International Conference for

ICT, Electronics & Mechatronics

IKTEM 2021, Proceedings of Lectures

konferenca IKT EM

AX ELEKTRONIKA

International Conference for

ICT, Electronics & Mechatronics

IKTEM 2021, Proceedings of Lectures

Urednik: Jurij Mikeln dipl. inž.
Avtorji: izr. prof. dr. Boštjan Batagelj, Radu Igret, Bostjan Snoj, Danilo Zimšek, Grega Močnik, Mitja Zupan, Matjaž Skubic, Matjaž Hribar, Gregor Spagnolo, Mirko Ivančič, Žiga Lausegger, Jernej Protner, Niko Herakovič, Jure Pigac, Marjan Bezjak
Tehnični urednik: Samo Gregorčič
Založnik: AX elektronika d.o.o.
Za založnika: Jurij Mikeln, dipl.inž.
Oblikovanje in grafična priprava: AX elektronika d.o.o. - grafični studio
Kraj izida: Domžale
Leto izida: 2021

PDF publikacija - PDF verzija
Način dostopa (URL) : https://iktem.si

Kataložni zapis o publikaciji (CIP) pripravili v Narodni in univerzitetni knjižnici v Ljubljani
COBISS.SI-ID 68998915
ISBN 978-961-6680-21-9 (PDF)

INDEX

4 Dear Colleagues,
Jurij Mikeln, B.Sc.E.E., President of the IKTEM Organizing Committee
Depala vas, June 2021

7 Kaj prinaša omrežje majhnih satelitov Starlink?
Avtor: izr. prof. dr. Boštjan Batagelj, bostjan.batagelj@fe.uni-lj.si

21 Quectel Wireless Solutions
https://www.quectel.com

49 BG95-M3 LPWA module in A1 Slovenia CatM network
Autor: Radu Igret, radu.igret@quectel.com

79 NB-IoT or LTE-M?
Autor: Bostjan Snoj, bostjan.snoj@A1.si

101 Face mask detection
Autor: Danilo Zimšek, danilo.zimsek@um.si
Autor: Grega Močnik, grega.mocnik@um.si

117 Automated PCB assembling for development and small series
Autor: Mitja Zupan, info@tivtec.com

141 Programiran je ANDROID naprav z GUI-O aplikacijo
Avtor: Matjaž Skubic, gammda@gmail.com

165 GUI-O application for Android devices
Autor: Matjaž Skubic, gammda@gmail.com

185 Comprehensive EMS and ODM solutions: FROM CONCEPTUAL DESIGN TO PRODUCTION
Autor: Matjaž Hribar, matjaz.hribar@ema.si

193 Operations != Response
Autor: Gregor Spagnolo , gregor@ssrd.io

207 Dinamične merilne lastnosti osciloskopov
Avtor: Mirko Ivančič, mirko@amiteh.com

219 LINUX VIRTUALIZATION
Autor: Žiga Lausegger, ziga@pistam.com

241 IoT and Digital Twin - Production Guiding Concept
Autor: Jernej Protner, jernej.protner@fs.uni-lj.si
Autor: Niko Herakovič, niko.herakovic@fs.uni-lj.si

257 3D printing forthewin
Autor: Jure Pigac, jure.pigac@student.um.si

275 Mechanum electric Vehicles MB-1/2020
Autor: Marjan Bezjak, marjan.bezjak@gmail.com

Dear Colleagues,

on behalf of Organizing Committee I warmly welcome you at IKTEM 2021 conference.

Firstly I'd like to thank to Faculty for Electronics from Ljubljana, ICT chair prof. Janez Bešter for their help at organizing the conference.

Also we'd like to thank to our sponsors that have supported us regardless strange Covid-19 situation.

And we'd like to thank to all lecturers who have prepared interesting lectures.

I'd like to say few words about IKTEM conference. IKTEM is being organized by Svet elektronike and Svet mehatronike magazines with a help of Faculty for Electronics from Ljubljana, Faculty for Electronics and Computing from Maribor and Slovenian Chamber of Commerce of which we thank Electronics and Electrical Industry Associationas well as Chamber of Business Services of Slovenia.

IKTEM 2021 venue was planned to be Rogla – as in the 2019 however, due to Covid-19 situation we have made it virtually via Zoom platform.

The conference brought many interesting lectures from the fields of ICT, electronics and mechatronics. All presentations are joint in this Proceedings of Lectures, while videos taken from presentations can be seen at Svet elektronike Youtube channel.

Jurij Mikeln, B.Sc.E.E., President of the IKTEM Organizing Committee
Depala vas, June 2021

konferenca
IKT
EM

International Conference for ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

Kaj prinaša omrežje majhnih satelitov Starlink?

izr. prof. dr. Boštjan Batagelj
bostjan.batagelj@fe.uni-lj.si

Univerza v Ljubljani
Fakulteta za elektrotehniko

Katedra za IKT
LSO Laboratorij za sevanje in optiko

Pričetki projekta Starlink

- Starlink je globalno satelitsko komunikacijsko omrežje, ki ga razvija ameriško podjetje SpaceX.

(Space Exploration Technologies Corporation)

Januarja 2015 v Seattlu lastnik podjetja SpaceX Elon Musk na odprtju podružnice SpaceX Seattle prvič predstavi satelitski projekt Starlink.
https://www.youtube.com/watch?v=AHeZHyOnsm4

STARLINK https://www.starlink.com/

Ambiciozni projekt bo v vesolju vzpostavil globalno satelitsko internetno omrežje, ki bo

- sposobno prenesti večino (cilj je 50%) internetnega prometa na dolgih razdaljah in
- okrog 10% lokalnega internetnega prometa nekega (ruralnega) območja.

Utirjenje satelitov

https://commons.wikimedia.org/wiki/File:Starlink_Mission_(47926144123).jpg

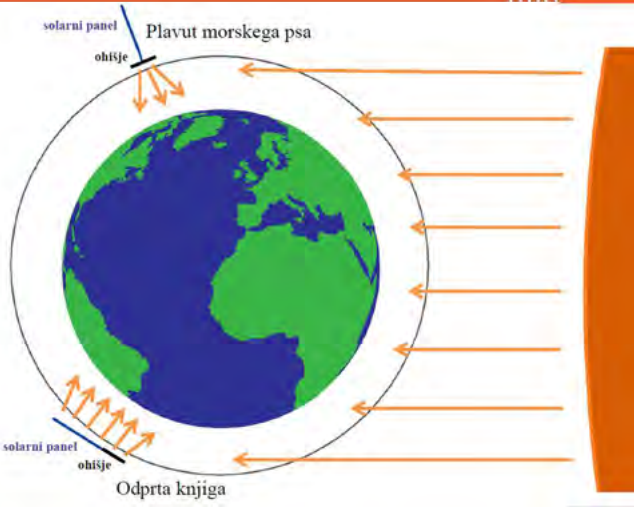
22. februar 2019	2 satelita
24. maj 2019	60 satelitov
11. november 2019	60 satelitov
7. januar 2020	60 satelitov
29. januar 2020	60 satelitov
17. februar 2020	60 satelitov
18. marec 2020	60 satelitov
22. april 2020	60 satelitov
18. maj 2020	60 satelitov
⋮	
26. maj 2021	60 satelitov

izstreljenih 1737
(1635 v tirnici)

- Nosilna raketa Falcon 9 (značilna po ponovni uporabi).
- Po vstavitvi v tirnico sateliti letijo skupaj, potem se razpršijo na različne položaje v tirnicah nad Zemljo.

Večerne lučke na nebu

- Kolona svetlih satelitov, potujočih čez večerno nebo.
- Prvih 60 satelitov (24. maj 2019) je bilo zelo vidnih in povzročilo zgražanje pri astronomih, ki so projekt označili kot bizaren, saj naj bi imel negativne posledice za prihodnost astronomskih raziskav.



- Sateliti so vidni, ko proti Zemlji odbijejo sončno svetlobo.
- Sateliti v nizkih tirnicah so vidni le zvečer in zjutraj, oddaljeni sateliti so vidni tudi ponoči.

- Ukrep je bil temen premaz na spodnji strani satelita, ki zmanjša odsev.

bostjan.batagelj@fe.uni-lj.si

Tveganje nezgode

https://spectrum.ieee.org/tech-talk/aerospace/satellites/the-odds-that-one-of-spacexs-internet-satellites-will-hit-someone

- Sestava prvih Starlink satelitov je zaradi
  - SiC laserskih zrcal,
  - vztrajnikov iz nerjavečega železa,
  - ionskega pospeševalnika iz titana in železa,
- imela riziko za človeško žrtev 1:18.200, kar je nad ESA in NASA zahtevami, ki znašajo 1:10.000.
- FCC je marca in junija 2017 izračunal skupno tveganje za človeško žrtev.

11.927 satelitov ÷ 6 let = 1.987 satelitov / leto ÷ 365 dni= 5,4 satelita / dan

skupno število satelitov

življenjska doba satelita

vsake 6 let bo ranjen ali ubit en zemljan!

- SpaceX se je branil s tem, da vsak dan na Zemljo pade med 62 in 242 meteoritov težjih od 10 g.
- Po sestanku med SpaceX in FCC (marec 2019) je SpaceX obljubil preoblikovanje satelite tako, da v celoti izgorijo v ozračju. Zato je znižal maso iz 386 kg na 260 kg.

https://spectrum.ieee.org/tech-talk/aerospace/satellites/spacex-claims-to-have-redesigned-its-starlink-satellites-to-eliminate-casualty-risks

ping

Ljubljana	
Amsterdam	29.066ms
Copenhagen	35.433ms
Dallas	136.918ms
London	33.125ms
Los Angeles	160.055ms
Moscow	58.833ms
Munich	11.978ms
New York	113.982ms
Paris	43.723ms
Rome	24.702ms
Stockholm	47.315ms
Tokyo	228.498ms
Toronto	105.743ms
Vienna	5.951ms
Zagreb	12.775ms

https://wondernetwork.com/pings

Svetlobni signal po optičnem vlaknu z lomnim količnikom n=1,5 prepotuje razdaljo od Ljubljane do Amsterdama (1250 km) v času

$$t = \frac{L}{\frac{c_0}{n}} = \frac{1250\ \text{km}}{2 \cdot 10^8\ \text{m/s}} = 4{,}17\ \text{ms}$$

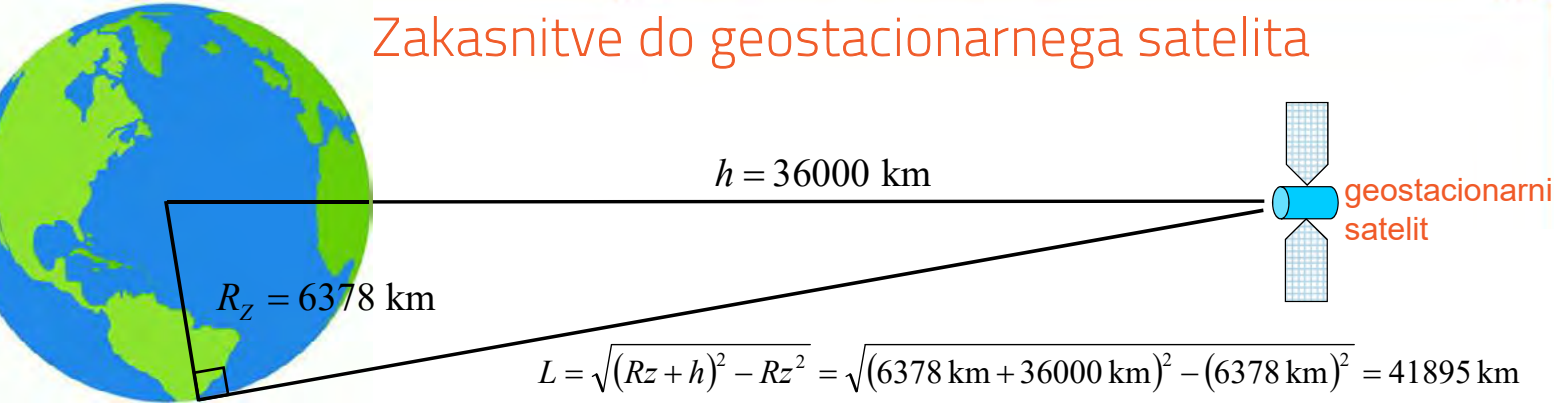
Ljubljana – Amsterdam – Ljubljana

$$2t = \underline{\underline{8{,}3\ \text{ms}}}$$

Procesiranje signala v telekomunikacijskih napravah predstavlja bistven del zakasnitve signala.

bostjan.batagelj@fe.uni-lj.si

Zakasnitve do geostacionarnega satelita



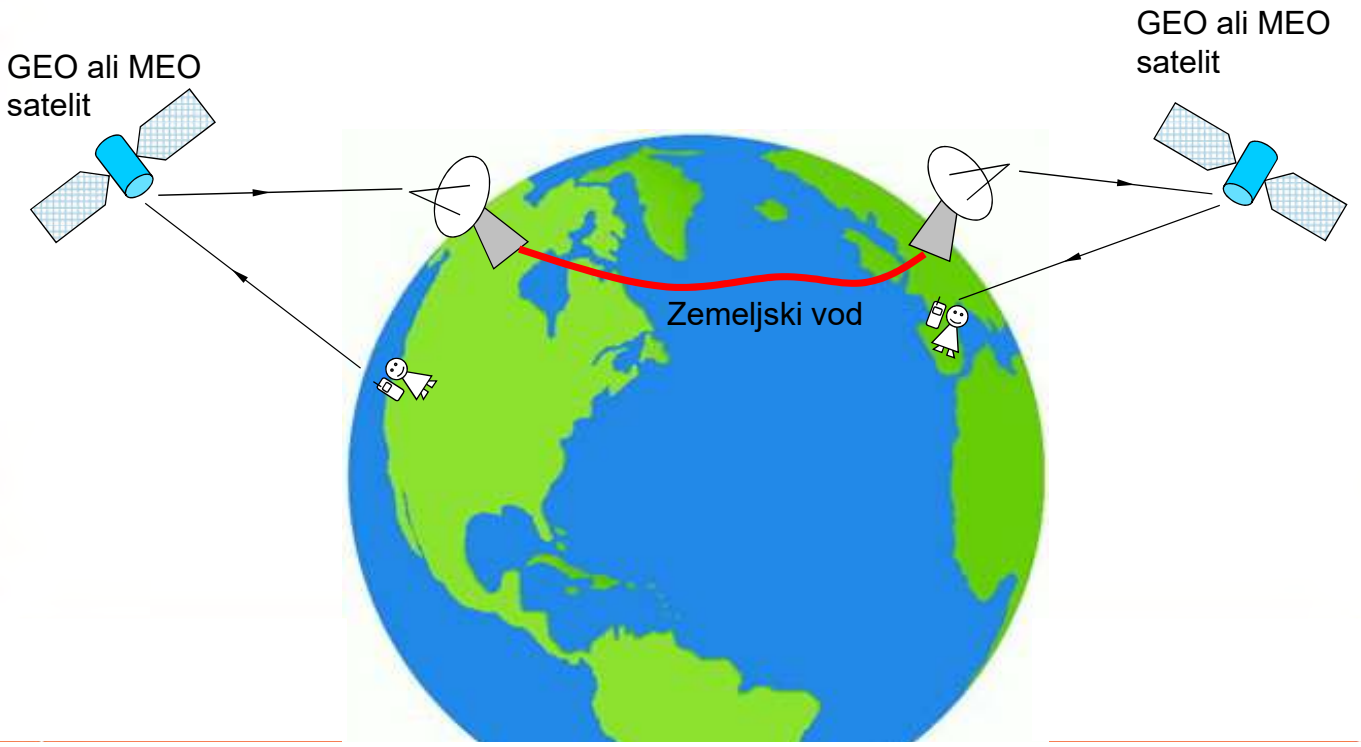
- Zakasnite za opazovalca, ki ima geostacionarni satelit v nadglavišču (zenitu).

$$t_{zenit} = \frac{h}{c_0} = \frac{36000\text{ km}}{3 \cdot 10^8\text{ m/s}} = 120\text{ ms} \qquad 2t_{zenit} = 240\text{ ms}$$

- Zakasnite za opazovalca, ki ima geostacionarni satelit na obzorju (horizontu).

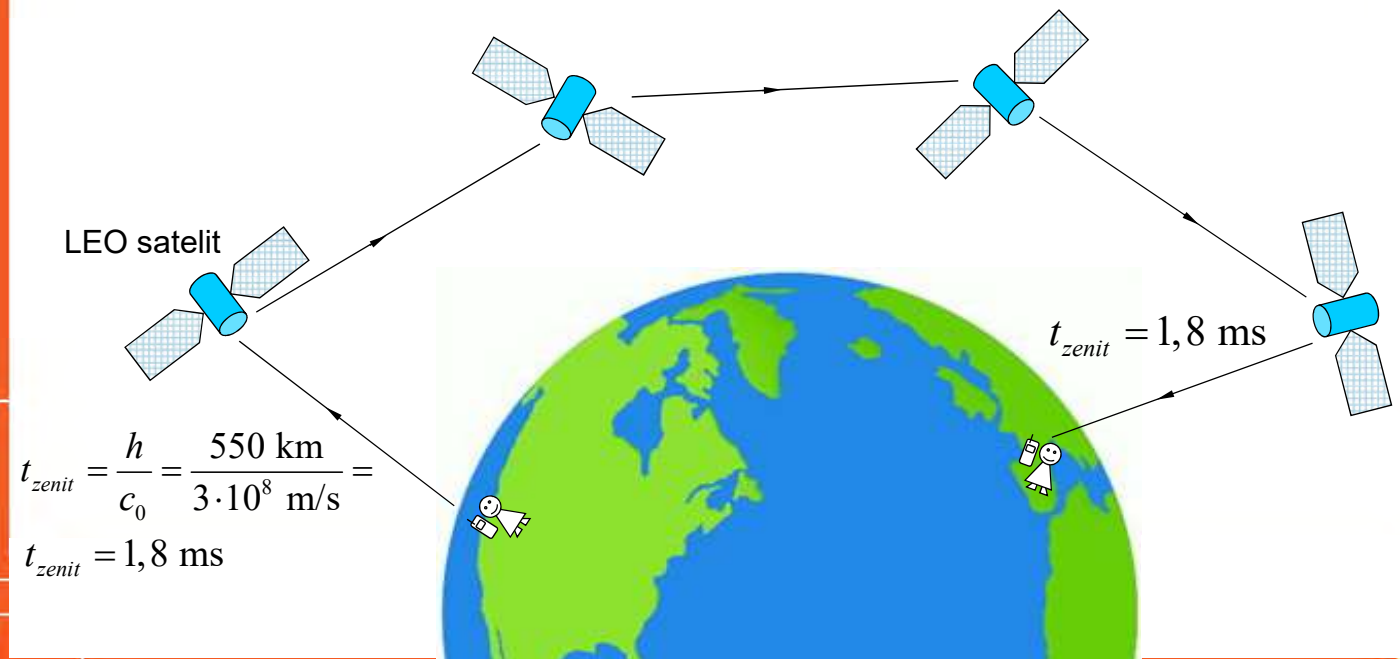
$$t_{horizont} = \frac{L}{c_0} = \frac{41895\text{ km}}{3 \cdot 10^8\text{ m/s}} = 140\text{ ms} \qquad 2t_{horizont} = 280\text{ ms}$$

Zakasnitve pri omrežju brez medsatelitskih povezav



Zakasnitve pri omrežju z medsatelitskmi povezavami

- V vesolju je potrebno **manj vozlišč**, da informacija prispe na cilj.
- Elektromagnetno valovanje potuje po vakuumu s 3/2 večjo hitrostjo, kot po optičnem vlaknu.



$$t_{zenit} = \frac{h}{c_0} = \frac{550\ \text{km}}{3 \cdot 10^8\ \text{m/s}} =$$

$$t_{zenit} = 1,8\ \text{ms}$$

Primerjava zakasnitev v optičnem in LEO satelitskem omrežju

- Elektromagnetno valovanje potuje po vakuumu s 3/2 večjo hitrostjo, kot po optičnem vlaknu.

- Uporaba optičnega vlakna z najkrajšo razdaljo med A in B

$$t_{AB} = \frac{L}{\frac{c_0}{n}} = \frac{nL}{c_0}$$

- Uporaba Starlinka s satelitom v zenitu in najrajše medsatelitske povezave med A in B

$$t_{AB} = \frac{L}{c_0} + 2\frac{h}{c_0}$$

$$t_{AB} = \frac{nL}{c_0} = \frac{L+2h}{c_0}$$

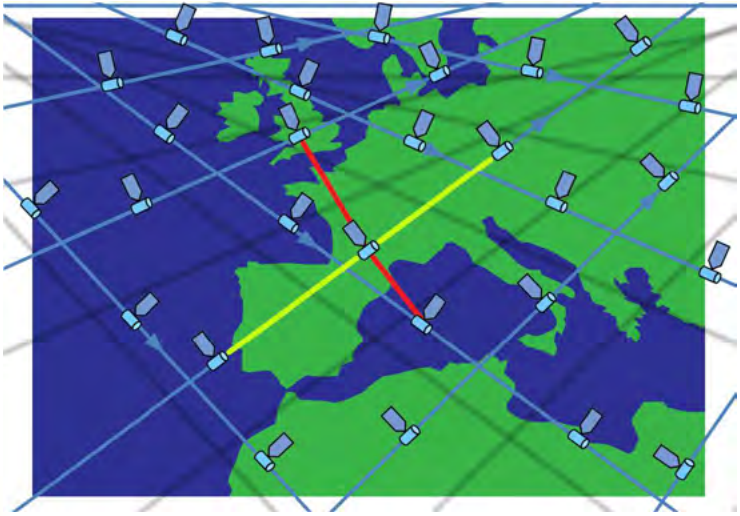
$$nL = L + 2h$$

$$L(n-1) = 2h$$

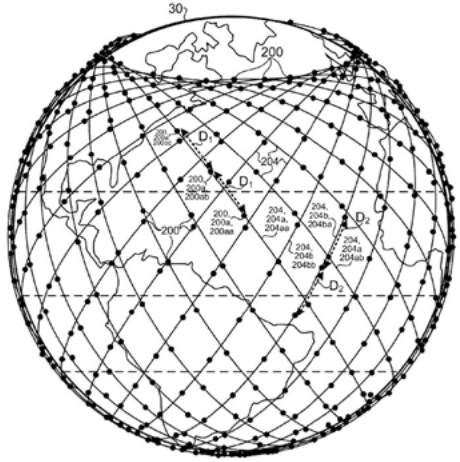
$$L = \frac{2h}{(n-1)} = \frac{2 \cdot 550\ \text{km}}{(1{,}5-1)} = \frac{1100\ \text{km}}{0{,}5} = 2200\ \text{km}$$

- Na dolge razdalje bo hitreje preko satelita Starlink v LEO, kot preko direktnega optičnega vlakna.
- Za natančen izračun je potrebno upoštevati:
  - Realne razdalje med sateliti (glej članek prof. Mark Handley "Delay is Not an Option: Low Latency Routing in Space") https://dl.acm.org/doi/10.1145/3286062.3286075
  - Zakasnitve v optičnih vozliščih, ki lahko predstavljajo povišanje zakasnitve za več kot 50%.

