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NODE

BIT Automation - AGV Manager

Case Study: Automobili Lamborghini – St. Agata Bolognese (BO) Italy

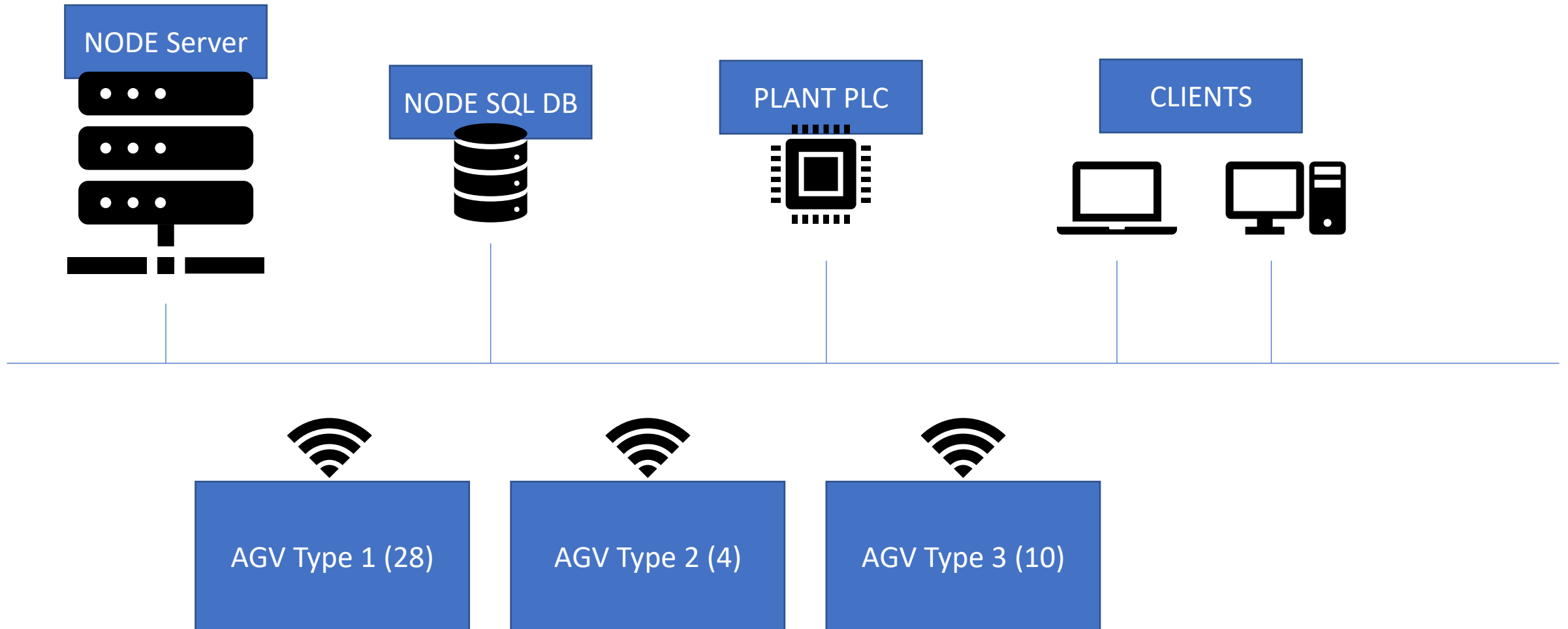
Introduction:

- ✓ NODE is an AGV Manager developed by BIT Automation in Italy.
- ✓ It is completely written in C# .NET and WPF for the UI part.
- ✓ It uses MS SQL Server database and can use Oracle database.
- ✓ It can run on every Windows OS.
- ✓ It can communicate with PLC via OPC, I/O modules or directly.
- ✓ Communication with SAP and factory ERP is foreseen.

Automobili Lamborghini – Case Study

- NODE is the system used to handle the 43 AGVs running in the Lamborghini URUS assembly line.
- We handle with the same manager 3 different types of AGV coexisting in the same layout.
- The system real time communicates with the plant's Siemens PLC S7 via UDP protocol and handles many I/Os.
- The UI Client is downloadable by any user in the network and ready to be used.

