like 'MOTION CONTROLLER', 'SERVO MOTOR', and 'SERVO DRIVE'. On the right, there is a product image of the MotionCreator hardware with the text 'MotionCreator', 'serial interface', 'wire-saving', 'motion controller', and 'SSC Net'.

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## Applications

## Double Rail Ball Mounter

Area	Taiwan
Products used	<ul style="list-style-type: none"> <li>■ IPC</li> <li>■ SSCNet Solution</li> <li>■ Stepper</li> <li>■ Over 200 points HSL remote I/O modules</li> <li>■ Independent vision inspection system</li> </ul>



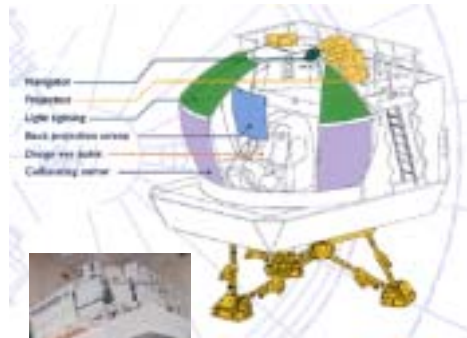
## Integrated Backend Process

Area	Southeast Asia
Products used	<ul style="list-style-type: none"> <li>■ IPC</li> <li>■ SSCNet solution</li> <li>■ AC Servo</li> <li>■ Steppers</li> <li>■ Over 200 points HSL remote I/O modules.</li> <li>■ Vision inspection system</li> </ul>

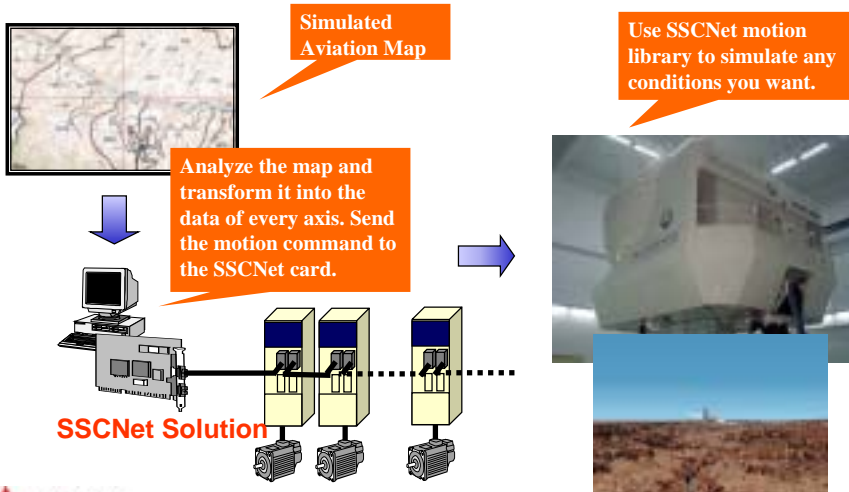


## SSCNet in Simulator Application(1)

- ❑ At least 6 axes can realize the **absolute synchronous motion**.
- ❑ Designers often adopt high power density motors. For this reason, users would like to have **good communication and anti-interference capability** for motion control card.
- ❑ Want **less wiring**.
- ❑ **Do not want to reduce motor speed** due to resolution setting in motors.



## SSCNet in Simulator Application(2)



## SSCNet in Simulator Application(3)

### □ Solution

- ✓ Use SSCNet solution to have the advantages of anti-interference and less wiring.
- ✓ Absolute synchronous motion can be realized.
- ✓ High resolution and high motion speed.

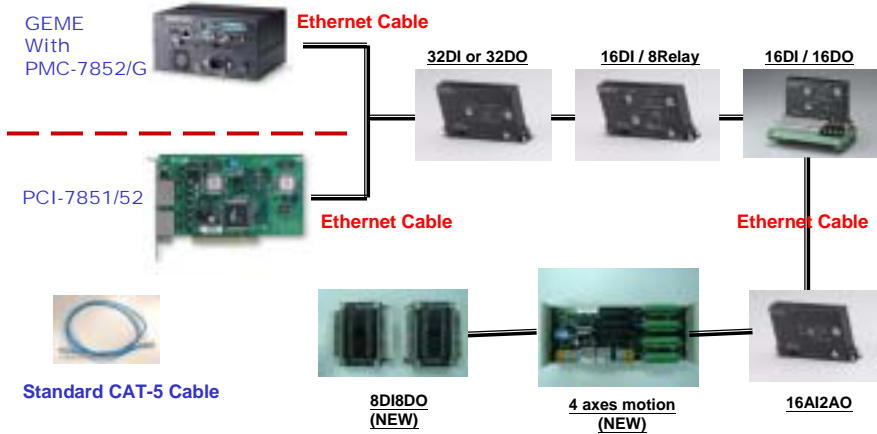


## Agenda

- Computer-Based Motion Control
- Pulse-Type Motion Control Solution
- SSCNET Motion Solution
- **Other Motion Solutions**
  - **HSL motion module & I/O Modules**
  - **Analog Motion card**
  - **SoftPLC**

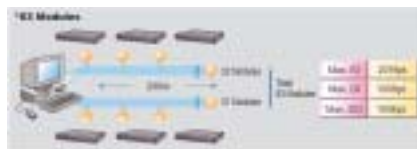


## HSL Solution



## HSL Solution Benefits

- Reduce cabling & wiring
- Easy to maintain, easy to repair (Slave module is Hot swappable)
- Easy to reconstruction
- Time deterministic, real-time
- Easy to program
- Huge number of I/O points
- Compact size
- Motion capability





## ADLINK HSL Solutions

### ❑ Master Card:

- PCI-7851/7852,

### ❑ System:

- GEME with PMC-7852.