Vesoljski segment



- 22 satelitov v vsaki od 72 tirnic.

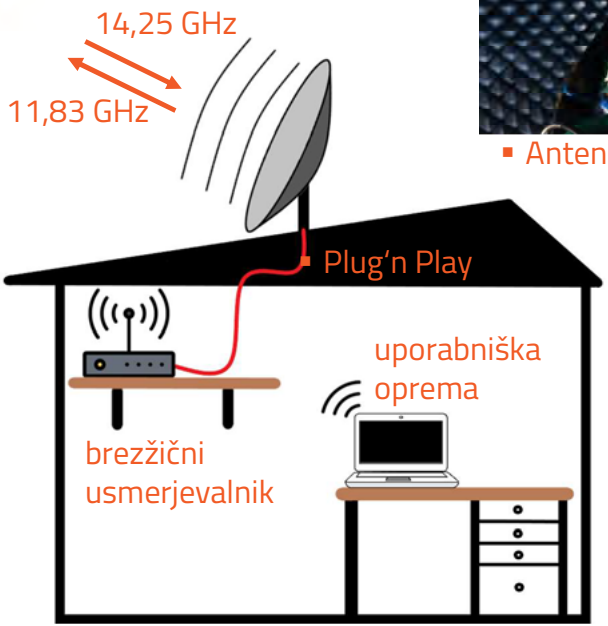


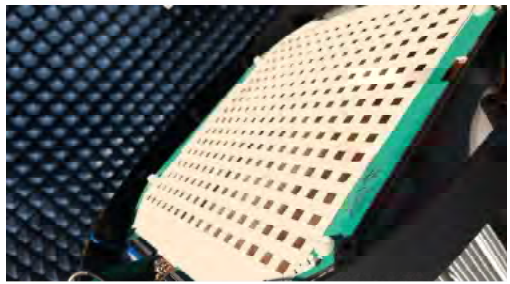
- medsatelitske zveze
- Patent „Satellite constellation“

Vir: https://patents.google.com/patent/US9973267B2/en

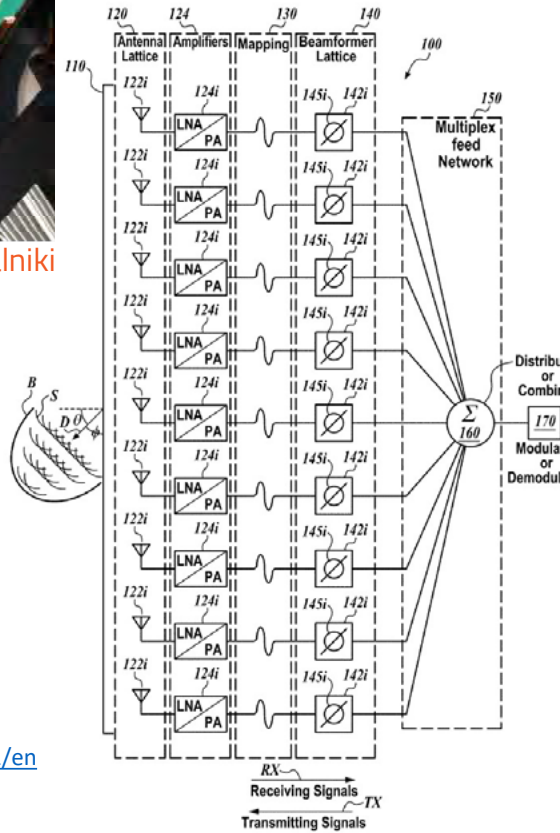
Vir: https://www.maxval.com/blog/featured-technologies-starlink-constellation/

Zemeljski segment





- Antensko polje s faznimi sukalniki



i-Dimensional Steering of Phased Array Antennas https://patents.google.com/patent/US10770790B1/en

amformer lattice for phased array antennas https://patents.google.com/patent/US20190253125A1/en

Zaključki

- Večino globalnega internetnega prometa bo najverjetneje nemogoče prevzeti.
- Starlink ne bo primeren za gosto poseljena področja (priznava Elon Musk), ker si zmogljivost enega satelita deli preveč uporabnikov.
- Zakasnitve v omrežju niso resen problem:
  - Sateliti so na nizki tirnici (bližnje kot Stuttgard)
  - Hitrost EM valovanja je večja, kot po optičnem vlaknu.
  - Na vmesni poti bo manj vozlišč, kot pri optičnem omrežju. Sateliti ne bodo delovali kot klasična vozlišča na Zemlji, ki pridelajo veliko zakasnitve na račun usmerjanja paketa. Usmerjevalni algoritmi bodo vnaprej poznani.
- Starlink bo reševal tudi ozko grlo v sedanjem omrežju, ki so zadnji kilometri do uporabnika.
- Starlink bo globalno internetno omrežje, ki bo prevladujoče (dominantno) v svojem segmentu.

https://www.delo.si/novice/znanoteh/starlink-moti-astronome-a-tudi-operaterje/

https://www.researchgate.net/publication/351391210_Evaluation_of_the_Starlink_Small_Satellite_Communications_Network_Technical_Specifications

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

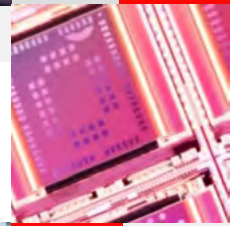
Quectel Wireless Solutions

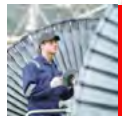
QUECTEL

May
202

Quectel Overview

Product Portfolio
IoT Applications





Build a Smarter World

www.quectel.com

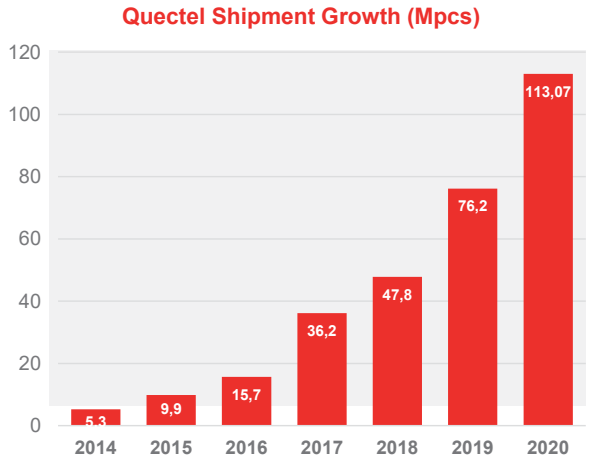
About Quectel

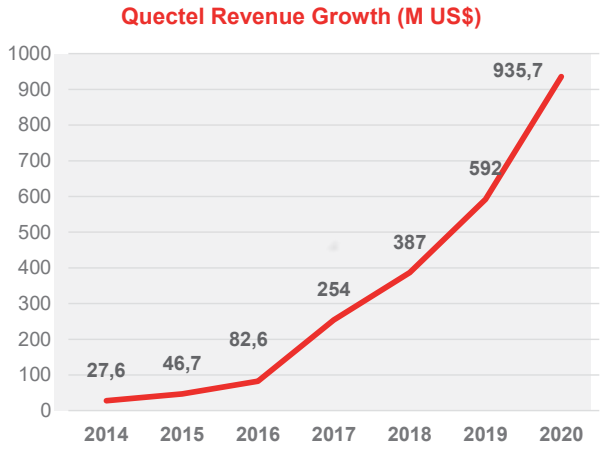
- Founded in October 2010
- **5 R&D Centers globally: Shanghai, Hefei, Foshan, Belgrade and Vancouver**
- Listed on the Shanghai Stock Exchange: Stock Code: **603236.SS**
- 50+ sales offices, 90+ distributors and 3000+ employees worldwide
- Monthly production capacity over **18 Mpcs**
- More than **6000** customers worldwide

www.quectel.com

Build a Smarter World

Quectel Key Figures





www.quectel.com

Build a Smarter World

Quectel's Market Position

QUECTEL

Number 1

Revenue
$935.7 million
(FY 2020)

CAGR Growth Rate
> 50%
(2018-2020)

Units Shipped
113.07 million
(FY 2020)

R&D Size
2300+ R&D engineers

Investment
Unparalleled investment in R&D & automation

www.quectel.com

Build a Smarter World

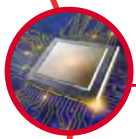
Quectel 360 Degree Support

1. System Evaluation

- Analyze customer's requirements
- Recommend the right module for the customer
- Antenna placement evaluation
- Antenna design

2. Design In

- Recommend referenced hardware designs
- Check schematic and layout
- Provide software design support

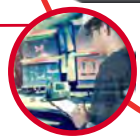


3. Prototype

- Provide design validation testing
- Recommend suppliers

4. Testing Service

- RF testing
- Power consumption testing
- Audio testing
- Reliability & environmental testing
- ESD testing
- Certification testing
- Antenna debug



5. Mass Production

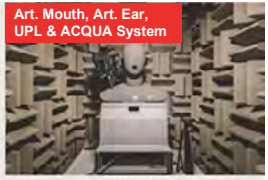
- Provide assembly and testing guidelines
- After-sales service

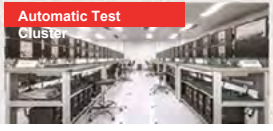
www.quectel.com

Build a Smarter World

State of the Art Laboratory Facilities

Our advanced laboratory ensures the reliability of Quectel modules. We also offer testing services for our customers' devices, thus saving them costs and accelerating time to market.





3000+ sqm
Total Laboratory Area

2500+
Test Stations

1000+
Global Certifications Achieved

www.quectel.com

Build a Smarter World

Manufacturers

Quectel modules are manufactured in **IATF16949**, **ISO14000** and **OHSAS18001** certified factories.

Qisda

Suzhou, China

Changzhou, China

Kunshan, China

TDG

Jiaxing, China

NEW KINPO GROUP

Manaus, Brazil

Kulim, Malaysia

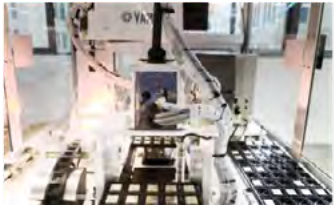
Automatic Production Line

QUECTEL

1 Automatic De-Paneling Machine & Optical Inspection System

2 Automatic DL & RF Calibration Test Station

3 Automatic Module Flatness Inspection System



6 Real Time Monitoring System for Production Line Quick Response

5 Automatic Tape and Reel Packaging System

4 Convection Oven for module de-humidification

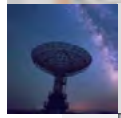
Automation video link

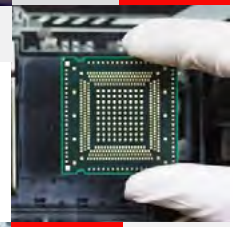
www.quectel.com

Quectel Overview

Product Portfolio

IoT Applications





Build a Smarter World

Quectel Portfolio

QUECTEL

Cellular Modules

2G
3G
LTE/ LTE-A
5G
LPWA
Automotive Modules
Smart Modules

Wi-Fi & BT Modules

Wi-Fi 4
Wi-Fi 5
Wi-Fi 6
Wi-Fi 6E
Wi-Fi Automotive

GNSS Modules

IoT
Automotive
Dead Reckoning
High Precision
Timing

Antenna

Various types of antennas matched to the module
5G/4G/3G/2G
LPWA
Wi-Fi & BT
GNSS

Our broad product portfolio covers the full range of solutions

www.quectel.com

Build a Smarter World

5G/ LTE-A Module Roadmap

QUECTEL

mmWave

Qx/YY Estimated Engineering Sample Time

Sub-6G

RG500L Series

RG520F Series Q4/21
RG520N Series Q3/21
RG50xQ Series

RM530F Series Q4/21
RM530N Series Q3/21
RM510Q Series

RM520F Series Q4/21
RM520N Series Q3/21
RM50xQ Series

Cat 12/ 16/18

EG18 Series
EG12 Series
EG120K Series Q3/21

EG512R Series

EM160R Series
EM12xR Series
EM12 Series

Cat 6

EG060K Series Q2/21
EG06 Series
EG060V Series

EP06 Series

EM06 Series

www.quectel.

LTE Standard Modules Roadmap

Product Lifetime > 2025

QUECTEL

	EC2x Series	EG9x Series	EM05 Series
Cat 4 (Qualcomm)	**EC25 series** -A/ -V/ -AF/ -AFX/ -AFXD/ -MX/ -AU/ -AUX/ -EU/ -EUX/ -E/ -J EC20-CE EG25-G EC25 Series / EC20-CE/ EG25-G Mini PCIe	**EG95 series** -NA/ -NAX/ -NAXD (Data-only) -AUX/ -E/ -EX	EM05 CE/ -E/ -G
Cat 4 (ASR)	**EC200T series** -CN/ -EU/ -AU EC200T Series Mini PCIe		
Cat 1 (Qualcomm)	**EC21 series** -A/ -V/ -AUT/ -AU/ -AUX/ -E/ -EU/ -EUX/ -KL/ -J EG21-G EC21 Series / EG21-G Mini PCIe	**EG91 series** -NA/ -NAX/ -NAXD(Data-only) -VX/ -AUX/ -E/ -EX	
Cat 1 (ASR)	**EC200S series** -CN/ -EU/ -EN*	**EG912Y series** -CN/ -EU	

-A/ -AF/ -AFX/ -AFXD/ -NA/ -NAX/ -NAXD (Data-only) / -VX (North America)
-AU/ -AUX (Latin America/ Australia/ New Zealand)
-AUT (Australia)
-CE/ -CN (China/ India)
-E (EMEA/ Korea/ Thailand/ India)
-EN (EMEA/ APAC)
-EU/ -EUX (EMEA/ Thailand)
-EX (EMEA)
-G (Global)
-J (Japan)
-KL (Korea)
-MX (Mexico)
-V (Verizon)

www.quectel.com

Build a Smarter World

Narrow Band & Low Speed Modules Roadmap

QUECTEL

		BG/BC/UG/M9x Series	BG/BC/M6xx Series	BG77x Series
LPWA Cat M, Cat NB, 2G GNSS (Optional)	Qualcomm	BG96 **BG95 Series** -M1/ -M2/ -M3/ -M4/ -M5/ -M6/ -MF/ -N1	BG600L-M3	BG77
	Sony	**BG95xA Series** -BG950A-GL/ -BG951A-GL Q2/21 -BG952A-GL/ -BG953A-GL Q4/21		**BG77xA Series** -BG770A-GL/ -BG772A-GL Q2/21 -BG773A-GL Q4/21
NB-IoT				
	Qualcomm		BC660K-GL	
	UNISOC	BC92	BC65	Qx/YY Estimated Engineering Sample Time "*" means under development.
	HISILICON	BC95-G	BC68	
	MEDIATEK		BC66 BC66-NA	
3G				
		UG96		UG89 UC200T ASR
2G				
	MEDIATEK	M95	M66 M66-DS M08-R M65 MC60	MC90

www.quectel.com

Build a Smarter World

Smart Modules Roadmap

QUECTEL

Premium
Octa-Core

-A/ -NA (North America)
-AU/ -AUL (ANZ/ Brazil)
-CE (China)
-E/ -EM (EMEA/ India/ Korea/ South Asia/ Latin America/ ANZ/ South Africa)
-J/ -JP (Japan)
-W/ -WL/ -MW/ -WF (Global)

SA800U-WF
SDA845

High
Octa-Core

SC66 Series
-CE/ -E/ -A/ -J/ -MW
Cat 6
SDM660

Medium
Octa-Core

SC600Y Series
-EM/ -NA/ -JP/ -WF
Cat 6
SDM450

SC600T Series
-EM/ -NA/ -JP/ -WF
Cat 6
MSM8953

SC606T Series
-EM/ -NA/ -WF
Cat 6
MSM8953

Entry
Quad-Core

SC20 Series
-CE/ -E/ -A/ -AU/ -J/ -W/
-EL/ -AL/ -AUL/ -WL
Cat 4
MSM8909

SC200R Series
-CE/ -EM/ -NA/ -WF
Cat 4
QCM2150

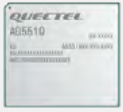
www.quectel.com

Build a Smarter World

Automotive Modules Roadmap

5G

SA515M



AG551Q Series
-CN*/ -EU*/
-NA*/ -JP

5G

AG550Q Series
-CN*/ -EU*/
-NA*/ -JP

5G

C-V2X

AG552Q Series
-CN*/ -EU*/
-NA*/ -JP

5G

DSDA

AG553Q Series
-CN*/ -EU*/
-NA*/ -JP

5G

C-V2X

DSDA

Cat 6-12

SA415M

AG520R Series
-CN/ -EU/ -NA/ -JP/ -LA*

LTE-A

C-V2X

AG521R Series
-CN/ -EU/ -NA/ -JP/ -LA*

LTE-A

Cat 4

MDM9628

AG35 Series
-CE/ -E/ -NA/ -LA/ -J

C-V2X

MDM9150

AG15

C-V2X AP

SA2150P

AG215S

www.quectel.com

-CE/ -CN (China)
-E (EMEA, Korea, Australia, India, Southeast Asia)
-EU (EMEA/ Korea/ Brazil/ India/ Australia)
-J/ -JP (Japan)
-LA (Latin America)
-NA (North America)

Build a Smarter World

Wi-Fi & Bluetooth Modules Roadmap

	Wi-Fi 4	Wi-Fi 5	Wi-Fi 6	Wi-Fi 6E
Hosted Wi-Fi Non-Automotive Grade	FC30R FC31R	FC21 FC20	FC62E Q2/21 FC64E Q2/21 FG50V	FC65E Q2/21 FC66E Q2/21
Hosted Wi-Fi Automotive Grade	AF20 AF50T AF51Y			
Stand-alone	HC06U Q2/21			FC41D Q2/21

Qx/YY Estimated Engineering Sample Time

"" means under development.*

www.quectel.com

GNSS Modules Roadmap

QUECTEL

GPS Only

L70 Series
L70
L70-R
L70-RL

Single-band GNSS

L76 Series
L76
L76-L
L76-LB

L26 Series
L26
L26-LB

L26-P
- GLONASS/ IMU raw data output
- DR + RTK (optional)

L26-DR
- ADR
- UDR
- Automotive (optional)

L26-T
Timing Applications

LG77L
Ultra-small: 7 x 7 x 2 mm

LC98S
- Timing Applications
- Maximized reliability

Multi-band GNSS

LC79D
- GPS/ GLONASS/ Galileo/ BeiDou L1 + IRNSS L5
- DR (optional)

LC29D
- GPS/ GLONASS/ Galileo/ BeiDou L1 + IRNSS L5
- BeiDou L5/ DR/ RTK (optional)

LG69T
- Automotive
- GPS/ Galileo/ BeiDou L1/L5
- GLONASS/ DR/ RTK/ Raw data output and ASIL B (optional)

Integrated Antenna

L80 Series
- L80/ L80-R
- GPS only

L86
GPS/ GLONASS/ Galileo

LC86L
- GPS+ GLONASS
- GPS+BeiDou (optional)

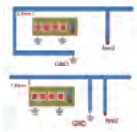
L89 Series
- L89/ L89 R2.0
- IRNSS GNSS
- AIS140 Compliant

L96
Embedded Chip Antenna

www.quectel.com

Quectel Antenna Services

1. Consulting & Evaluation



- Feasibility & Architecture Study
- Risk Identification
- Initial Proof of Concept
- Antenna Component Selection

2. Design

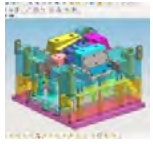
- Antenna Placement
- Antenna Layout Design
- RF Specification Design
- Antenna System Design & Optimization
- Gerber File Review

3. Testing & Certification

- Antenna OTA Testing
- Interference Mitigation
- Support for CE/ FCC/ PTCRB radio approval
- Pre-certification OTA Testing for 2G/ 3G/ 4G/ 5G

4. Manufacturing

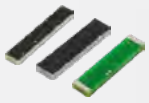
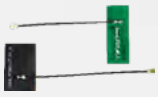
- Antenna Sample
- Tooling & Molding
- Assembly and Production Test
- Delivery



www.quectel.com

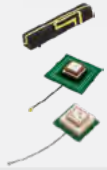
Build a Smarter World

Cellular Antennas

	LTE(4G)	5G	5G (Mid-High Bands)	5G mmWave
Internal/ Embedded	 YC0001AA YC0002AA YC0003AA 4G PCB Chip YC0017  YF0006DA YF0022AA YFCA002AA	YP0009CA 5G PCB Chip YC0018 YF0020AA YF0002AA YF0002DA	YP0009AA YP0009BA YF0017AA YF0017BA YF0002BA YF0002CA	
External-Direct mount	YCN001AA YE0002AA YE0013AA YGL001AA	YE0001BA YE0003AA YE0007AA YE0025AA		
External-Cabled	YB0010AA YB0016AA YE0006AA YE0010AA YE0021AA YE0029AA	YE0027AA YE0028AA YE0037AA YXH001AA		YM0012AA
External-Cabled Combo	YB0015AA (LTE+GNSS+2.4) YB0032AA (LTEx2) YB0033AA (LTEx2+GNSS)	YB0006AA (7in1) YB0007xx (5Gx4) 5G combo 9in1		RA510TRWAA-N00-NNNNA

Wi-Fi/BT and GNSS Antennas

QUECTEL

	Wi-Fi/BT	GNSS	With L5
Internal/ Embedded Ceramic SMD	YC0009AA YC0010AA YC0011AA		
Internal/ Embedded Cabled	YF0011AA YKB001DA		
External-Direct mount	YE0031AA YE0032AA YE0038AA Wi-Fi 6/6E		
Internal/ Embedded Passive		YG0005AA YG0008AA YG0062AA	 YC0008AA YG0030AA YCGO012A A
Internal/ Embedded Active		YG0034AA YG0021AA YG0032AA YG0015AA	GNSS dual band FPC YFGA002AA GNSS L1&L2&L5
External-Cabled Active		YG0035AA YLY001CA	YB0017AA YG0028AA