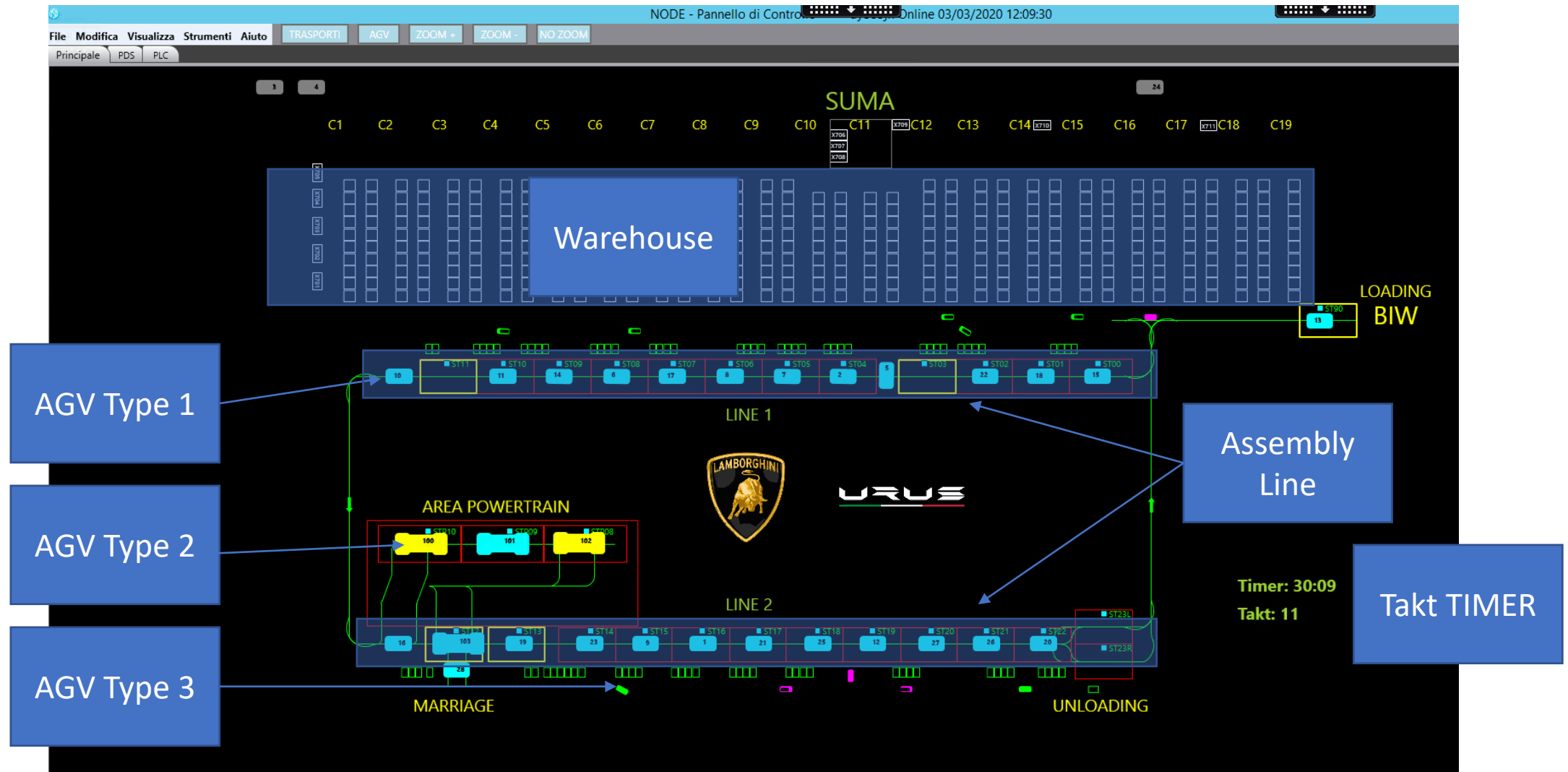
System Overview - Architecture



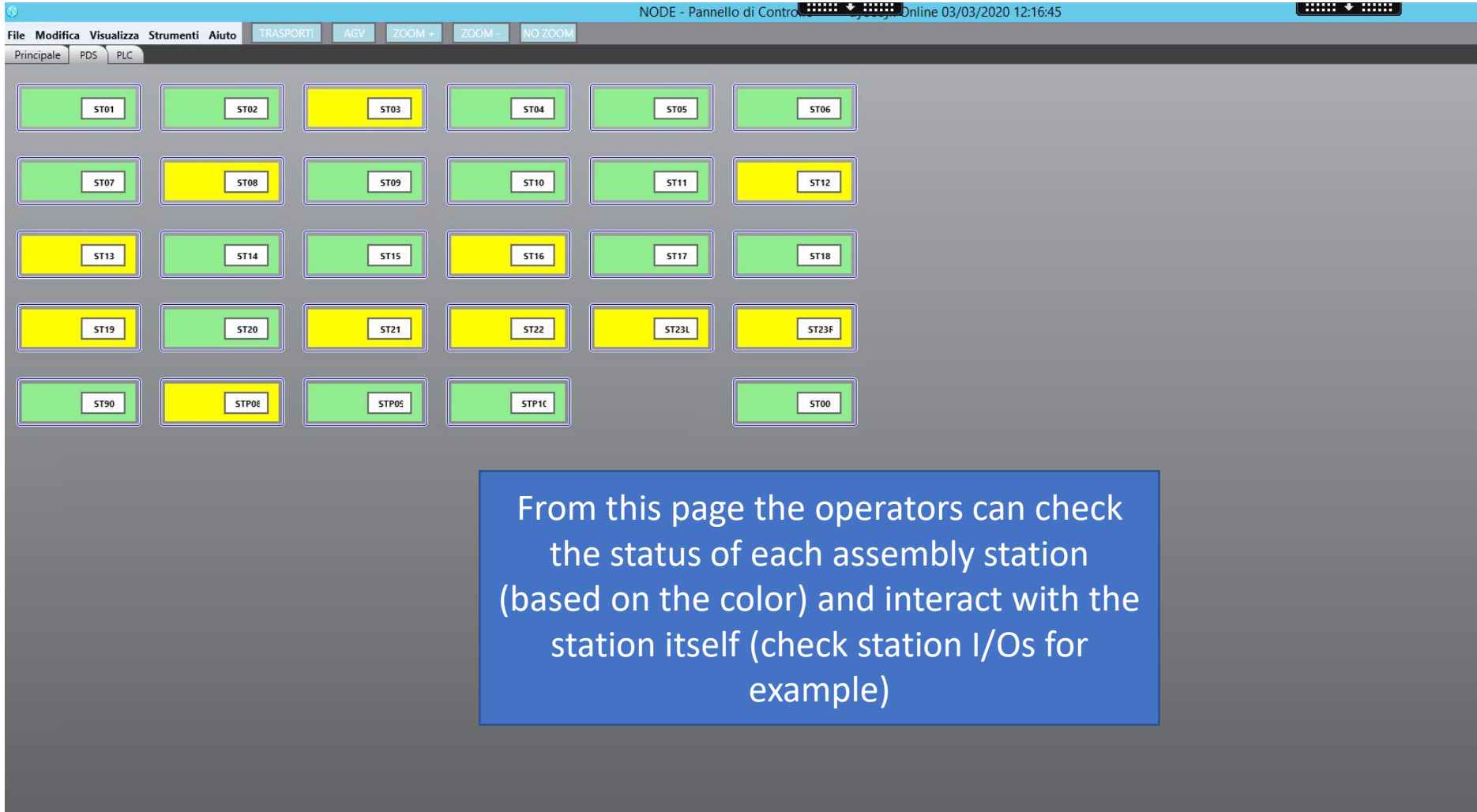
System Overview - Operativity

- The plant PLC handles the progression of the assembly line.
- When the TAKT timer expires (around 30 minutes) all the assembly stations (23 in total) are marked in the PLC as ready to go.
- The Node system reads this information from the PLC and if some other conditions are true, it gives a command to ALL the assembly AGV (type 1 and 2) to move to the next assembly station with the car.
- Every times the timer expires the mouse AGV fleet (type 3), start the taking trolleys full of assembly components to the line from the warehouse in a fixed sequence and then go back to the chargers.

System Overview – AGV UI



System Overview – Assembly Stations UI



The screenshot displays a control panel interface for assembly stations. The top menu bar includes 'File', 'Modifica', 'Visualizza', 'Strumenti', and 'Aiuto'. Below this, there are tabs for 'Principale', 'PDS', and 'PLC'. The main area shows a grid of 24 assembly stations, each represented by a colored box with a label. The stations are arranged in five rows: Row 1 (ST01-ST06), Row 2 (ST07-ST12), Row 3 (ST13-ST18), Row 4 (ST19-ST23F), and Row 5 (STP0E-STP1C, ST00). The status of each station is indicated by its color: green for normal operation and yellow for an alert or error state. The top right corner shows the system name 'NODE - Pannello di Controllo' and the date/time 'Online 03/03/2020 12:16:45'. There are also zoom controls ('ZOOM +', 'ZOOM -', 'NO ZOOM') and a 'TRASPORTI' button.