### ❑ Slave Module :

- DI8DO8, R8DI16
- DI16DO16
- DI32, DO32 (use 2 ID)
- AI16AO2
- 8DI, 8DO (NEW)
- 4 Axes Motion Module (NEW)

### ❑ Utility: LINK Master



## HSL Motion Solutions

### ■ HSL-4XMO Key Features

- On board DSP ( TMS320C6711 ) + Motion ASIC
- Support up to 63 axes in one HSL master
- Motion point table management
- Sequence download for precision timing motion control
- All features of 8164 Pulse type motion card

Will be available in Oct. 2004



# Applications

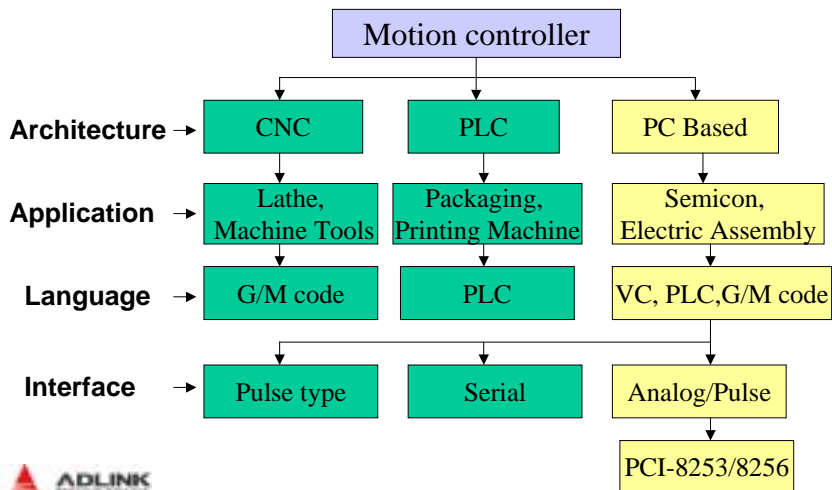
## ■ Semiconductor or LCD machinery

- Multiple Axes requirements
- Distributed applications
- Integration with HSL I/O modules

Will be available in the 1st Q of 2005



# Market Segmentation



## PCI-8253/8256: PCI 3/6 Axis Analog/Pulse Motion controller

### ■ Hardware features:

- Applied Motors: General purpose servo or stepper
- Bus Interface: PCI bus (GEME & cPCI will be released later)
- On board DSP: TI TMS320C6711D
- Full closed loop analog or pulse output
- Analog output resolution: 16bit
- Maximum pulse frequency: 4MHz
- Mechanical I/O: PEL, MEL, ORG
- External Encoder Input: 3 axes Incremental (4MHz Max.)
- Additional I/O: 16DI/16DO on PCI-8253. 3 AD channel.
- OS Support: Windows XP, Linux



## PCI-8253/8256: PCI 3/6 Axis Analog/Pulse Motion controller

### ■ Software features:

- Over 100 function calls in VB, VC
- MotionCreator Utility
- G/M code interface
- Electric CAM
- SoftPLC interface



# Applications

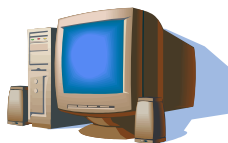
- Semiconductor or LCD machinery
- Packaging machine
- Molding machine
- General purpose high end manufacturing machines

Will be available in the 1st Q of 2005



## ADLINK PC-Based Software PLC

PLC Program  
Development  
(IEC 61131-3 language)



Windows 2000/XP



PLC  
Application  
code

1. PLC Application Code download for execution
2. On-line data monitor



Ethernet

PLC Program  
Execution (Target)



GEME with WinCE

•Support Peripheral Interface :

- Motion : MPC-8372, MPC-8164
- Local I/O : MPC-7632/7664
- Remote I/O :NuDAM and HSL



Will be available by project

## Summary

ADLINK is sincerely willing to work with you as partners and help you with our expertise on motion control. Your Inquiries or questions are always welcomed.

**LONG TERM BUSINESS  
WIN – WIN  
Partnership**



## Thank You

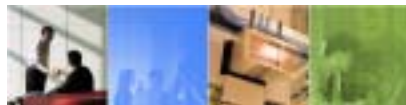


**Technology**



**ADLINK**

**Customer**



**Service**