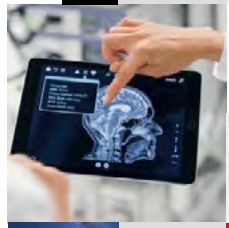
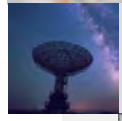
www.quectel.com

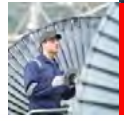
Build a Smarter World

Quectel Overview
Product Portfolio

IoT Applications

Build a Smarter World



Target Applications

QUECTEL

Telematics & Transport

- Automotive OEMs
- Vehicle Tracking
- Asset Tracking
- Ship Tracking
- Fleet Management
- OBD
- Vehicle DVRs
- Special Purpose Vehicles (SPV)
- Usage-Based Insurance (UBI)

Energy

- Electricity Meters
- Gas Meters
- Water Meters
- Heat Meters
- Smart Grid
- Wind Turbines
- Solar Panels
- Charging Piles

Payment

- Wireless POS
- Cash Registers
- ATMs
- Vending Machines
- Top-up Machines

www.quectel.com

Build a Smarter World

Target Applications

Safety

- Alarms
- Intrusion Detection
- Smoke Detectors
- Gas Detectors
- Motion Sensors
- Asset Protection

Smart Cities

- Street Lighting
- Traffic Lights
- Sharing Economy
- Smart Elevators
- Smart Parking
- Parking Meters
- Toll Collection Systems
- Digital Signage
- Advertisement Displays
- Smart Bins
- Outdoor LED Lighting

Gateways

- DTUs
- Consumer Routers
- Industrial Routers
- VOIP
- Servers
- Wi-Fi Hotspots

www.quectel.com

Build a Smarter World

Target Applications

QUECTEL

Industry

- Industrial PDAs/ Scanners
- Industrial PCs
- Rugged Tablet PCs
- Pipeline Monitors
- Robots
- Flowmeters
- UAVs
- Industrial Refrigerators
- Indoor Air Monitors
- Water Valves/ Pump Controls

Life & Healthcare

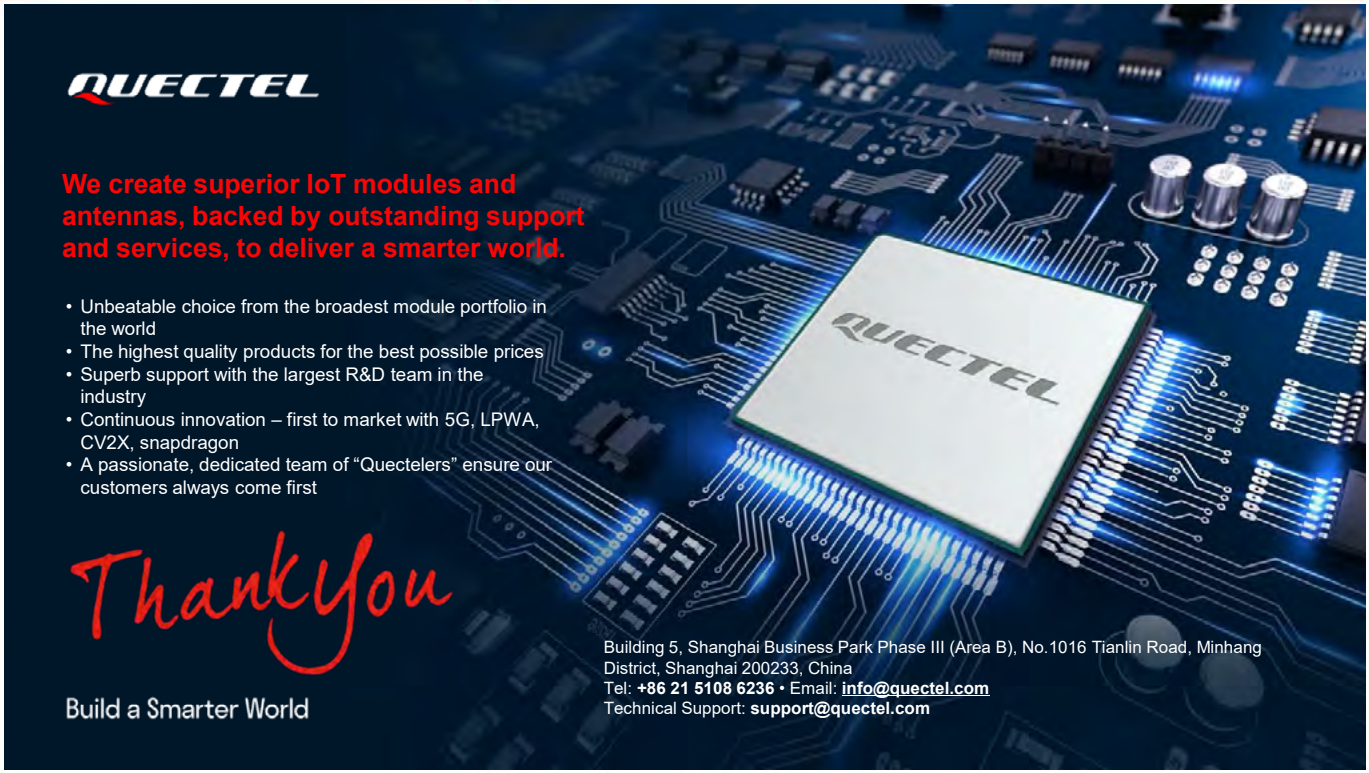
- Personal Trackers
- Pet Trackers
- Wearables
- Home Automation
- Elderly Monitoring
- Remote Medical Equipment
- Glucometers
- Blood Pressure Monitors
- Recreational Machines
- Patient Monitoring Laptops

Agriculture & Environment

- Trail Cameras
- Food Traceability
- Farmland Monitoring
- Farm Machinery Management
- Meteorological Stations
- Wildlife Tracking
- Irrigation
- Environmental Monitoring

www.quectel.com

Build a Smarter World


QUECTEL
We create superior IoT modules and antennas, backed by outstanding support and services, to deliver a smarter world.
• Unbeatable choice from the broadest module portfolio in the world
• The highest quality products for the best possible prices
• Superb support with the largest R&D team in the industry
• Continuous innovation – first to market with 5G, LPWA, CV2X, snapdragon
• A passionate, dedicated team of "Quectelers" ensure our customers always come first
ThankYou
Build a Smarter World
QUECTEL
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236 • Email: info@quectel.com
Technical Support: support@quectel.com

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

BG95-M3 LPWA module in A1 Slovenia CatM network

Quick Setup Info & Live Demo

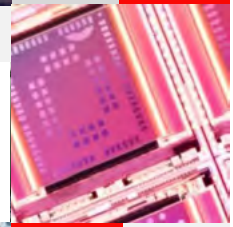
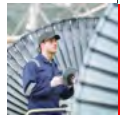
Radu Igret, Field Application Engineer

QUECTEL

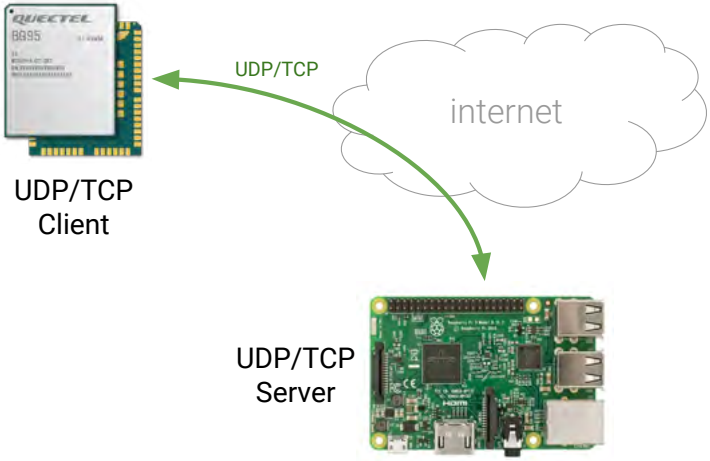
Build a Smarter World

CatM test system architecture
BG95 EVB Kit
Connection to BG95 module
Initial Setup & Configuration
Send & Receive UDP data
Get GNSS positioning info
Send & Receive TCP data
Enable Power Saving Mode

Build a Smarter World

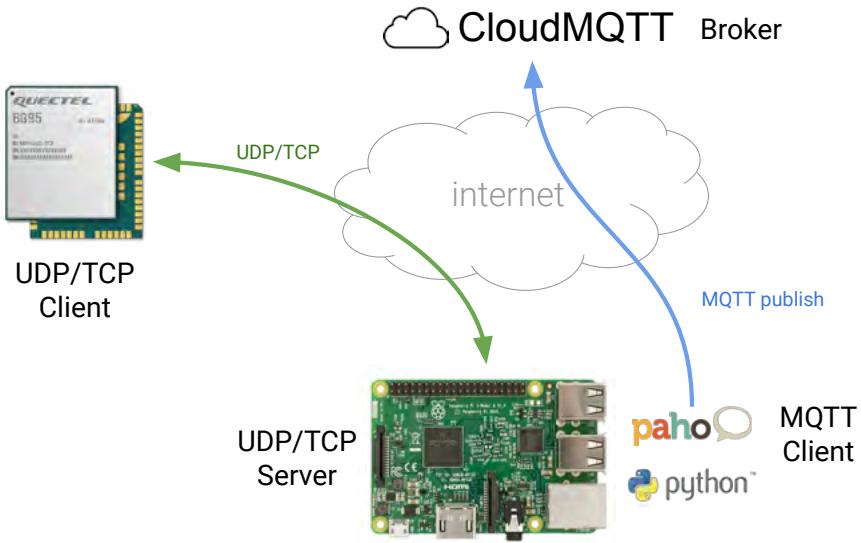
CatM test system architecture



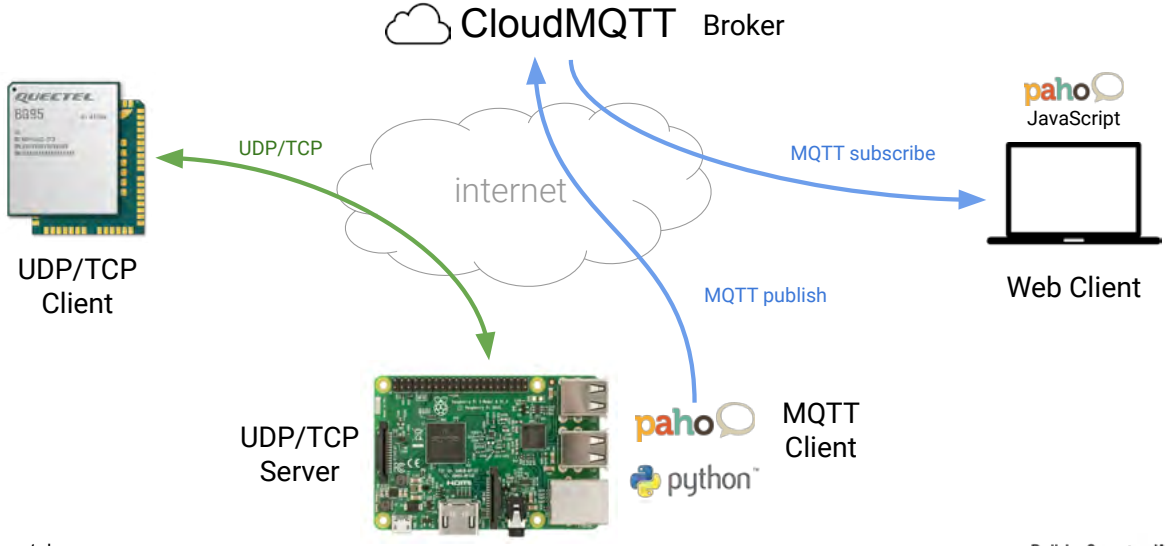
www.quectel.com

Build a Smarter World

CatM test system architecture



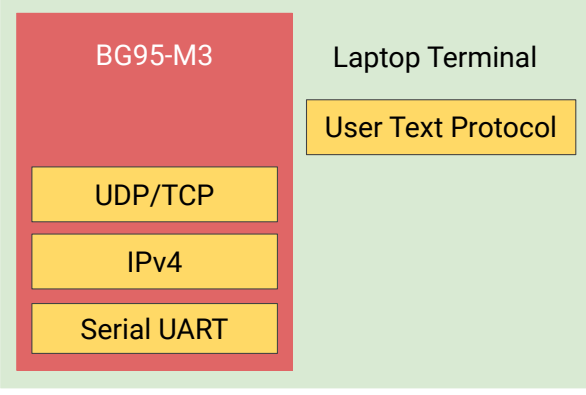
CatM test system architecture



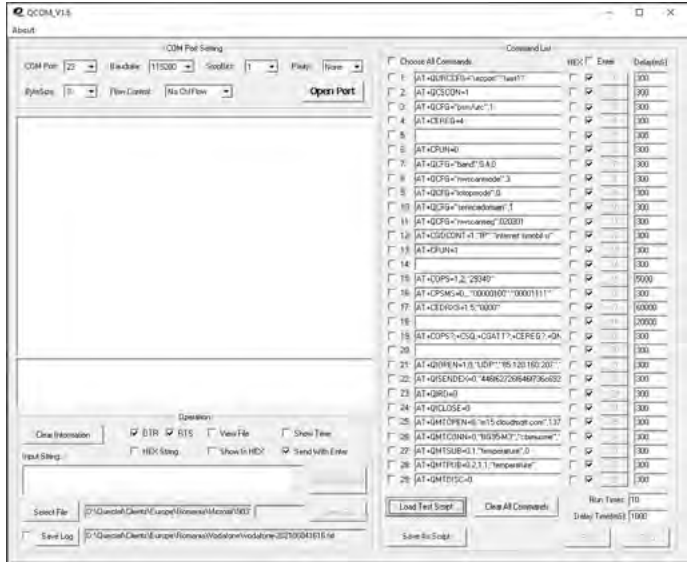
www.quectel.com

Build a Smarter World

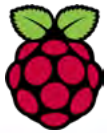
Communication layers



QCom serial terminal



UDP/TCP test server



python™

web: bit.ly/a1-udp-server

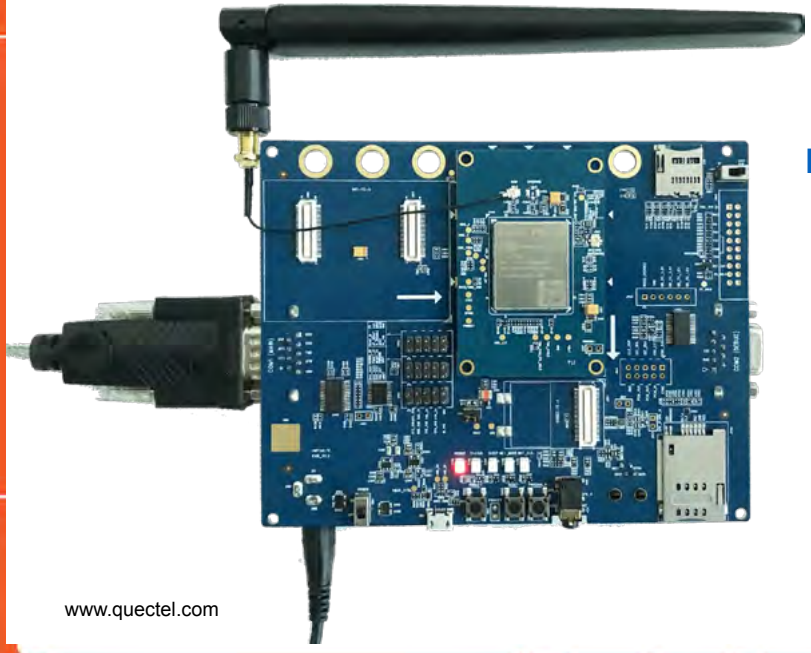
IP: **85.120.160.207***

port: **16666** [UDP]

port: **5000** [TCP]

* IP is dynamic, check web link for current allocated IP

BG95 EVB Kit



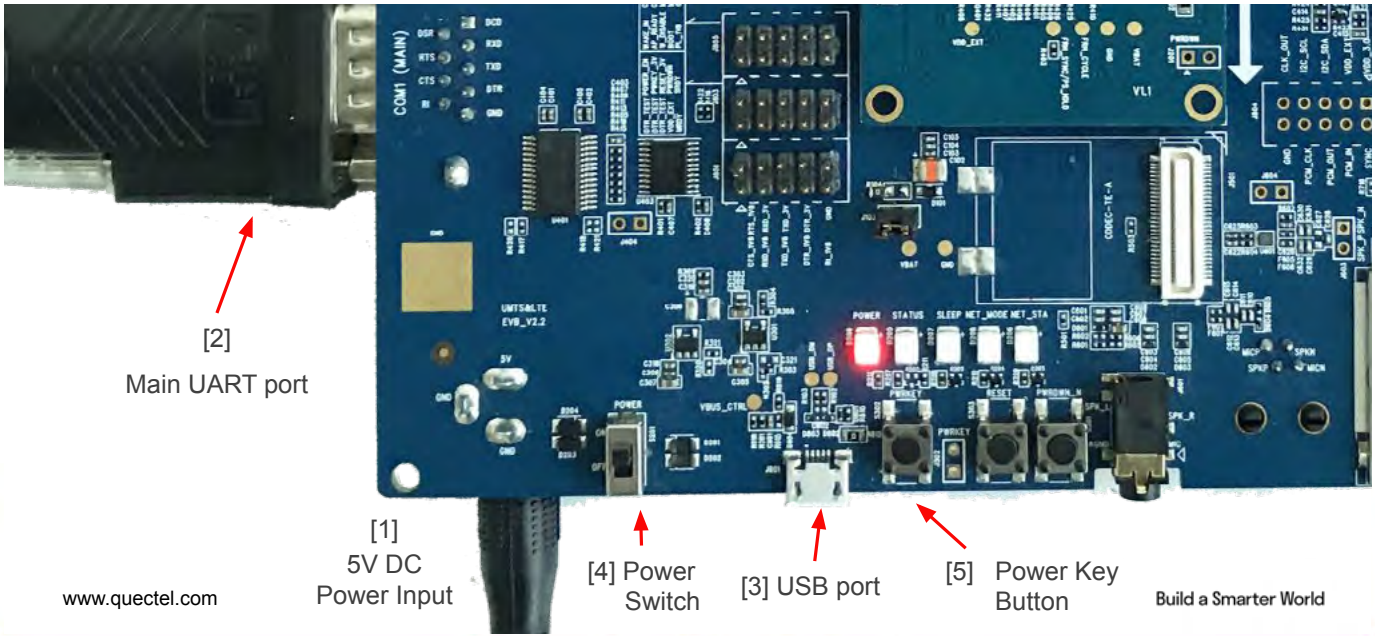
bit.ly/Quectel-CatM-A1-Slovenia

- Documentation
- Drivers
  - FTDI USB RS232 cable
  - Quectel 5G&LTE Windows USB Driver
- Firmware
- Tools
  - QCom
  - QFlash

www.quectel.com

Build a Smarter World

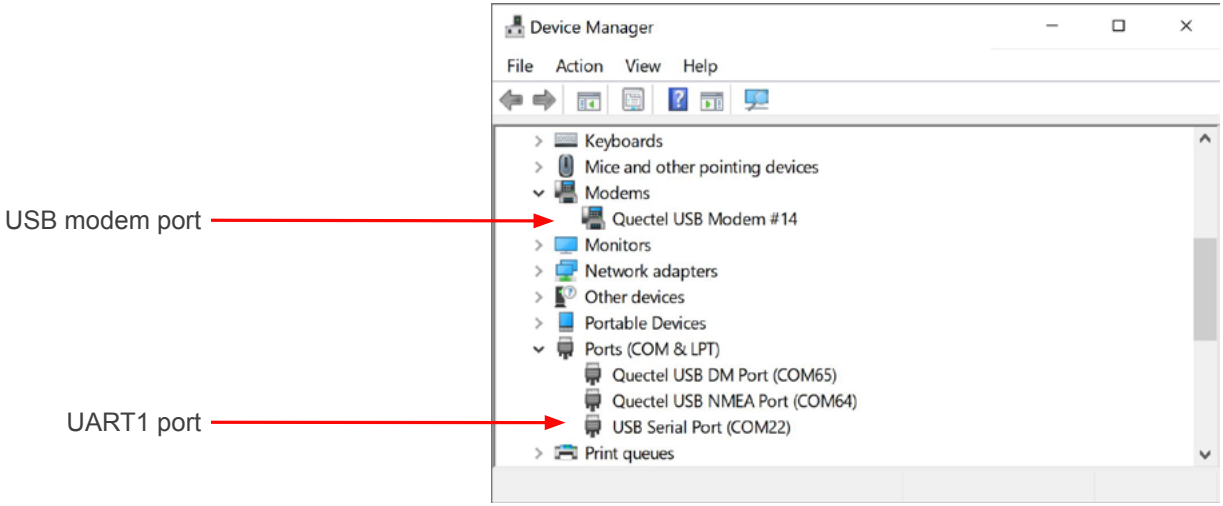
BG95 EVB Kit turn on sequence



www.quectel.com

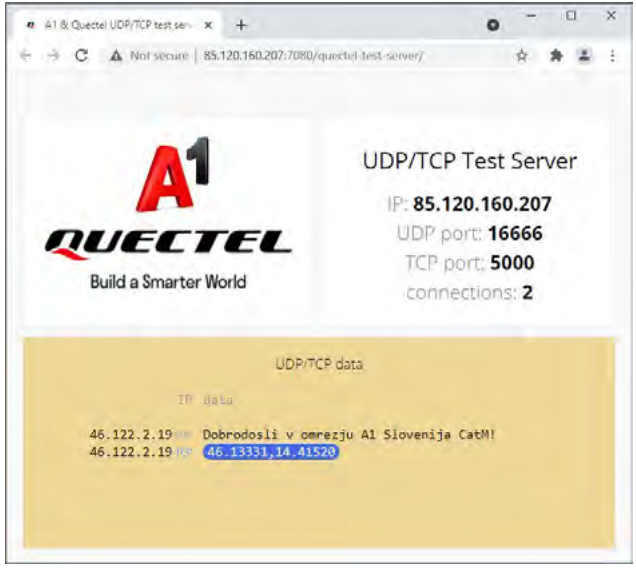
Build a Smarter World

Connection to BG95 module



Visualize UDP/TCP data

bit.ly/a1-udp-server



Initial Setup & Configuration

1. Enable URCs
2. Setup band and working mode to speedup cell search
3. Configure APN & manual operator selection
4. Query network & attachment info