From this page the operators can check the status of each assembly station (based on the color) and interact with the station itself (check station I/Os for example)

System Overview – PLC UI

NODE - Pannello di Controllo [redacted] Online 03/03/2020

File Modifica Visualizza Strumenti Aiuto TRASPORTI AGV ZOOM + ZOOM - NO ZOOM

Principale PDS PLC

Stato Segnali PLC

Point	ItemIndex	Address	Type	Comm	State	Forced
PlcStartCounter	100000	1.00.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PlcMessageLenght	100200	1.02.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LastPlcMessageRecvd	100400	1.04.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PlcGeneralEmergency	100600	1.06.00	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PlcPlantCycleStarted	100601	1.06.01	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BreakStarted	100602	1.06.02	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MarriageStarted	100605	1.06.05	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PlcTaktTime	100606	1.06.06	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PlcWatchDog	100607	1.06.07	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TaktTimerMinutes	100800	1.08.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TaktTimerSeconds	101000	1.10.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftUP ST01	101200	1.12.00	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftDown ST01	101201	1.12.01	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Go ST01	101202	1.12.02	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emergency ST01	101203	1.12.03	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
StationEnabled ST01	101204	1.12.04	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ObjectOutOfSpace ST01	101205	1.12.05	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ReleaseShutter ST01	101206	1.12.06	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CloseShutter ST01	101304	1.13.04	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TemporaryStop ST01	101305	1.13.05	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
StepsOn ST01	101306	1.13.06	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LiftHeight ST01	101400	1.14.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftUP ST02	101600	1.16.00	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftDown ST02	101601	1.16.01	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Go ST02	101602	1.16.02	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emergency ST02	101603	1.16.03	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
StationEnabled ST02	101604	1.16.04	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ObjectOutOfSpace ST02	101605	1.16.05	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ReleaseShutter ST02	101606	1.16.06	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CloseShutter ST02	101704	1.17.04	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TemporaryStop ST02	101705	1.17.05	In	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
StepsOn ST02	101706	1.17.06	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftHeight ST02	101800	1.18.00	***	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftUP ST03	102000	1.20.00	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LiftDown ST03	102001	1.20.01	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Go ST03	102002	1.20.02	In	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

From this page the operators can check the status of all the plant PLC's I/Os and interact with them (for example force a DigInput value to 1 or to 0)

System Overview - AGV Status

Stato e Dettagli AGV

Restart <input type="checkbox"/>	AGV N°: 206	Loaded	Stato: Execute
Libero <input type="checkbox"/>	Trunk: 581		Nodo: X581
EOF <input type="checkbox"/>	Distanza: 420		Tipo: LineFeed
Branch <input type="checkbox"/>	Voltaggio: 25.13		Da: B321
Batt Scarica <input type="checkbox"/>	Timer: 1183		TO#: 22
Manuale <input type="checkbox"/>	X: 62415		Fase: Drop1
Carico <input type="checkbox"/>	Y: 69673		Destinazione: 2D16
	Direzione: 179,00		Confidenza: 86
	Batteria: 93%		In Attesa di:
	Velocità (m/s): 1,0		
	Nodi Bloccati: 581,582,583,584,633		

Disabilita Comanda

From this page the operators can check the status of a specific AGV (e.g. status bits, active order, battery voltage, speed, etc...)

System Overview - Order Status

TO	Stato	AGV	Tipo	Dst1	Dst2	Da	IDCarico	Priorità	TID
13	Active	207	Park	X707		NODE		Normal	13
9	Active	103	Park	X109		NODE		Normal	9
11	Active	200	Move	6S75	X622	NODE		Normal	11
18	Active	207	Move	10D22	X640	NODE		Normal	18
20	Active	202	Move	13D60	X648	NODE		Normal	20
21	Active	205	Move	5S48	X619	NODE		Normal	21
22	Active	206	Move	2D21	X609	NODE		Normal	22
23	Active	209	Move	8S50	X631	NODE		Normal	23
26	Active	203	Move	16S63	X661	NODE		Normal	26
1	Active	210	Park	X711		NODE		Normal	1

From this page the operators can check the status the active orders in the plant (in this case the mouse AGV orders) and interact with them (cancel, create, edit)

Other cases

- NODE system can be used to **replace an old AGV Manager** (e.g. for an old Digitron system) and handle the AGVs, if the AGV communication protocol is available.
- NODE system can even **handle AGVs from different manufacturers** (e.g. Digitron AGVs and AGVE LGVs) in the same plant, sharing the same layout, if the AGV communication protocol is available.

And much more...

NODE system has many other functionalities:

- System maintenance windows to check and edit system parameters **real-time, no restart required!** (e.g. traffic rules, system timers, IP address, etc...)
- It can display **different floors** of the same plant.
- We can add **had-hoc functionality** based on the customer requirements.
- We can **simulate** with a built in AGV simulator.
- **And much more!**



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