Enable Unsolicited Result Codes

//redirect URCs to main serial port uart1

```
AT+QURCCFG="urcport","uart1"
```

//enable Connected/Disconnected URCs

```
AT+QCSCON=1
```

//enable EPS network registration status URCs

```
AT+CEREG=4
```

//enable PSM enter URCs

```
AT+QCFG="psm/urc",1
```

Speedup cell search for CatM A1.si

QUECTEL

//turn radio OFF to avoid repeated triggering of cell search

AT+CFUN=0

Speedup cell search for CatM A1.si

//configure CatM for B3 only (FDD 1800 MHz) to speed up cell search

```
AT+QCFG="band",0,4,0
```

//configure for LTE mode only (GSM is disabled)

```
AT+QCFG="nwscanmode",3
```

//enable LTE-M only (NBIoT is disabled)

```
AT+QCFG="iotopmode",0
```

//configure network scan sequence with priority for LTE CatM (eMTC > NBIoT > GSM)

```
AT+QCFG="nwscanseq",020301
```

//enable Packet Switched service domain only (CS domain is disabled)

```
AT+QCFG="servicedomain",1
```

Configure APN & manual operator

//configure APN for PDP context in A1 Slovenia network

```
AT+CGDCONT=1,"IP","internet.simobil.si"
```

//turn radio ON to enable network search

```
AT+CFUN=1
```

// (optional) configure manual operator selection for Slovenia (293) A1 (40) CatM (8)

```
AT+COPS=1,2,"29340",8
```

// (optional) or configure automatic operator selection for CatM (8) only

```
AT+COPS=0,,,8
```

Query attachment status info

```
//query current selected operator
AT+COPS?
   +COPS: 0,0,"A1 SI ",8        //automatic registration
   +COPS: 1,2,"29340",8         //manual registration

//query attachment status (1=attached, 0=detached)
AT+CGATT?
   +CGATT: 1

//query EPS registration status
AT+CEREG?
   +CEREG: 4,1,"277E","79105",8,,,"00001111","00000100"
```

Query attachment status info

QUECTEL

```
//query current network information (network type, MCCMNC, band, ARCFN)
AT+QNWINFO
   +QNWINFO: "eMTC","29340","LTE BAND 3",1400

//query assigned IP (PDP context id, IPv4, IPv6)
AT+CGPADDR
   +CGPADDR:
        1,
        46.122.2.19,
        42.0.26.32.33.0.87.127.90.135.98.146.106.186.66.30
```

Send & Receive UDP data

//open a UDP connection as a client to a specific UDP server, port

```
AT+QIOPEN=1,0,"UDP","85.120.160.207",16666
   +QIOPEN: 0,0
```

//send HEX UDP data with fixed length

```
AT+QISENDEX=0,"413120536c6f76656e696a61204361744d"
   SEND OK
```

//send ASCII UDP data with variable length (enter ASCII string w/o ENTER, end with 0x1A)

```
AT+QISEND=0
   >Hello!<CTRL+Z>
   SEND OK
```

ASCII <> HEX conversion

Send & Receive UDP data

//open a UDP connection as a client to a specific UDP server, port

```
AT+QIOPEN=1,0,"UDP","85.120.160.207",16666
   +QIOPEN: 0,0
```

//send HEX UDP data with fixed length

```
AT+QISENDEX=0,"413120536c6f76656e696a61204361744d"
   SEND OK
```

//send ASCII UDP data with variable length (enter ASCII string w/o ENTER, end with 0x1A)

```
AT+QISEND=0
   >Hello!<CTRL+Z>
   SEND OK
```

Send & Receive UDP data

QUECTEL

```
//URC to notify that data has been received no socket 0
   +QIURC: "recv",0
//send HEX UDP data with fixed length
AT+QIRD=0
   +QIRD: 39
   A1 Slovenija CatM
AT+QIRD=0
   +QIRD: 6
   Hello!
//close connection
AT+QICLOSE=0
```

Configure GNSS & read current position

//turn on GNSS

AT+QGPS=1

//query position information dd.ddddd (<UTC>,<LAT>,<LONG>,<HDOP>,<ALT>,<FIX>,...)

AT+QGPSLOC=2

```
+CME ERROR: 516    //fix not ready yet
```

AT+QGPSLOC=2

```
+QGPSLOC:82622.000,
46.13330,14.41482,
1.5,280.6,3,0.00,0.0,0.0,160621,06
```

//turn off GNSS

AT+QGPSEND

Send & Receive TCP data

QUECTEL

//open a TCP connection as a client to a specific TCP server, port

```
AT+QIOPEN=1,0,"TCP","85.120.160.207",5000
    +QIOPEN: 0,0
```

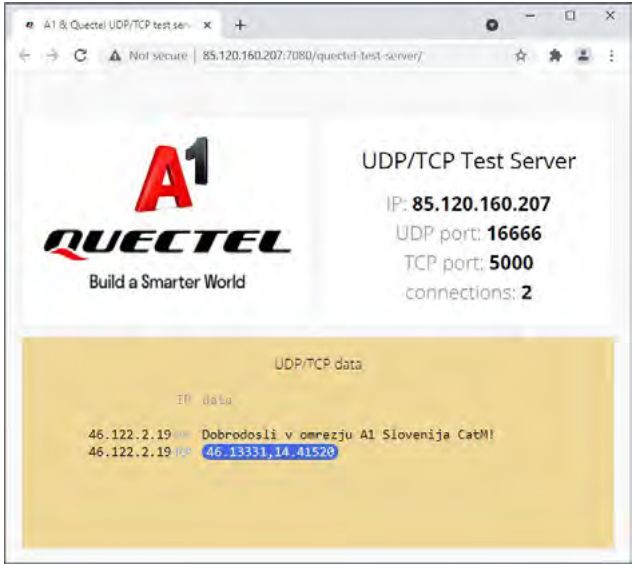
//send ASCII UDP data with variable length (enter ASCII string w/o ENTER, end with 0x1A)

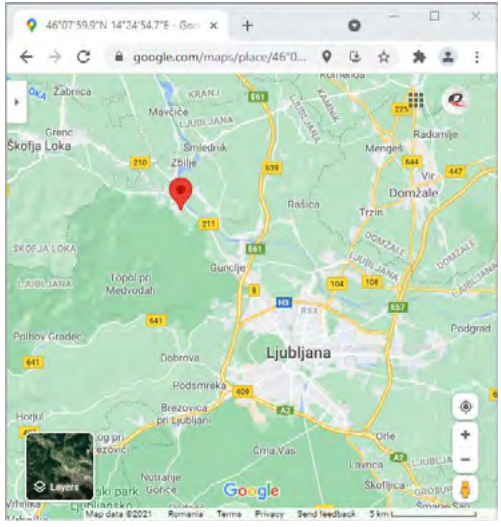
```
AT+QISEND=0
    >46.13322,14.41490<CTRL+Z>
    SEND OK
```

//close connection

```
AT+QICLOSE=0
```

Visualize sent data on web





www.quectel.com

Build a Smarter World

Enable Power Saving Mode

//enable PSM, (TAU) T3412=40min=2400s, (IDLE) T3324=30s

```
AT+CPSMS=1,,,"00000100","00001111"
```

//open a UDP connection as a client to a specific UDP server, port

```
AT+QIOPEN=1,0,"UDP","85.120.160.207",16666
```

//send HEX UDP data with fixed length

```
AT+QISENDEX=0,"456e61626c696e672050534d202e2e2e"
```

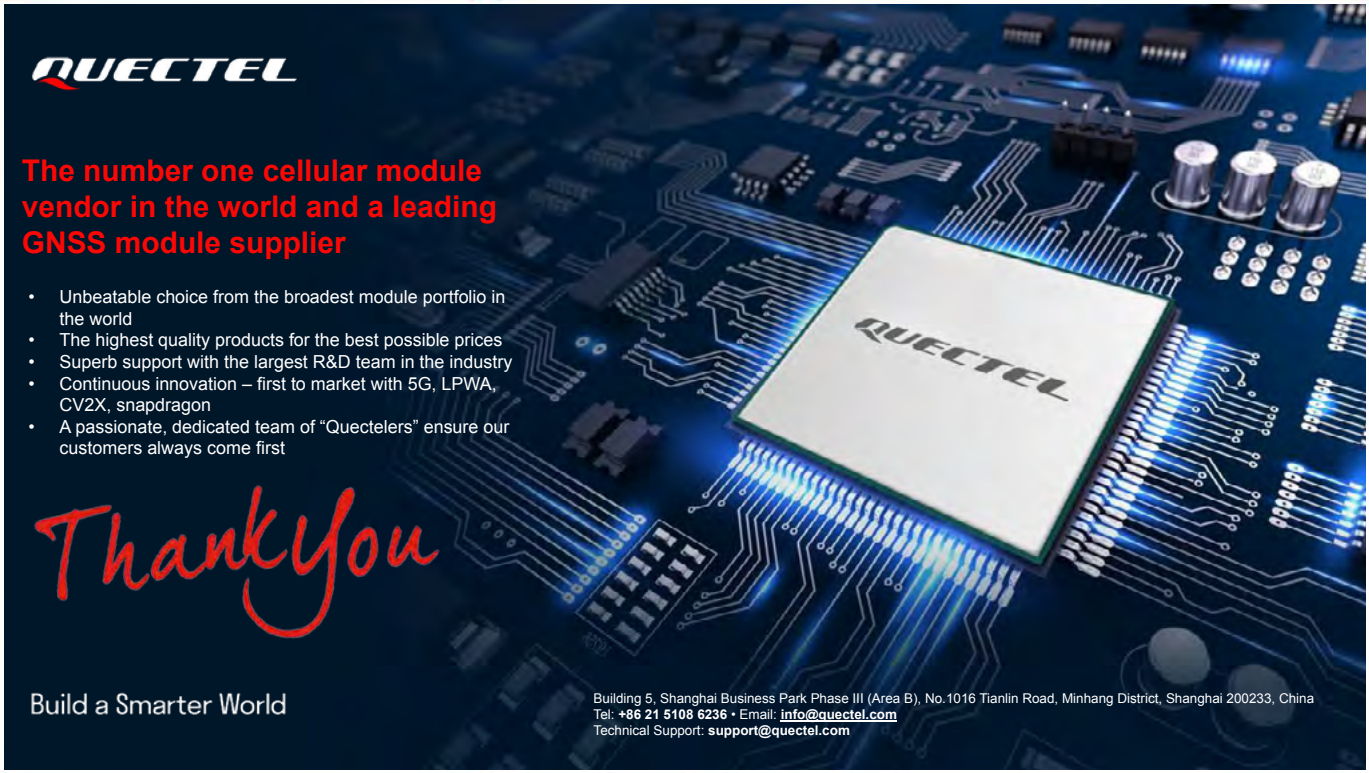
```
+QCSCON: 1,0
```
//after 10s, Inactive timer expires, module enters IDLE mode

```
PSM POWER DOWN
```
//after 30s, IDLE timer expires, module enters PSM mode

QUECTEL

The number one cellular module vendor in the world and a leading GNSS module supplier

- Unbeatable choice from the broadest module portfolio in the world
- The highest quality products for the best possible prices
- Superb support with the largest R&D team in the industry
- Continuous innovation – first to market with 5G, LPWA, CV2X, snapdragon
- A passionate, dedicated team of “Quectelers” ensure our customers always come first



ThankYou

Build a Smarter World

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: **+86 21 5108 6236** • Email: **info@quectel.com**
Technical Support: **support@quectel.com**

International Conference for ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

NB-IoT or LTE-M?

- Bostjan Snoj – A1 Slovenia

Basic definitions, what are NB-IoT and LTE-M

- Cellular IoT: 2G, 3G, 4G, NB-IoT, LTE-M
- NB-IoT and LTE-M are both cellular technologies standardized by 3GPP,
- both are developed for Low Power Wide Area Network (LPWAN) type of devices,
- usually battery powered (Low Power),
- having in mind longer range and deeper in-house penetration (Wide Area),
- both are part of 4G technology,
- and will continue to be the basic IoT technologies in the 5G (future proof).

- From cost perspective: low price because of low module complexity.
- Both inherit privacy and security policy to which we are used to from LTE.
- Number of IoT devices foreseen tens of billions till 2025

Basic definitions, what are NB IoT and LTE-M

- Both are suitable technologies for M2M solution development,
- are designed for low data transfer rates,
- used to operate in hard reaching areas / environments,
- replacing 2G and 3G technologies.
- Both use operator‘s licensed spectrum,
- which can guarantee QoS,
- 3GPP Release 14 compliant in A1 network (feature reach).

Looks like they are mirror image one of the other? Right?

- Let‘s find key differences among all common features.

Key differences between NB-IoT and LTE-M

- Voice over LTE and SMS

	NB-IoT	LTE-M
VoLTE	No	Provider specific
SMS	Yes	Yes
Mobility support	No	Yes
Bands	B3, B20	B3, B20
In-house penetration	Excellent	Good

- VoLTE If needed it will be available at A1 network.
- Mobility: no handover for NB IoT!

Key differences between NB-IoT and LTE-M

- Transfer Rate and Bandwidth

	NB-IoT	LTE-M
Bandwidth	180kHz	1,4MHz
Speed DL	<100kbps	300kbps
Speed UL	<100kbps	370kbps

- Use Case dependant! Think about how to reduce amount of data to transfer!

Key differences between NB-IoT and LTE-M

- Network

	NB-IoT	LTE-M
Number of Connections	Max every 15min	No limit
Connection mode	Half Duplex	Full Duplex
Latency	1s – 60s	50-100ms
Standard IP protocols	No	Yes
Need for special protocols	Yes	No need

Key differences between NB-IoT and LTE-M

- Functions

	NB-IoT	LTE-M
Static IP V4	Yes	Yes
S2S VPN	Yes	Yes
Private Radius	Yes	Yes
IP V6 support	Available soon in A1 network	Available soon A1 network

Key differences between NB-IoT and LTE-M

- Functions

	NB-IoT	LTE-M
Remote control	Yes/No (UC dep.)	Yes
Firmware updates	No	Yes
Grow with UCs	No	Yes

- Remote control for some non critical actions available in NB-IoT.
- Small speed and protocol specific requests in NB-IoT restrict FW upgrades.
- Since no updates available, it is not possible to grow with Use Cases

Key differences between NB-IoT and LTE-M

- Reference Signals Received Power (RSRP)

	NB-IoT	LTE-M
RSRP Excellent Signal Strength	>-90 dBm	>-85 dBm
RSRP Good Signal Strength	-90 dBm to -105dBm	-86 dBm to -100 dBm
RSRP Fair Signal Strength	-106 dBm to -116 dBm	-101 dBm to -112 dBm
RSRP Poor Signal Strength	-117 dBm to -121 dBm	-113 dBm to -120 dBm
RSRP Dead Signal Strength	<-122 dBm	<-121 dBm

Key differences between NB-IoT and LTE-M

- Reference Signal Received Quality (RSRQ)

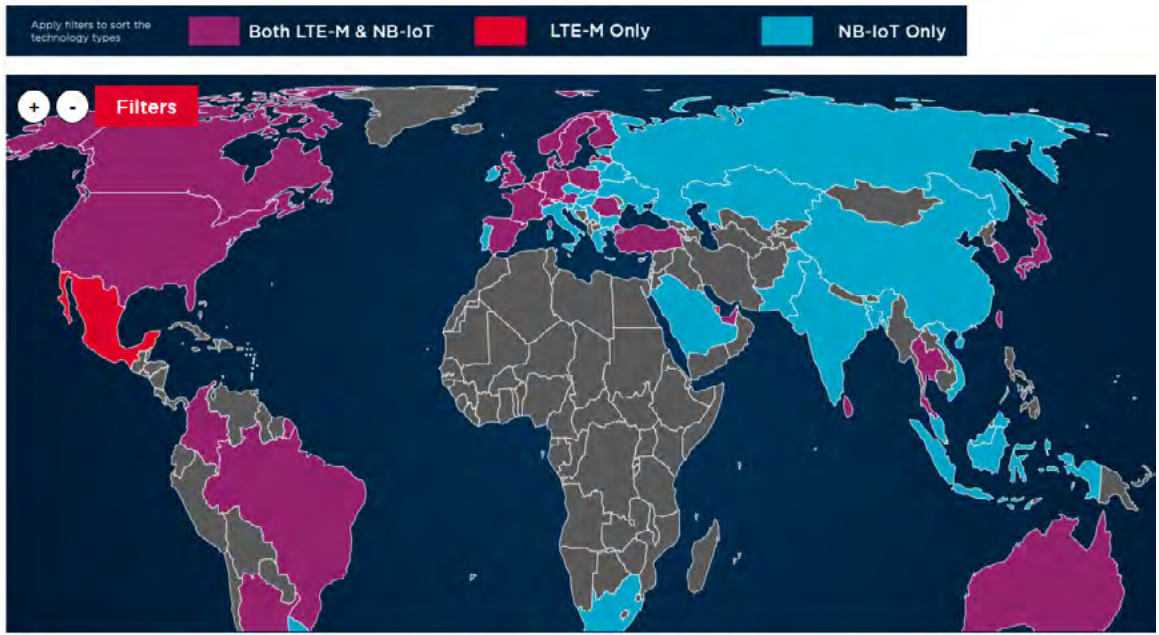
	NB-IoT	LTE-M
RSRQ Excellent Signal Quality	>-9 dB	>-9 dB
RSRQ Good Signal Quality	-9 dB to -12 dB	-9 dB to -12 dB
RSRQ Fair to Poor Signal Quality	<-13 dB	<-13 dB

Key differences between NB-IoT and LTE-M

- Functions

	NB-IoT	LTE-M
First focus - Europe	Yes	
Secondary focus - Europe		Yes
First focus – North America		Yes
Secondary focus - North America	Yes	
First focus - Asia	Yes	
Secondary focus - Asia		Yes

Mobile IoT Deployment Map (source: GSMA, Jun 2021)



Source: https://www.gsma.com/iot/deployment-map

Typical mistake when deciding NB-IoT or LTE-M
TCP for NB-IoT

- **Using TCP protocol for NB-IoT technology**
  - NB-IoT in theory supports both TCP and UDP protocols. But this is misleading!
  - NB-IoT facts:
    - High Latency
    - Half Duplex connection
    - UE attach delays
  - TCP facts:
    - sensitive to delays
    - Sensitive to packet losses during data transmission
    - Slower than UDP
- Solution:
  - If retransmission of lost packets on transport layer is absolutely necessary, than consider moving to LTE-M.
  - Use UDP (and resolve the packet loss on application level if needed).
- A1 measurement: UDP packet loss <1%, TCP packet loss can become quickly over 90%

13

Typical mistake when deciding NB-IoT or LTE-M

- **Server side on UE over NB-IoT technology**
  - It is not battery friendly solution (draining batteries, no deep sleep possible)
  - Delays over the network may result in packet loss during high buffer loads in network

- Solution:
  - Move to LTE-M
  - Redesign the application to have a client on UE side

Typical mistake when deciding NB-IoT or LTE-M

- **Sending data in short intervals over NB-IoT**
  - NB-IoT facts:
    - Slow speed
    - Latency
    - No retransmission of lost packets is possible on transport level
  - Data may be generated faster, than we are possible to flush them over NB-IoT

- Solution:
  - Move to LTE-M.
  - Redesign the application not to be so brutal sending data.

Good practice

- Use appropriate protocols if working on NB-IoT:
  - CoAP (UDP)
  - (CoAP)/LWM2M (UDP)
  - MQTT-SN (designed to use UDP)
- Reboot:
  - There is a lot of Software running inside User Equipment. Therefore there is no guarantee, that code is bug-free. Consider periodical rebooting if there is a large number of IoT devices with no management option.
- Fall back:
  - Detect abnormal SW behaviour and enable fall-back scenario (wake up in minimal maintenance mode)
- Antenna design:
  - Antenna design is underestimated. Antenna with high gain, optimal radiation diagram is half of a success in harsh RF conditions.

Conclusion

- LTE-M will emerge faster and faster since it is easier for application development and maintaining, having always the door open for easy new Use Cases introduction.

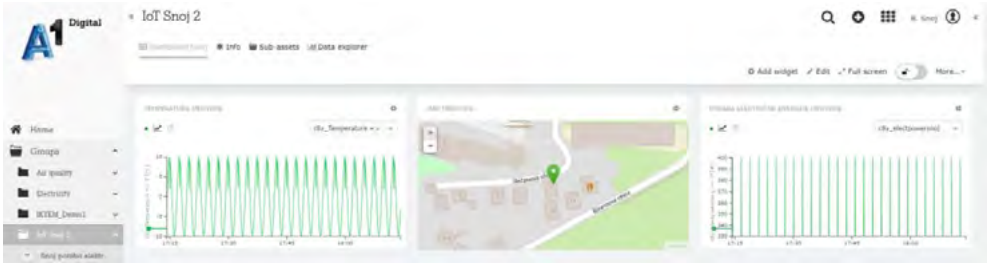
- NB-IoT is here now and that is the fact. Since it was available prior to LTE-M in EU, it has a bit of advantage in terms of commercial progress . NB-IoT will stay mainly for the simple applications on larger scale. For example sensors and meters, where functional requirements are firmly defined at the beginning of the project, and are not subject to change and where deeper in-house penetration and wider range is absolutely necessary.

- Think about your Use Case and use appropriate technology. After deploying thousands of IoT devices, there is no way back! Consider even supporting both technologies for the same Use Case.

17

Cumulocity IoT platform on Exoscale cloud

EXOSCALE



Cumulocity

Development environment

- Quectel is giving development boards for BG95-M3 development (EVB Kit).
- A1 is giving NB-IoT and LTE-M test SIM cards, to use them with EVB.
- A1 is giving test access to Cumulocity to store and visualize data received from IoT devices.
- Cumulocity and SIM test period is 2 months (with possible extension)
- Submit your requests to:

https://pametneresitve.si/iktem-2021/

LTE-M launching in A1 network

A1 will launch LTE-M technology to be available in complete A1 network in JULY 2021!

Thank you!

Boštjan Snoj
Lead Internet of Things Expert (IoT)
@ bostjan.snoj@A1.si
A1 Slovenija, d. d.
Šmartinska 134b
SI - 1000 Ljubljana

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

Face mask detection

D. Zimšek, G. Močnik

Laboratory for
Digital Signal Processing
UM FERI Maribor

DSP LAB

Content

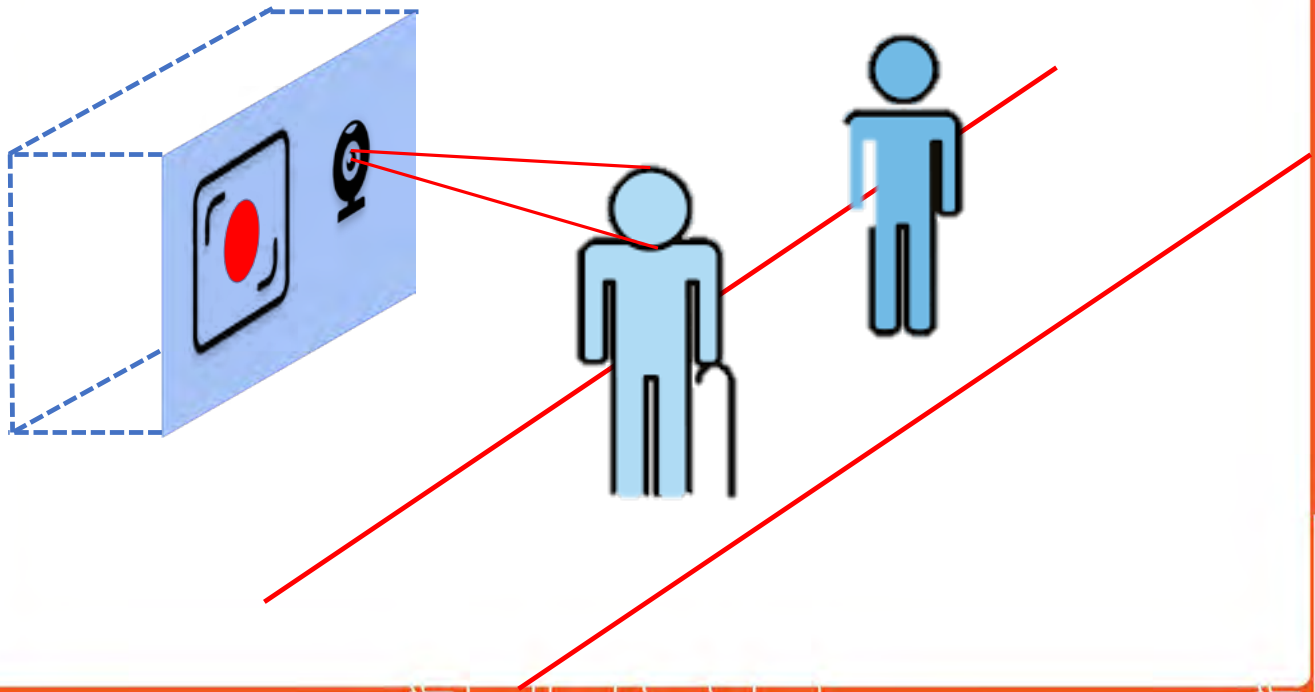
- Introduction
- Computer vision
  - Techniques
- Learning techniques
- Dataset of faces and faces with masks
- Hardware
- Results
- Conclusion

Introduction

To confine the spread of Covid-19, the government has issued a decree to wear masks indoors. Students are required to wear masks when physically attending classes.

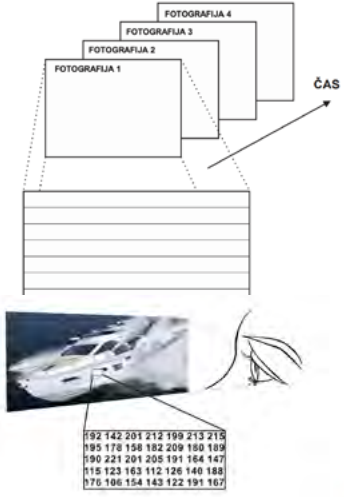
At our faculty, we made a device that checks if everyone who enters through the main door has a mask on their face and if the mask is worn correctly.

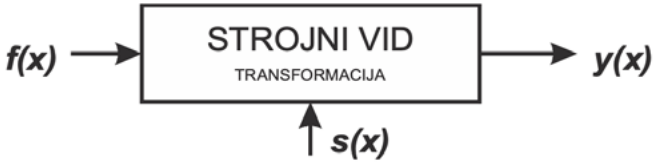
Face mask detection system design



Computer vision

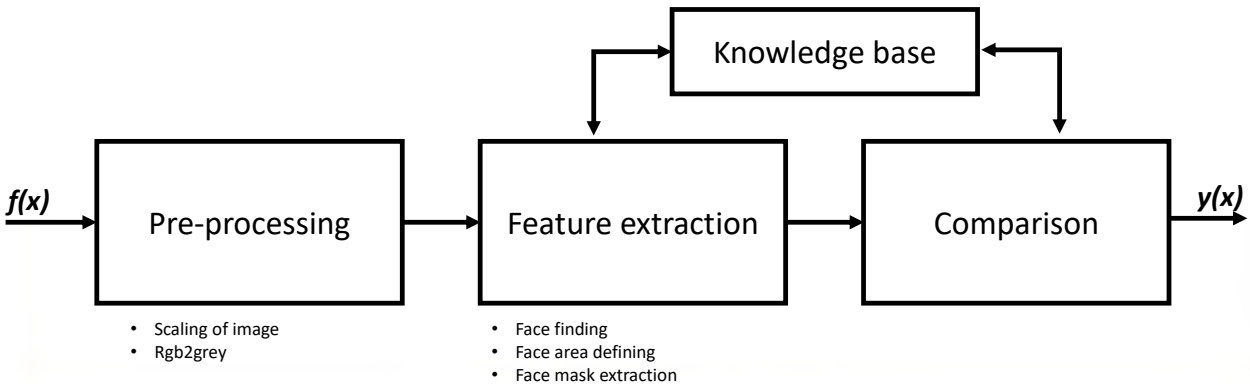
- The input signal is a video stream from the camera. Using computer vision we find key information in a digital image, with which we make decisions and influence the output signal.



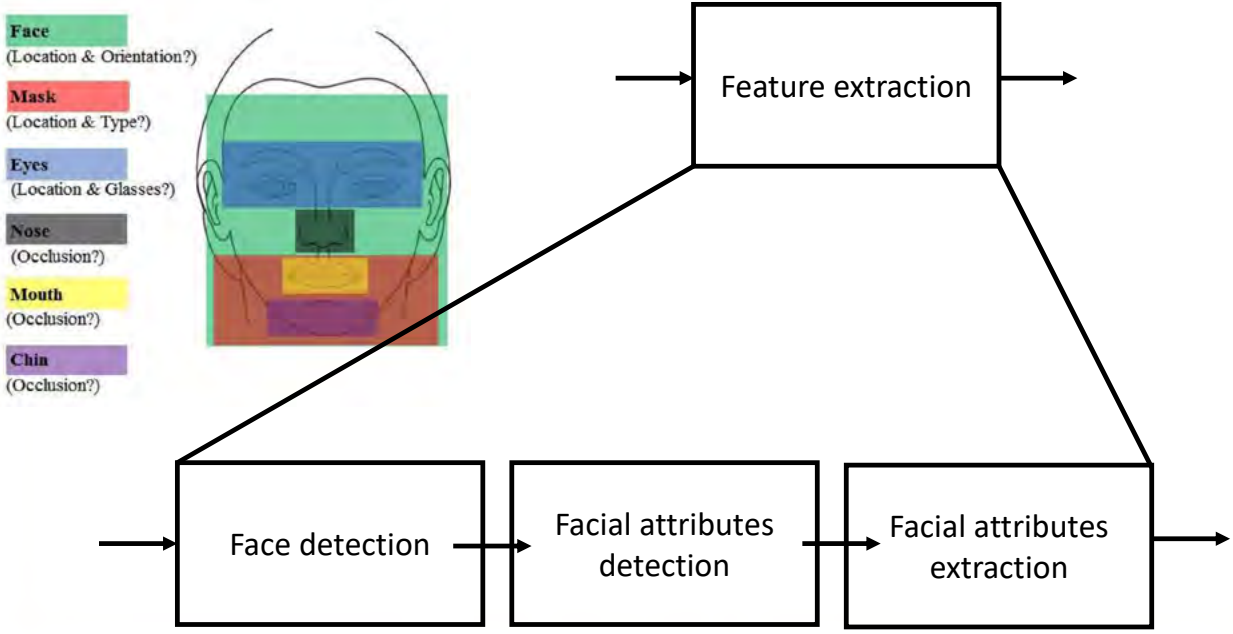


Computer vision - techniques

- 0. step: Pre-processing of digital images
- 1. step: Feauture extraction
- 2. step: Comparison with dataset
- 3. step: set output



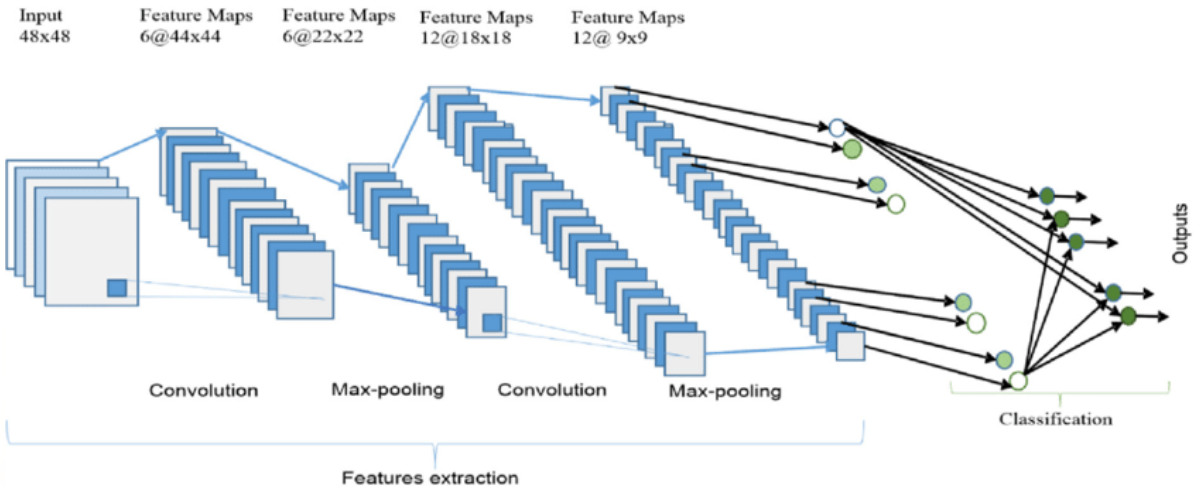
Computer vision - techniques



Vir slike: Shiming Ge, Jia Li, Qiting Ye, Zhao Luo; "Detecting Masked Faces in the Wild With LLE-CNNs", 2017

Learning techniques

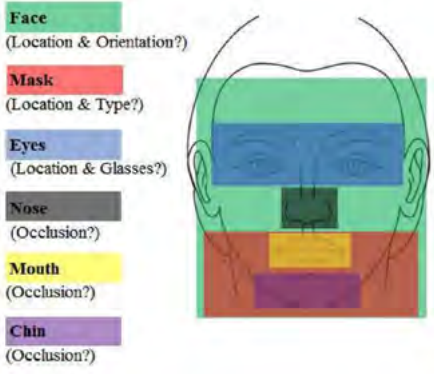
- Neural Networks (**Convolutional** Neural Network)



Vir slike:(2019). A State-of-the-Art Survey on Deep Learning Theory and Architectures. Electronics. 8. 292. 10.3390/electronics8030292.

Dataset of faces and faces with masks

- MaFA: A Dataset of Masked Faces
  - Facial attributes
  - Aroung 35k digital images of masks
  - Around 400k of all digital images in dataset
  - **Dataset with representative facial image with different attributes**



Vir: https://imsg.ac.cn/research/maskedface.html

Dataset of faces and faces with masks

- WIDER FACE: A dataset of faces
  - 32,203 images labelled with 393,703 faces with a high degree of variability in scale
  - **State of the art**

Vir: https://imsg.ac.cn/research/maskedface.html

Hardware

- NVIDIA Jetson (JETSON AGX XAVIER DK)
  - System on Modul (SoM) including CPU, GPU, memory, power management, ...
  - **HDMI**
  - **USB**
- Monitor (HDMI)
- Steel stand

Results

- Evaluation with custom built dataset
  - 1.5k images of faces
  - 500 images of faces with face masks
  - Around 2k images with other content (without faces)
- Results: **82.33 %**

Conclusion

- The system has successfully performed given task
- Possible future improvements:
  - More systems at each building entrance
  - Better user interface/experience
  - Adding a system for Body temperature measuring
  - Fine-tuning pretrained model
  - Adjusting neural network parameters for higher density of detection per minute

Thank you for your attention

Q&A

International Conference for ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

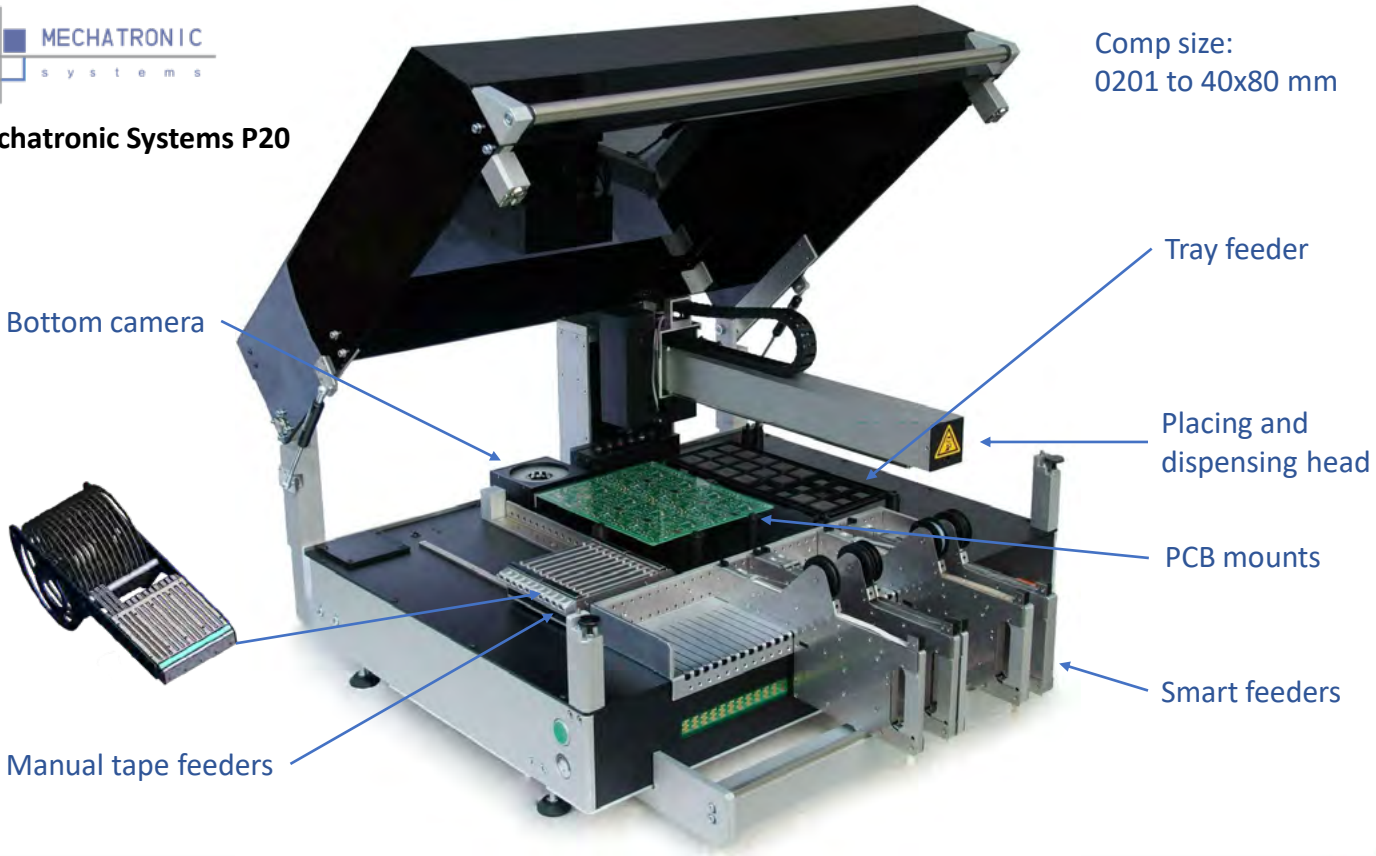
Automated PCB assembling for development and small series

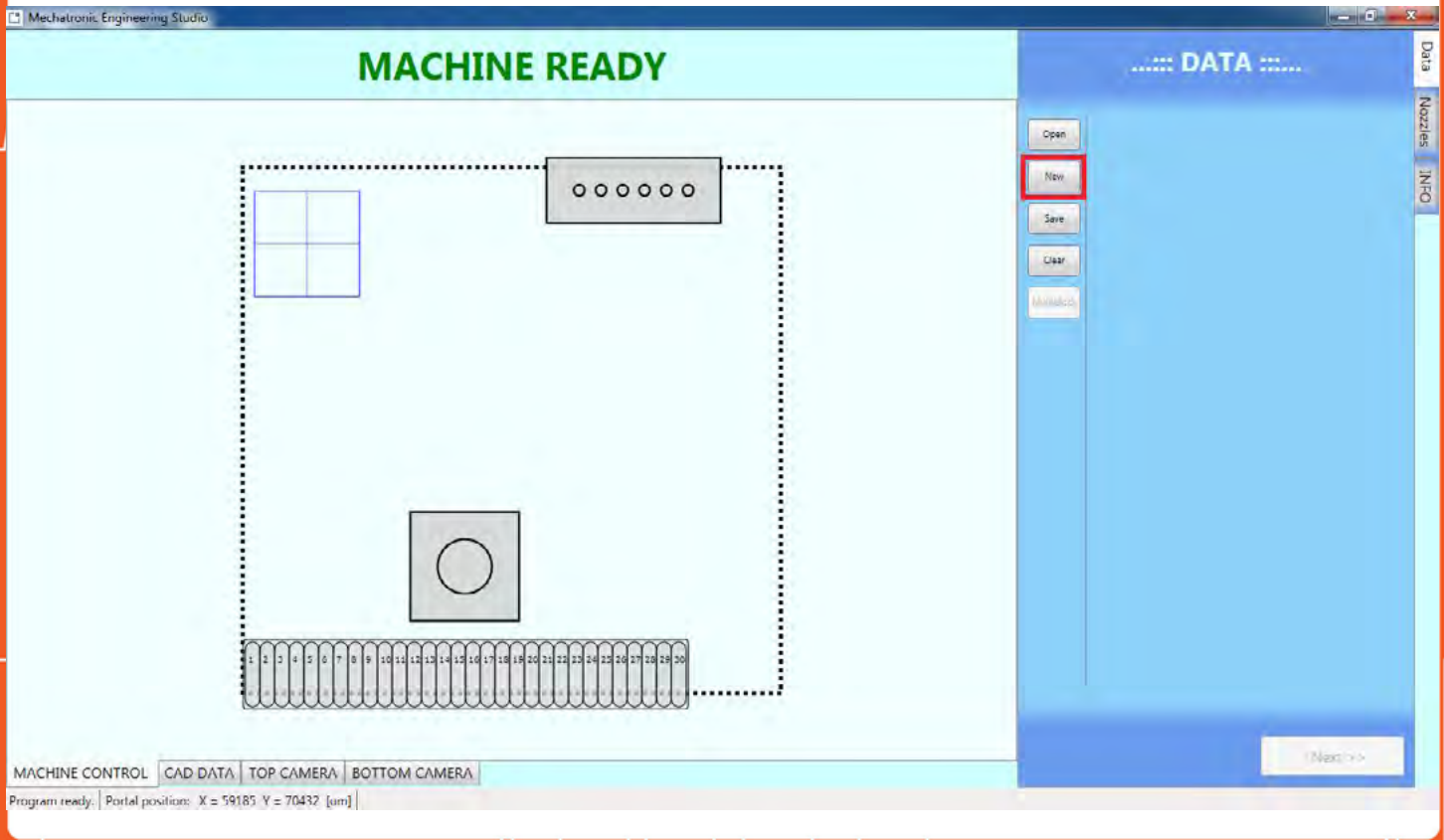
Mitja Zupan
Managing Director

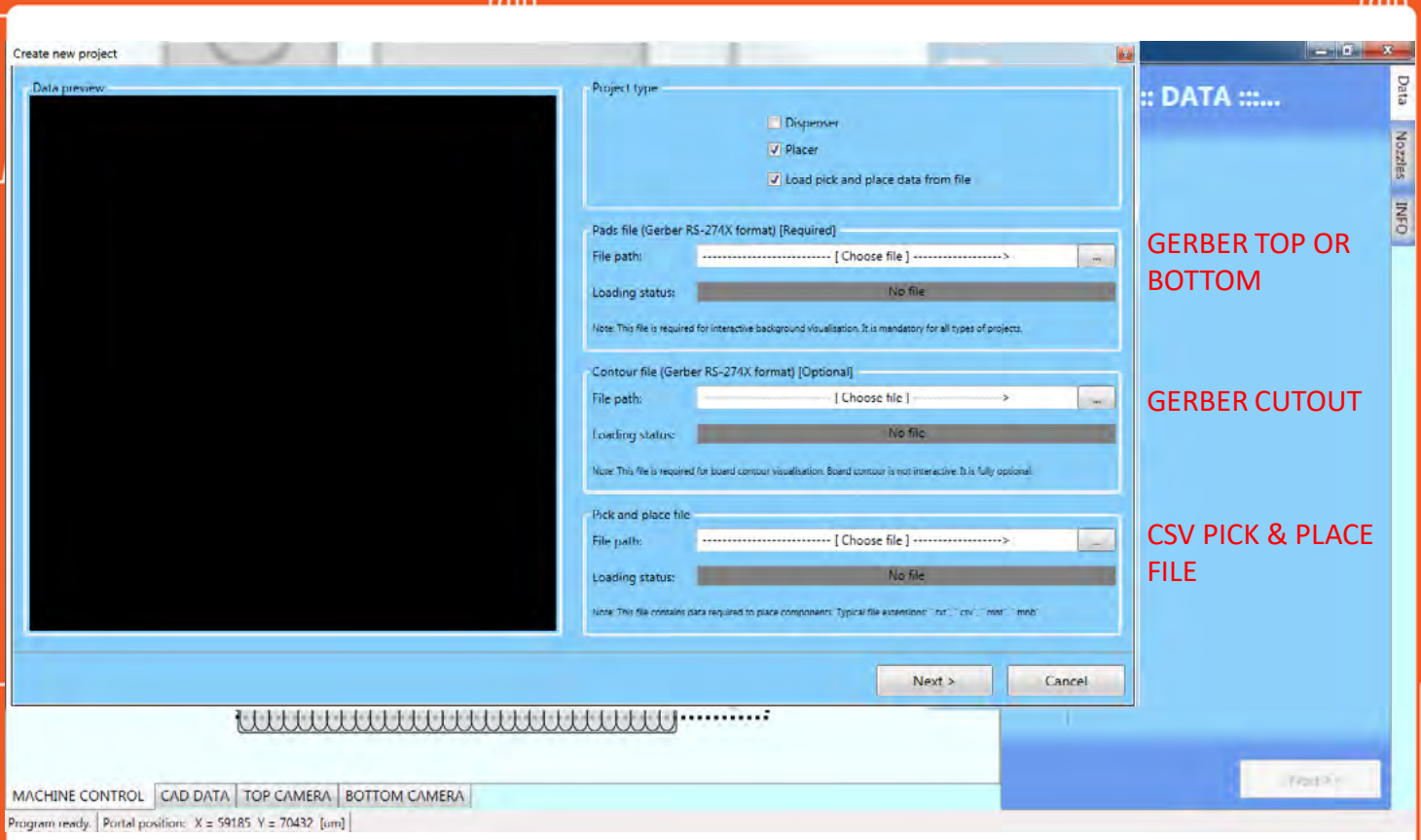
TIVTEC

MECHATRONIC
systems

Mechatronic Systems P20




Mechatronic Engineering Studio
MACHINE READY
..... DATA .....
Data
Nozzles
INFO
Open
New
Save
Clear
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA
Program ready.
Portal position: X = 59185 Y = 70432 [um]

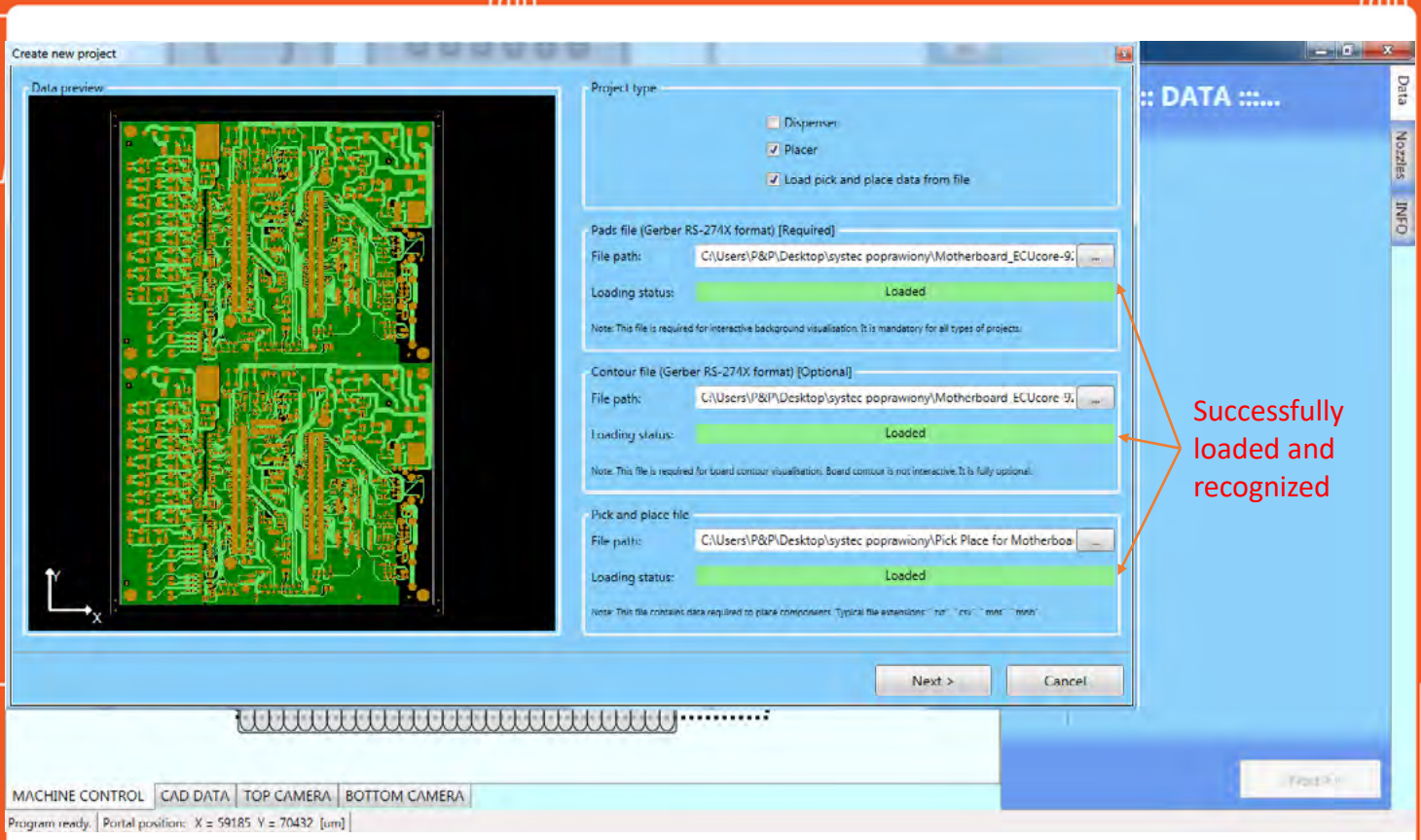

Create new project
Data preview:
Project type
Dispenser
Placer
Load pick and place data from file
Pads file (Gerber RS-274X format) [Required]
File path:
[Choose file]
Loading status:
No file
Note: This file is required for interactive background visualisation. It is mandatory for all types of projects.
Contour file (Gerber RS-274X format) [Optional]
File path:
[Choose file]
Loading status:
No file
Note: This file is required for board contour visualisation. Board contour is not interactive. It is fully optional.
Pick and place file
File path:
[Choose file]
Loading status:
No file
Next >
Cancel
:: DATA ::
Data
Nozzles
INFO
GERBER TOP OR BOTTOM
GERBER CUTOUT
CSV PICK & PLACE FILE
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA
Program ready.
Portal position: X = 59185 Y = 70432 [um]

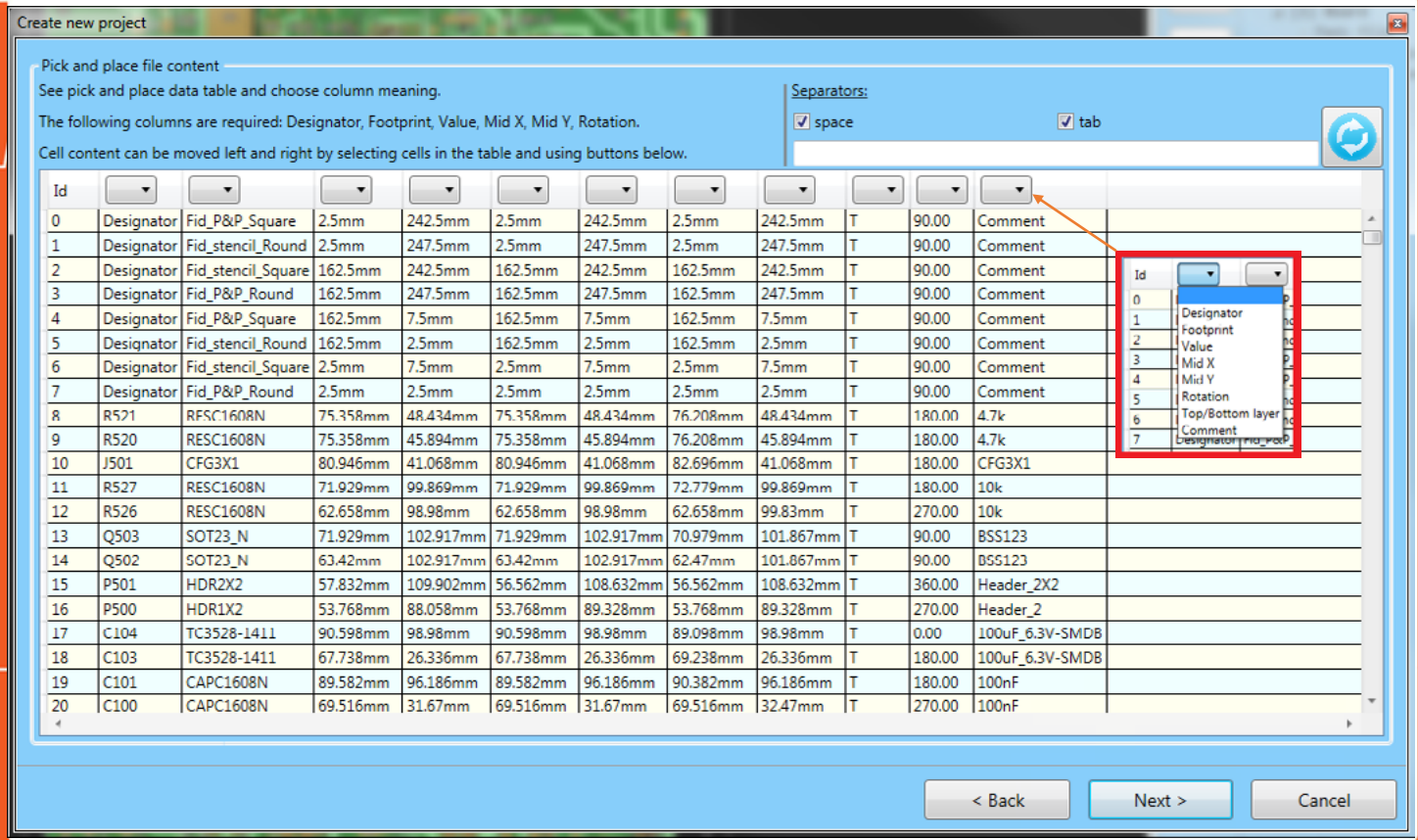
CSV Pick & Place file composition

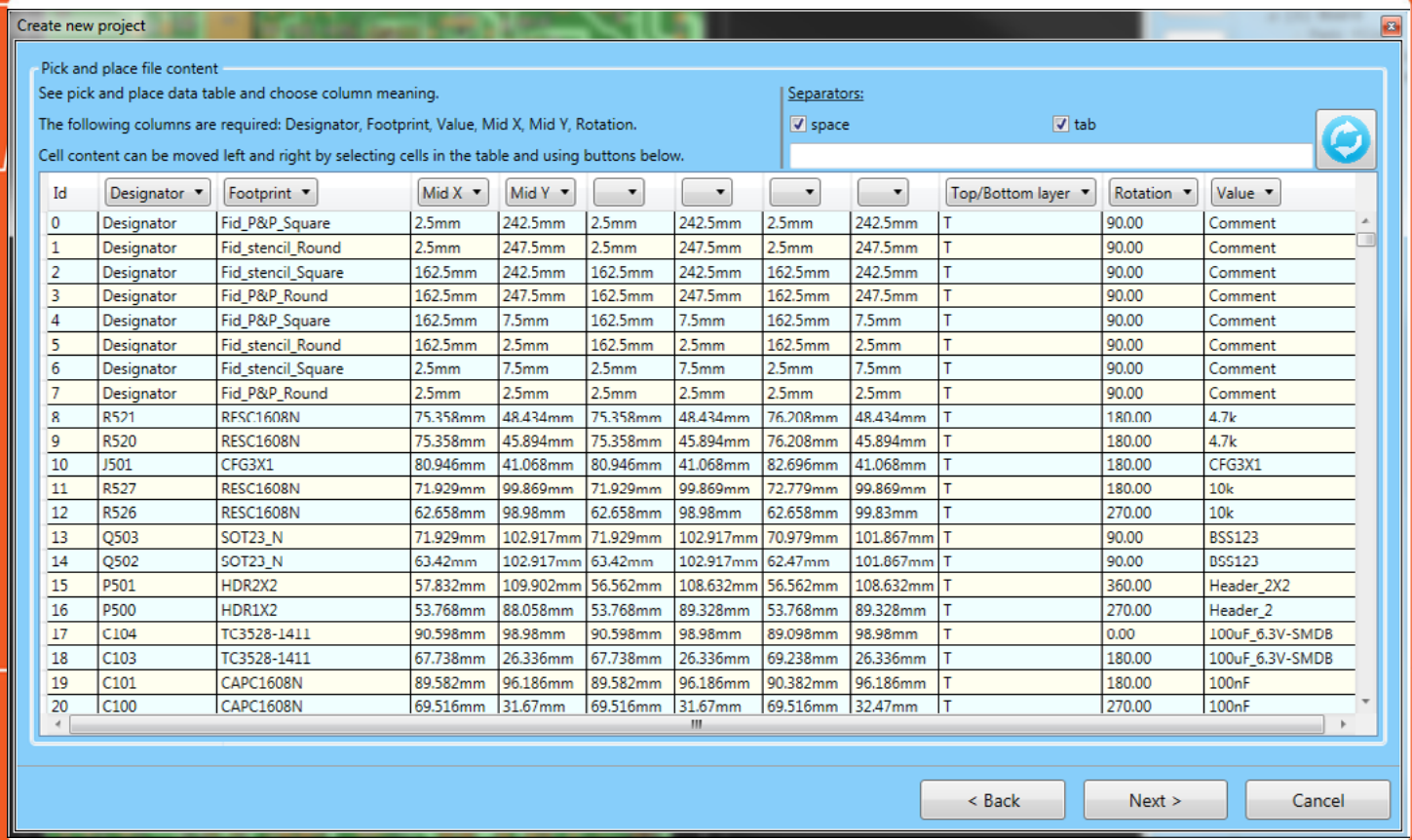
mainBoard_arm7x_bott.csv - Notepad

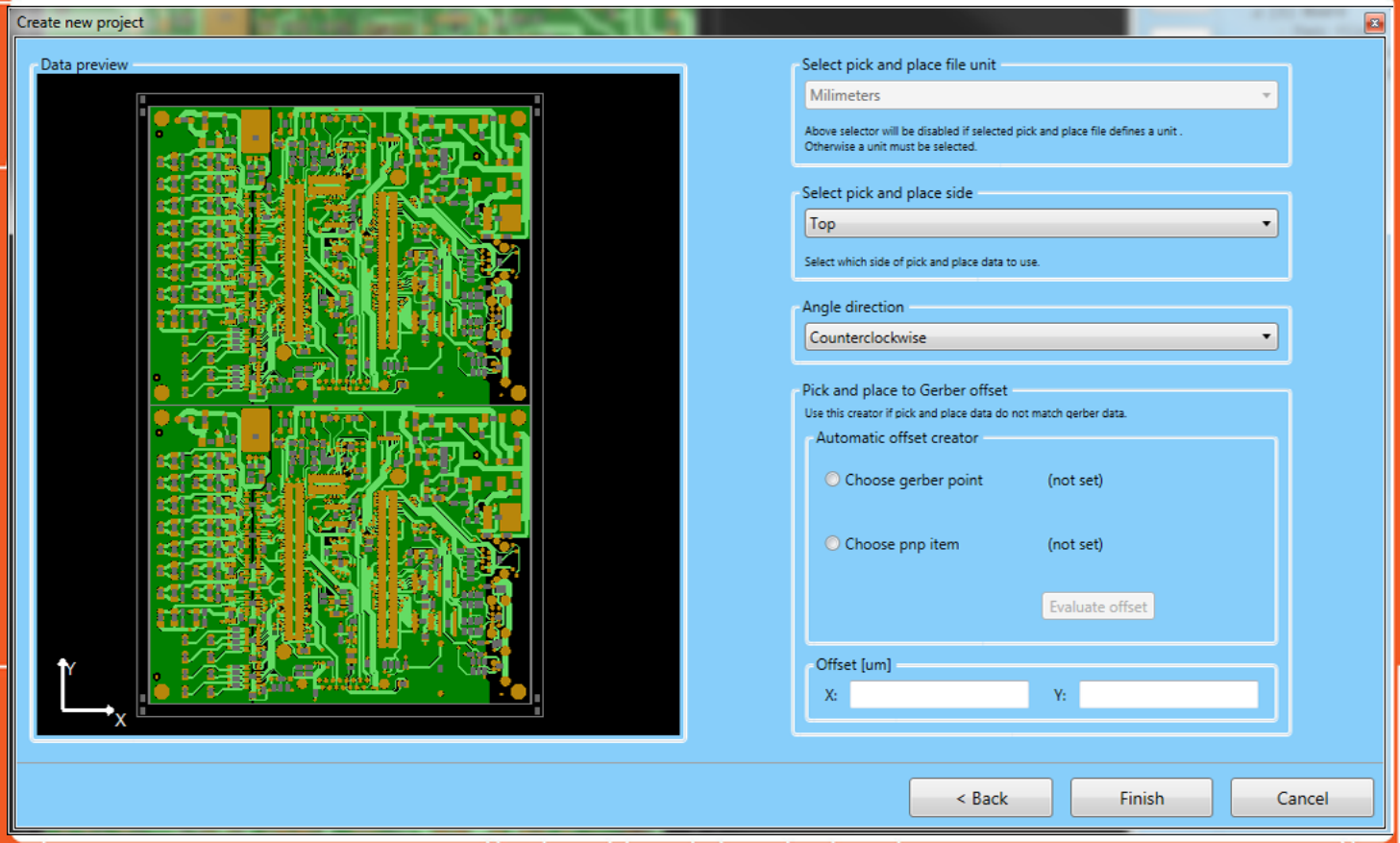
File Edit Format View Help

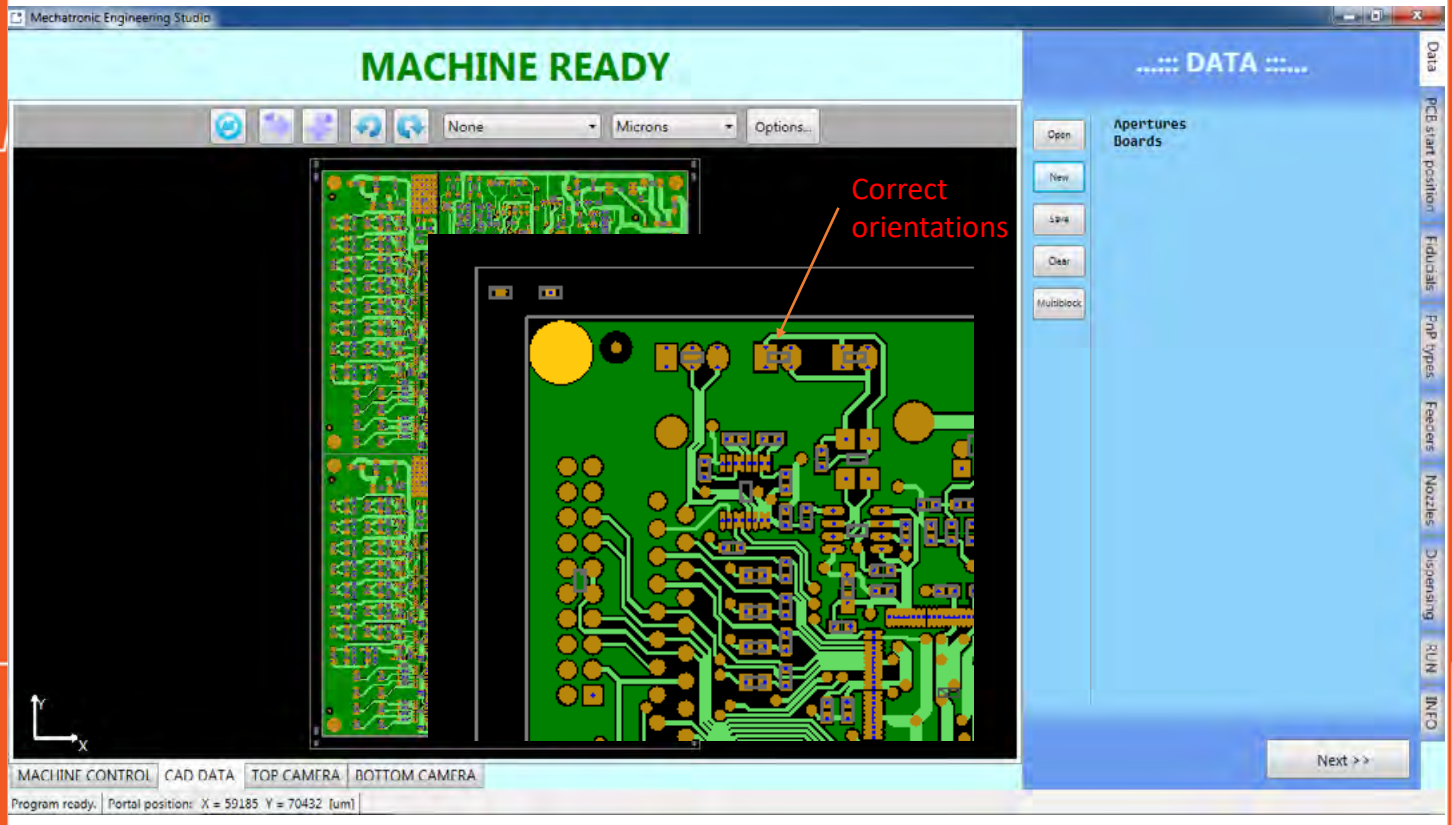
```
"Designator","Footprint","Mid X","Mid Y","Ref X","Ref Y","Pad X","Pad Y","Layer","Rotation","Comment"
""
"D50","CD2012-0805","3155mil","5160mil","3155mil","5160mil","3155mil","5122.599mil","Bottom","90.00","LL-S172YC-2Y"
"D49","CD2012-0805","3235mil","5160mil","3235mil","5160mil","3235mil","5122.599mil","Bottom","90.00","LL-S172YC-2Y"
"D48","CD2012-0805","3315mil","5160mil","3315mil","5160mil","3315mil","5122.599mil","Bottom","90.00","LL-S172YC-2Y"
"D47","CD2012-0805","3395mil","5160mil","3395mil","5160mil","3395mil","5122.599mil","Bottom","90.00","LL-S172YC-2Y"
"D46","CD2012-0805","3360mil","4640mil","3360mil","4640mil","3360mil","4602.599mil","Bottom","90.00","LL-S172SC-2S"
"D45","CD2012-0805","3280mil","4640mil","3280mil","4640mil","3280mil","4602.599mil","Bottom","90.00","LL-S172YC-2Y"
"D44","CD2012-0805","3200mil","4640mil","3200mil","4640mil","3200mil","4602.599mil","Bottom","90.00","LL-S172GC-2A"
"CON27","SL_3.50_06_180G_1604510000","1893.306mil","7004.999mil","2237.795mil","7005mil","2237.794mil","7004.999mil","Bottom","180.00","SL 3.5/6/180G3.2SN OR"
"CON26","SL_3.50_06_180G_1604510000","4141.692mil","6999.999mil","4486.181mil","7000mil","4486.18mil","6999.999mil","Bottom","180.00","SL 3.5/6/180G3.2SN OR"
"CON25","SL_3.50_06_180G_1604510000","2886.102mil","7004.999mil","3230.591mil","7005mil","3230.59mil","7004.999mil","Bottom","180.00","SL 3.5/6/180G3.2SN OR"
"CON24","SL_3.50_06_180G_1604510000","5131.692mil","6999.999mil","5476.181mil","7000mil","5476.18mil","6999.999mil","Bottom","180.00","SL 3.5/6/180G3.2SN OR"
"CON23","SL_3.50_06_180G_1604510000","5810mil","6748.895mil","5810mil","6404.408mil","5810mil","6404.408mil","Bottom","90.00","SL 3.5/6/180G3.2SN OR"
"CON22","SL_3.50_06_180G_1604510000","5810mil","5771.102mil","5810mil","5426.614mil","5810mil","5426.614mil","Bottom","90.00","SL 3.5/6/180G3.2SN OR"
"CON21","SL_3.50_06_180G_1604510000","5820mil","4783.306mil","5820mil","4438.819mil","5820mil","4438.818mil","Bottom","90.00","SL 3.5/6/180G3.2SN OR"
"CON20","SL_3.50_06_180G_1604510000","5820mil","3794.488mil","5820mil","3450mil","5820mil","3449.999mil","Bottom","90.00","SL 3.5/6/180G3.2SN OR"
```

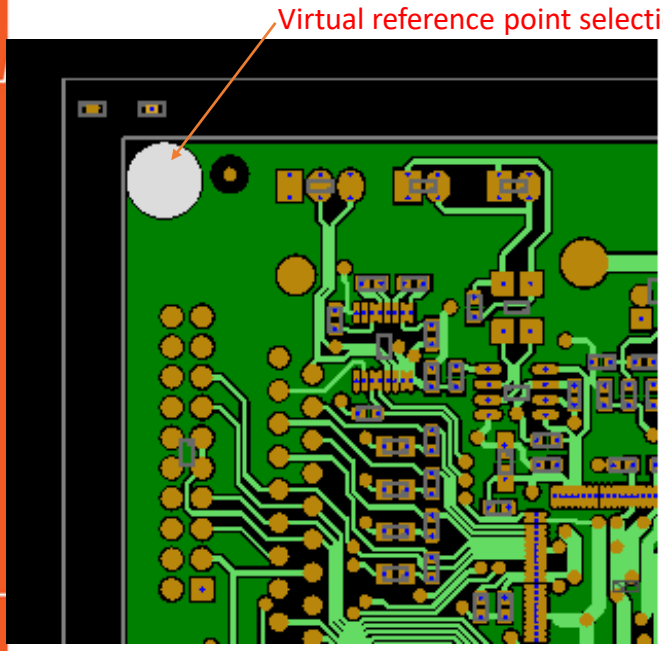

Create new project
Data preview
Project type
Dispenser
Placer
Load pick and place data from file
Pads file (Gerber RS-274X format) [Required]
File path:
C:\Users\P&P\Desktop\systec poprawiony\Motherboard_ECUcore-9.
Loading status:
Loaded
Note: This file is required for interactive background visualisation. It is mandatory for all types of projects.
Contour file (Gerber RS-274X format) [Optional]
File path:
C:\Users\P&P\Desktop\systec poprawiony\Motherboard_ECUcore-9.
Loading status:
Loaded
Note: This file is required for board contour visualisation. Board contour is not interactive. It is fully optional.
Pick and place file
File path:
C:\Users\P&P\Desktop\systec poprawiony\Pick Place for Motherboa
Loading status:
Loaded
Next >
Cancel
:: DATA ::
Data
Nozzles
INFO
Successfully loaded and recognized
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA
Program ready.
Portal position: X = 59185 Y = 70432 [um]

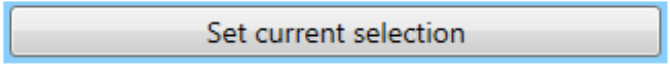

Create new project
Pick and place file content
See pick and place data table and choose column meaning.
The following columns are required: Designator, Footprint, Value, Mid X, Mid Y, Rotation.
Cell content can be moved left and right by selecting cells in the table and using buttons below.
Separators:
space
tab
Id
0 Designator Fid_P&P_Square 2.5mm 242.5mm 2.5mm 242.5mm 2.5mm 242.5mm T 90.00 Comment
1 Designator Fid_stencil_Round 2.5mm 247.5mm 2.5mm 247.5mm 2.5mm 247.5mm T 90.00 Comment
2 Designator Fid_stencil_Square 162.5mm 242.5mm 162.5mm 242.5mm 162.5mm 242.5mm T 90.00 Comment
3 Designator Fid_P&P_Round 162.5mm 247.5mm 162.5mm 247.5mm 162.5mm 247.5mm T 90.00 Comment
4 Designator Fid_P&P_Square 162.5mm 7.5mm 162.5mm 7.5mm 162.5mm 7.5mm T 90.00 Comment
5 Designator Fid_stencil_Round 162.5mm 2.5mm 162.5mm 2.5mm 162.5mm 2.5mm T 90.00 Comment
6 Designator Fid_stencil_Square 2.5mm 7.5mm 2.5mm 7.5mm 2.5mm 7.5mm T 90.00 Comment
7 Designator Fid_P&P_Round 2.5mm 2.5mm 2.5mm 2.5mm 2.5mm 2.5mm T 90.00 Comment
8 R521 RESC1608N 75.358mm 48.434mm 75.358mm 48.434mm 76.208mm 48.434mm T 180.00 4.7k
9 R520 RESC1608N 75.358mm 45.894mm 75.358mm 45.894mm 76.208mm 45.894mm T 180.00 4.7k
10 J501 CFG3X1 80.946mm 41.068mm 80.946mm 41.068mm 82.696mm 41.068mm T 180.00 CFG3X1
11 R527 RESC1608N 71.929mm 99.869mm 71.929mm 99.869mm 72.779mm 99.869mm T 180.00 10k
12 R526 RESC1608N 62.658mm 98.98mm 62.658mm 98.98mm 62.658mm 99.83mm T 270.00 10k
13 Q503 SOT23_N 71.929mm 102.917mm 71.929mm 102.917mm 70.979mm 101.867mm T 90.00 BSS123
14 Q502 SOT23_N 63.42mm 102.917mm 63.42mm 102.917mm 62.47mm 101.867mm T 90.00 BSS123
15 P501 HDR2X2 57.832mm 109.902mm 56.562mm 108.632mm 56.562mm 108.632mm T 360.00 Header_2X2
16 P500 HDR1X2 53.768mm 88.058mm 53.768mm 89.328mm 53.768mm 89.328mm T 270.00 Header_2
17 C104 TC3528-1411 90.598mm 98.98mm 90.598mm 98.98mm 89.098mm 98.98mm T 0.00 100uF_6.3V-SMDB
18 C103 TC3528-1411 67.738mm 26.336mm 67.738mm 26.336mm 69.238mm 26.336mm T 180.00 100uF_6.3V-SMDB
19 C101 CAPC1608N 89.582mm 96.186mm 89.582mm 96.186mm 90.382mm 96.186mm T 180.00 100nF
20 C100 CAPC1608N 69.516mm 31.67mm 69.516mm 31.67mm 69.516mm 32.47mm T 270.00 100nF
Designator
Footprint
Value
Mid X
Mid Y
Rotation
Top/Bottom layer
Comment
< Back
Next >
Cancel

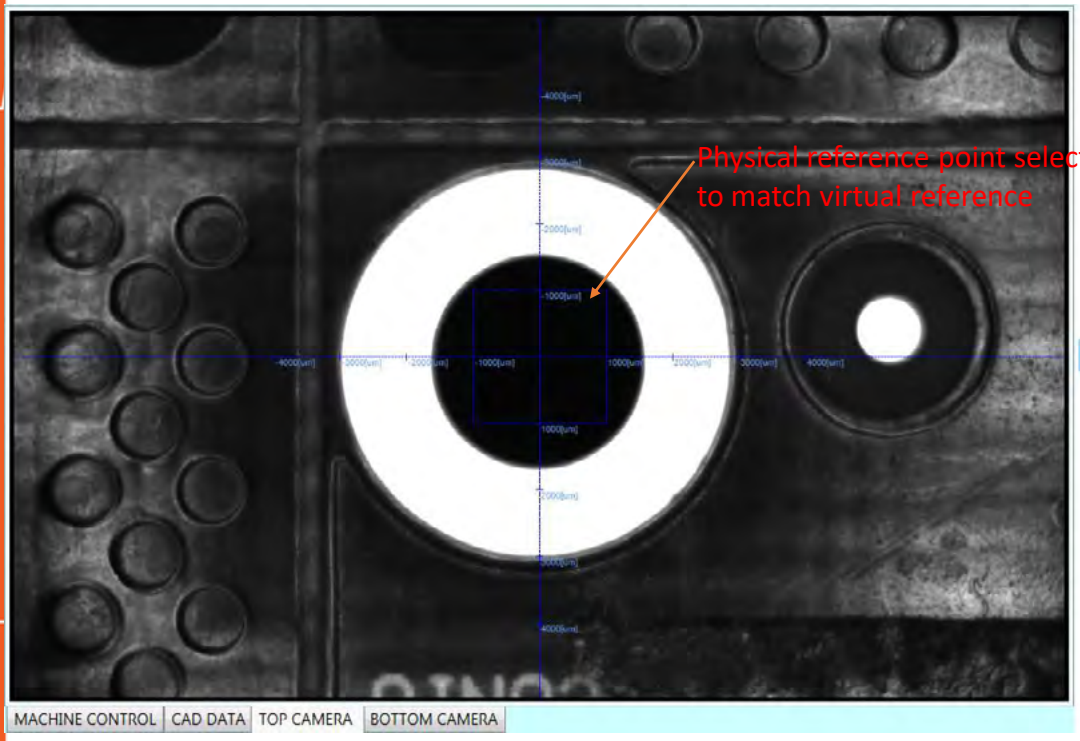

Create new project
Pick and place file content
See pick and place data table and choose column meaning.
The following columns are required: Designator, Footprint, Value, Mid X, Mid Y, Rotation.
Cell content can be moved left and right by selecting cells in the table and using buttons below.
Separators:
space
tab
Id
Designator
Footprint
Mid X
Mid Y
Top/Bottom layer
Rotation
Value
0 Designator Fid_P&P_Square 2.5mm 242.5mm 2.5mm 242.5mm 2.5mm 242.5mm T 90.00 Comment
1 Designator Fid_stencil_Round 2.5mm 247.5mm 2.5mm 247.5mm 2.5mm 247.5mm T 90.00 Comment
2 Designator Fid_stencil_Square 162.5mm 242.5mm 162.5mm 242.5mm 162.5mm 242.5mm T 90.00 Comment
3 Designator Fid_P&P_Round 162.5mm 247.5mm 162.5mm 247.5mm 162.5mm 247.5mm T 90.00 Comment
4 Designator Fid_P&P_Square 162.5mm 7.5mm 162.5mm 7.5mm 162.5mm 7.5mm T 90.00 Comment
5 Designator Fid_stencil_Round 162.5mm 2.5mm 162.5mm 2.5mm 162.5mm 2.5mm T 90.00 Comment
6 Designator Fid_stencil_Square 2.5mm 7.5mm 2.5mm 7.5mm 2.5mm 7.5mm T 90.00 Comment
7 Designator Fid_P&P_Round 2.5mm 2.5mm 2.5mm 2.5mm 2.5mm 2.5mm T 90.00 Comment
8 R521 RESC1608N 75.358mm 48.434mm 75.358mm 48.434mm 76.208mm 48.434mm T 180.00 4.7k
9 R520 RESC1608N 75.358mm 45.894mm 75.358mm 45.894mm 76.208mm 45.894mm T 180.00 4.7k
10 J501 CFG3X1 80.946mm 41.068mm 80.946mm 41.068mm 82.696mm 41.068mm T 180.00 CFG3X1
11 R527 RESC1608N 71.929mm 99.869mm 71.929mm 99.869mm 72.779mm 99.869mm T 180.00 10k
12 R526 RESC1608N 62.658mm 98.98mm 62.658mm 98.98mm 62.658mm 99.83mm T 270.00 10k
13 Q503 SOT23_N 71.929mm 102.917mm 71.929mm 102.917mm 70.979mm 101.867mm T 90.00 BSS123
14 Q502 SOT23_N 63.42mm 102.917mm 63.42mm 102.917mm 62.47mm 101.867mm T 90.00 BSS123
15 P501 HDR2X2 57.832mm 109.902mm 56.562mm 108.632mm 56.562mm 108.632mm T 360.00 Header_2X2
16 P500 HDR1X2 53.768mm 88.058mm 53.768mm 89.328mm 53.768mm 89.328mm T 270.00 Header_2
17 C104 TC3528-1411 90.598mm 98.98mm 90.598mm 98.98mm 89.098mm 98.98mm T 0.00 100uF_6.3V-SMDB
18 C103 TC3528-1411 67.738mm 26.336mm 67.738mm 26.336mm 69.238mm 26.336mm T 180.00 100uF_6.3V-SMDB
19 C101 CAPC1608N 89.582mm 96.186mm 89.582mm 96.186mm 90.382mm 96.186mm T 180.00 100nF
20 C100 CAPC1608N 69.516mm 31.67mm 69.516mm 31.67mm 69.516mm 32.47mm T 270.00 100nF
< Back
Next >
Cancel

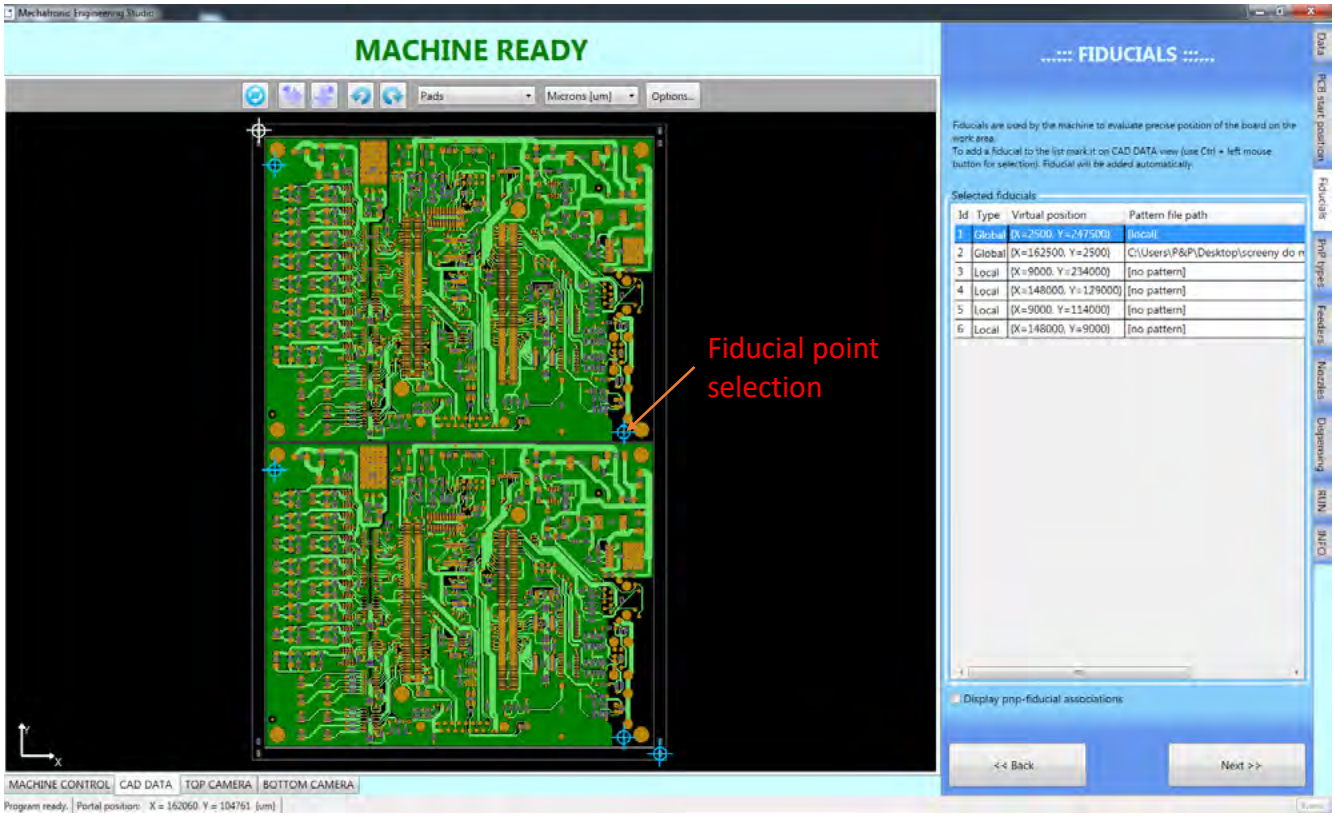

Create new project
Data preview
Y
X
Select pick and place file unit
Milimeters
Above selector will be disabled if selected pick and place file defines a unit .
Otherwise a unit must be selected.
Select pick and place side
Top
Select which side of pick and place data to use.
Angle direction
Counterclockwise
Pick and place to Gerber offset
Use this creator if pick and place data do not match gerber data.
Automatic offset creator
Choose gerber point
(not set)
Choose pnp item
(not set)
Evaluate offset
Offset [um]
X:
Y:
< Back
Finish
Cancel

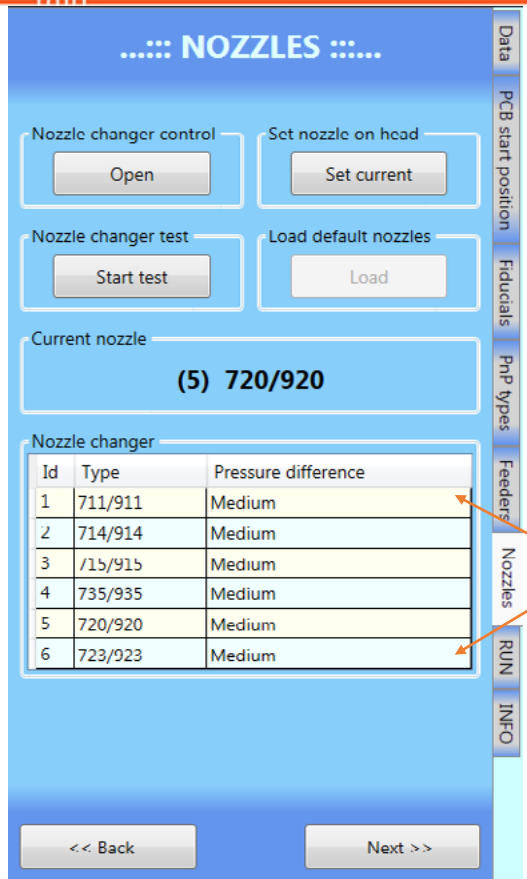

Mechatronic Engineering Studio
MACHINE READY
None
Microns
Options...
Correct orientations
..... DATA .....
Apertures
Boards
Open
New
Save
Clear
Multiblock
Data
PCB start position
Fiducials
FnP types
Feeders
Nozzles
Dispensing
RUN
INFO
Next >>
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA
Program ready.
Portal positions: X = 59185 Y = 70432 [um]


Virtual reference point selection


Set current selection

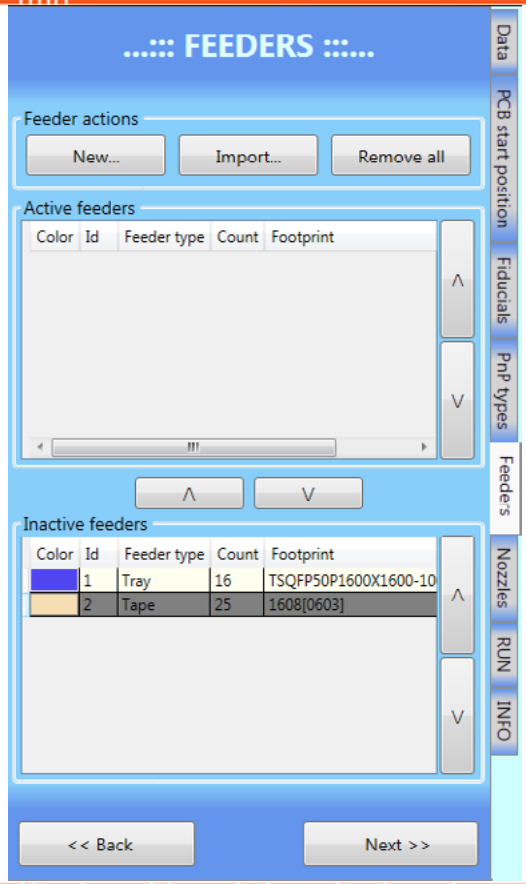

Physical reference point selection
to match virtual reference
Set at current portal position
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA

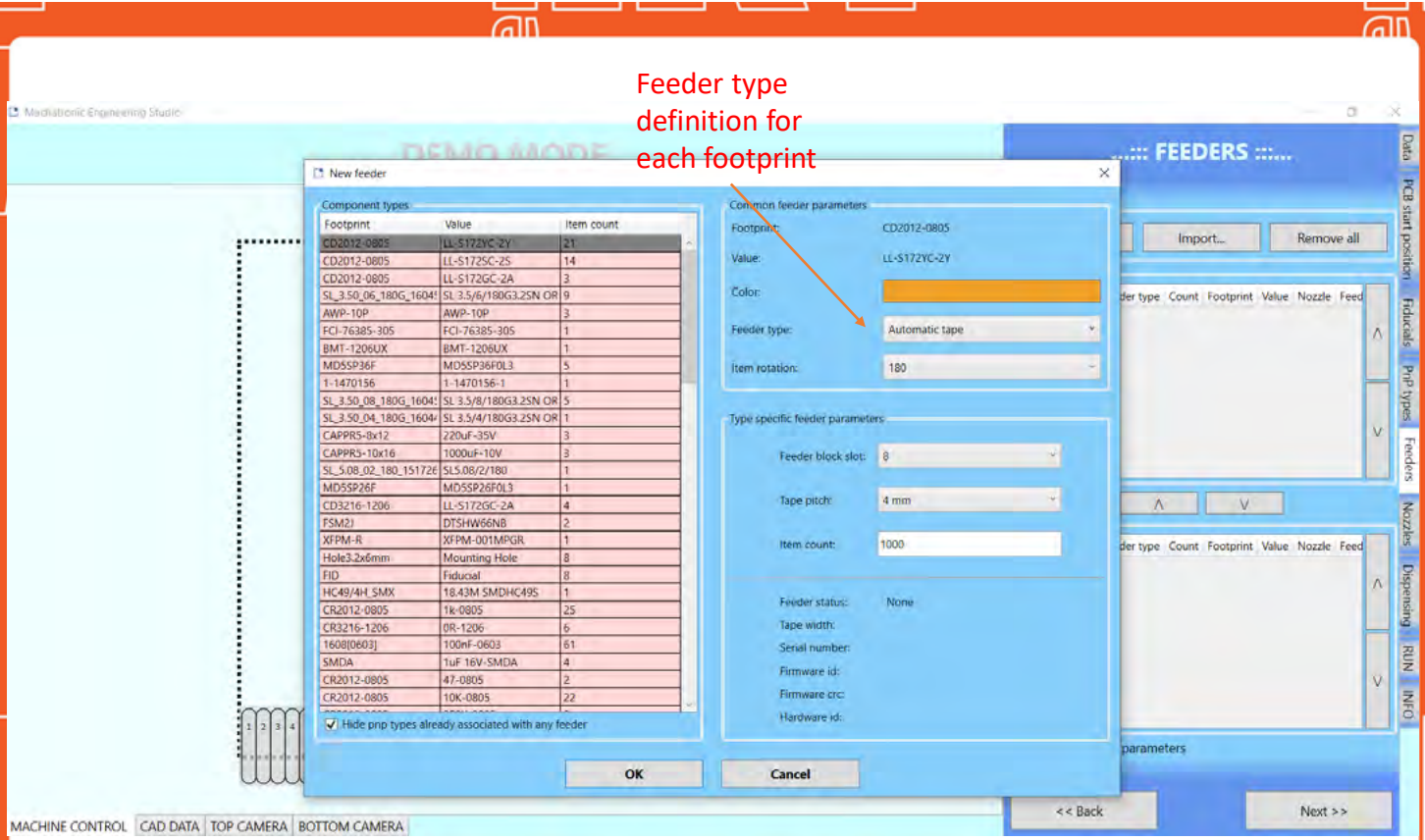

MACHINE READY
Pads
Microns [um]
Options...
Fiducial point selection
..... FIDUCIALS .....
Fiducials are used by the machine to evaluate precise position of the board on the work area.
To add a fiducial to the list mark it on CAD DATA view (use Ctrl + left mouse button for selection). Fiducial will be added automatically.
Selected fiducials
Id | Type | Virtual position | Pattern file path
1 | Global | [X=2500, Y=247500] | [local]
2 | Global | [X=162500, Y=2500] | C:\Users\P&P\Desktop\screeny do n
3 | Local | [X=9000, Y=234000] | [no pattern]
4 | Local | [X=148000, Y=129000] | [no pattern]
5 | Local | [X=9000, Y=114000] | [no pattern]
6 | Local | [X=148000, Y=9000] | [no pattern]
Display pnp-fiducial associations
<< Back
Next >>
Data
PCB start position
Fiducials
PnP types
Feeders
Nozzles
Dispensing
RUN
INFO
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA
Program ready.
Portal position: X = 162060 Y = 104761 [um]

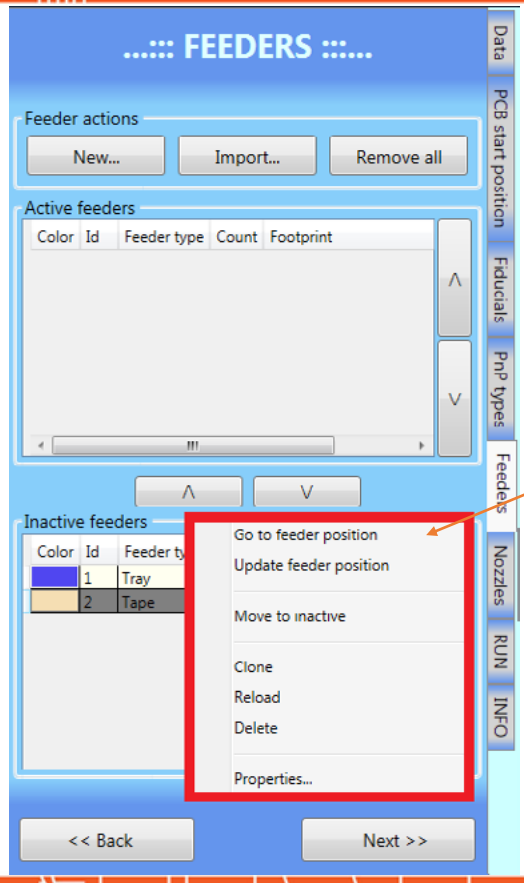


List of nozzles in automatic nozzle exchanger

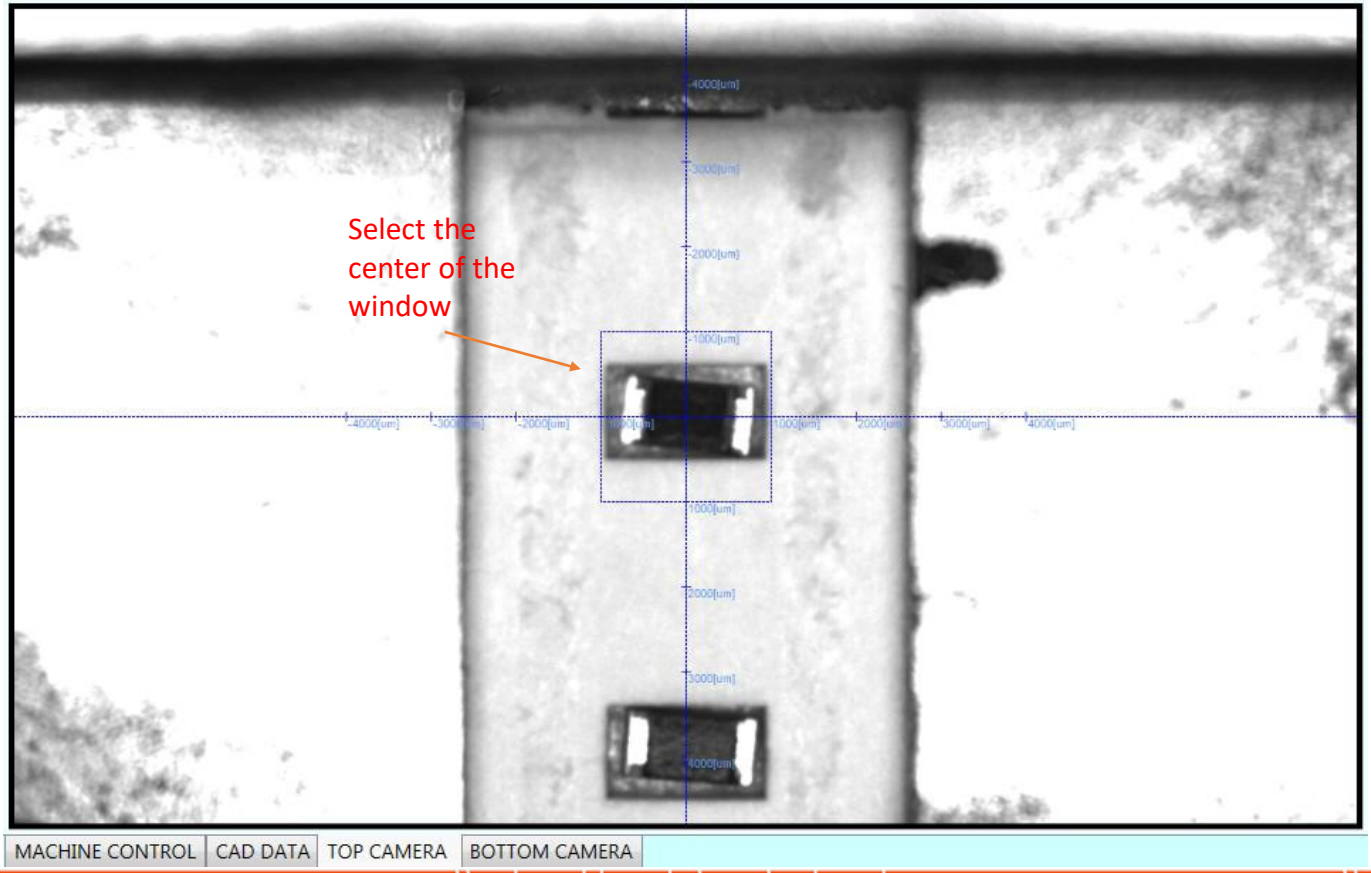
Inactive feeder list



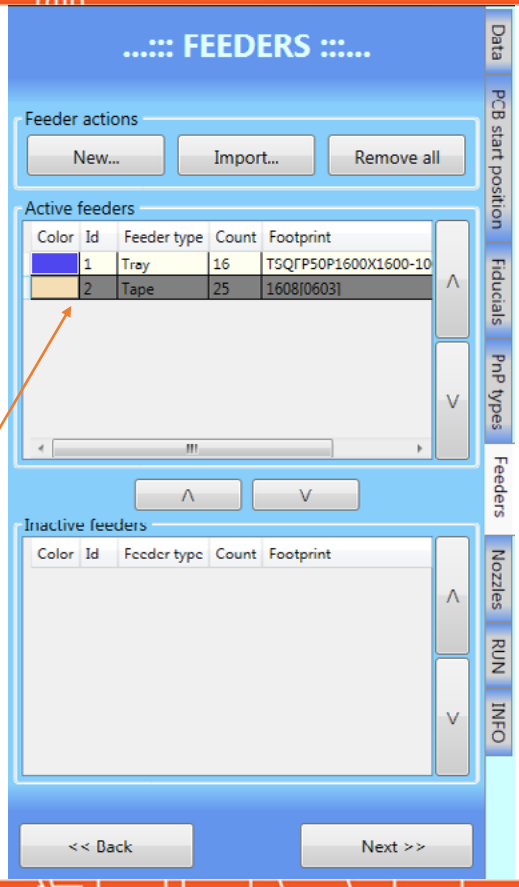

Feeder type
definition for
each footprint
New feeder
Component types
Footprint
Value
Item count
Common feeder parameters
Footprint:
CD2012-0805
Value:
LL-S172YC-2Y
Color:
Feeder type:
Automatic tape
Item rotation:
180
Type specific feeder parameters
Feeder block slot:
Tape pitch:
4 mm
Item count:
1000
Feeder status:
None
Tape width:
Serial number:
Firmware id:
Firmware crc:
Hardware id:
Hide pnp types already associated with any feeder
OK
Cancel
FEEDERS
Import...
Remove all
<< Back
Next >>
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA



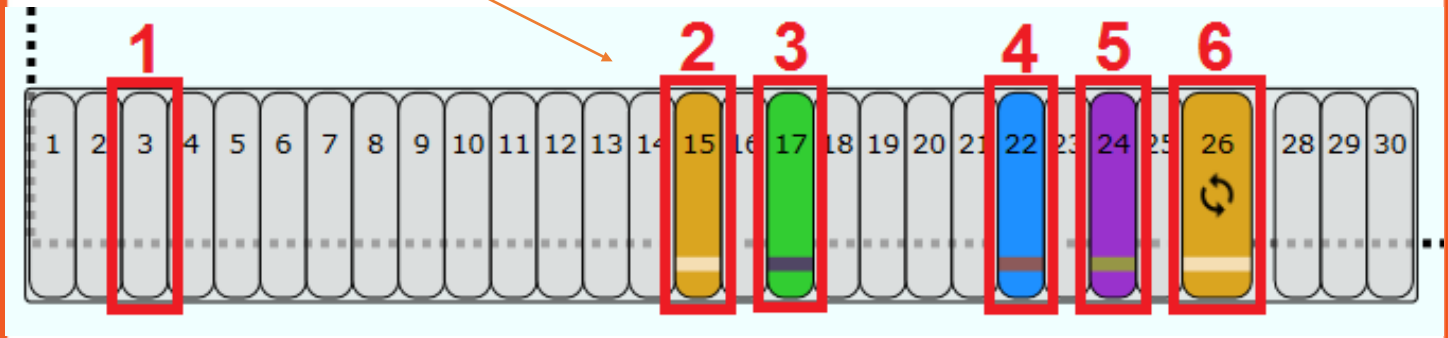
Component pickup position definition

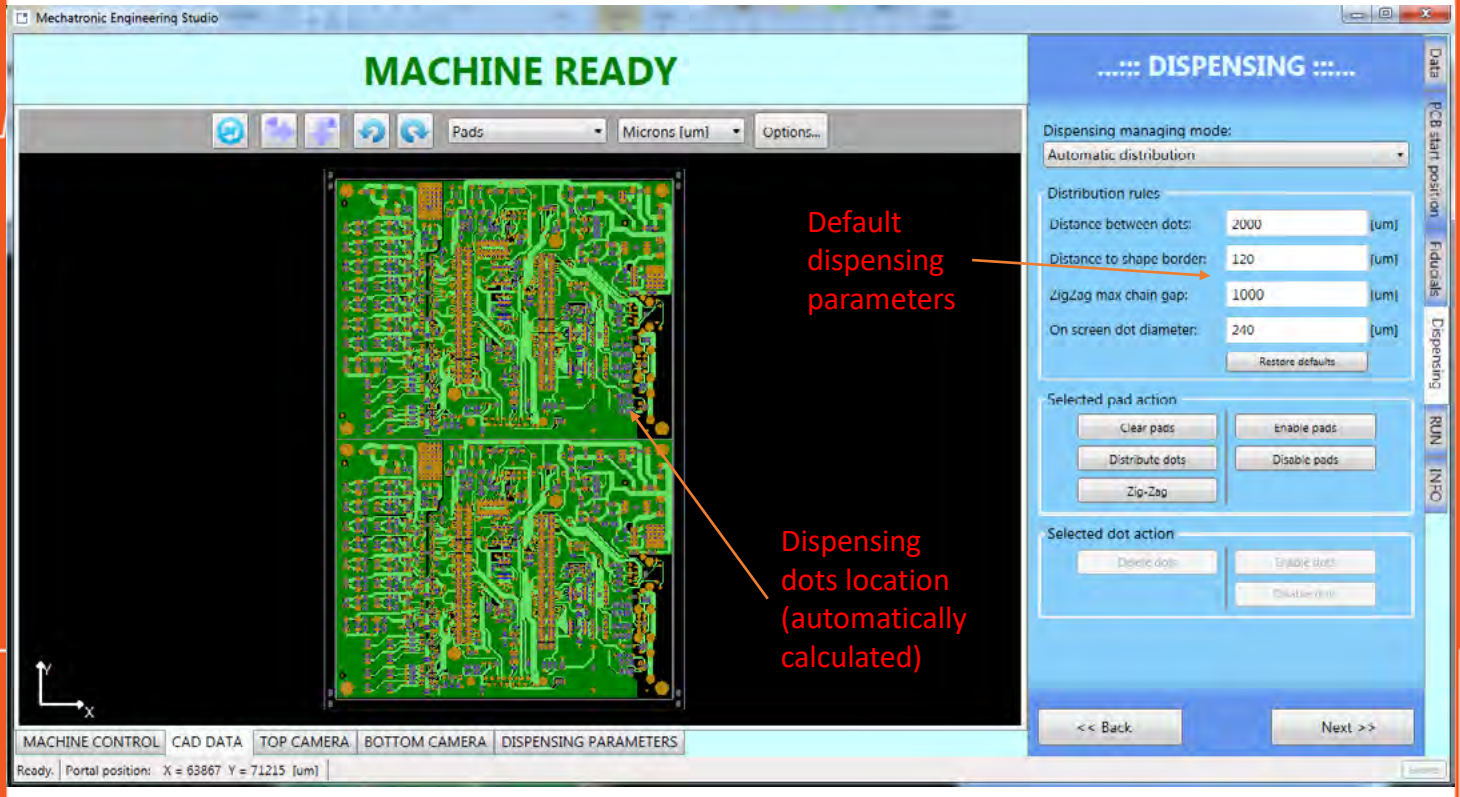

Select the center of the window
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA

Feeders moved from inactive to active (feeders needed for current project)

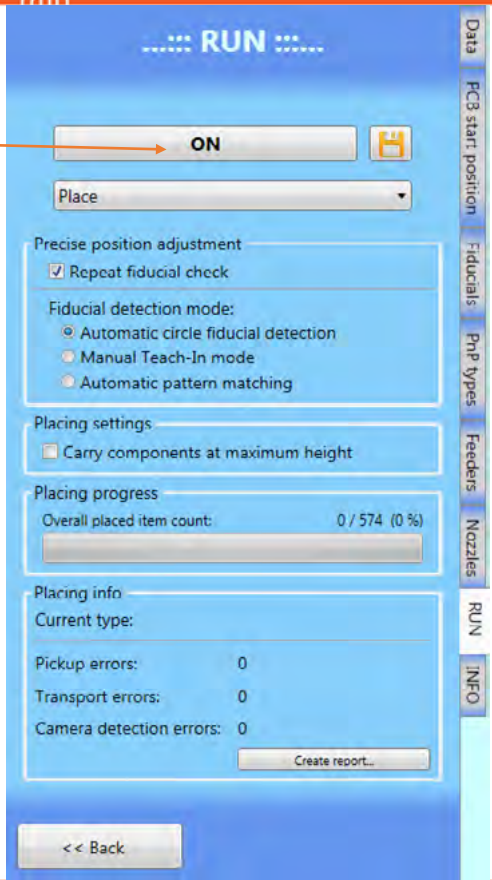


Visualization
of available
and removed
smart feeders




Mechatronic Engineering Studio
MACHINE READY
Pads
Microns [um]
Options...
..... DISPENSING .....
Data
PCB start position
Fiducials
Dispensing
RUN
INFO
Dispensing managing mode:
Automatic distribution
Distribution rules
Distance between dots: 2000 [um]
Distance to shape border: 120 [um]
ZigZag max chain gap: 1000 [um]
On screen dot diameter: 240 [um]
Restore defaults
Selected pad action
Clear pads
Enable pads
Distribute dots
Disable pads
Zig-Zag
Selected dot action
Delete dots
Enable dots
Disable dots
Default dispensing parameters
Dispensing dots location (automatically calculated)
<< Back
Next >>
MACHINE CONTROL
CAD DATA
TOP CAMERA
BOTTOM CAMERA
DISPENSING PARAMETERS
Ready.
Portal position: X = 63867 Y = 71215 [um]

Start of placing and dispensing



https://www.youtube.com/watch?v=_K_JbH8H1Lw

Programiran je ANDROID naprav z GUI-O aplikacijo

Matjaž Skubic

www.gui-o.com

Imagine GUI-O create

Programiranje ANDROID naprav

- Večkrat so naprave brez GUI vmesnika, ker so GUI predragi
- Naprave z GUI vmesnikom – so kompleksne in drage

- Potrebni razvojniki za Android platformo
- Za vsak tip naprave druga uporabniška aplikacija

- Potrebno znanje objektno orientiranih jezikov
- Pri GUI-O to znanje ni več potrebno

www.gui-o.com

Prednosti GUI-O

- GUI-O ni orodje za razvoj uporabniškega vmesnika – to je univerzalen, izdelan, grafični vmesnik.
- Začetek uporabe ne zahteva instalacije orodij in usposabljanje
  - Za začetek je dovolj en sam kratek string in vmesnik deluje: |TG UID:tg1 X:50 Y:50
- Od enostavnega do zahtevnega vmesnika uporabnik dodaja elemente in parametre
- Ločevanje med vmesnikom za podporo razvoja in uporabniškim vmesnikom ni več potrebno.

www.gui-o.com

Kaj prinaša GUI-O ?

- Razvojnik na strani naprave je tudi razvojnik Android aplikacije
- Spremembe se enostavno izvajajo iz projekta v projekt
- Ni potrebno zaposlovati Android programerjev
- Univerzalnost, enostavnost
- Bistveno manjši stroški razvoja

www.gui-o.com

Primer uporabe GUI-O

- Za vse sisteme, ki jih lahko povezujemo z Android napravami
  - RS232
  - UART-USB
  - UART-Bluetooth
  - UART-Bluetooth BLE
  - UART-WiFi

www.gui-o.com

Primer uporabe GUI-O

- up: Microchip ARM, STM ,PIC, AVR, 8051
- STM
- Arduino
- PLC
- Raspberry PI
- Orange PI
- Embeded PC
- PC Win, Linux, …

GUI-O je veliko več kot touch screen na napravi!

www.gui-o.com

Razvojna okolja

- C++
- Arduino
- C#
- Delphy
- STM
- Pyton
- Bascom

...

www.gui-o.com

GUI-O delovanje

- Namestitev:
  - https://www.gui-o.com/
  - https://play.google.com/store/apps/details?id=com.guio.guioapp

Google Play

GUI-O meni

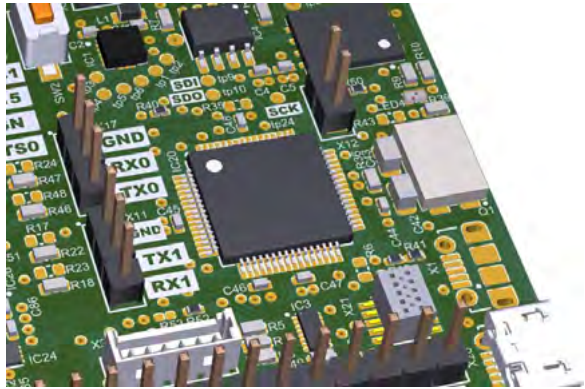
www.gui-o.com

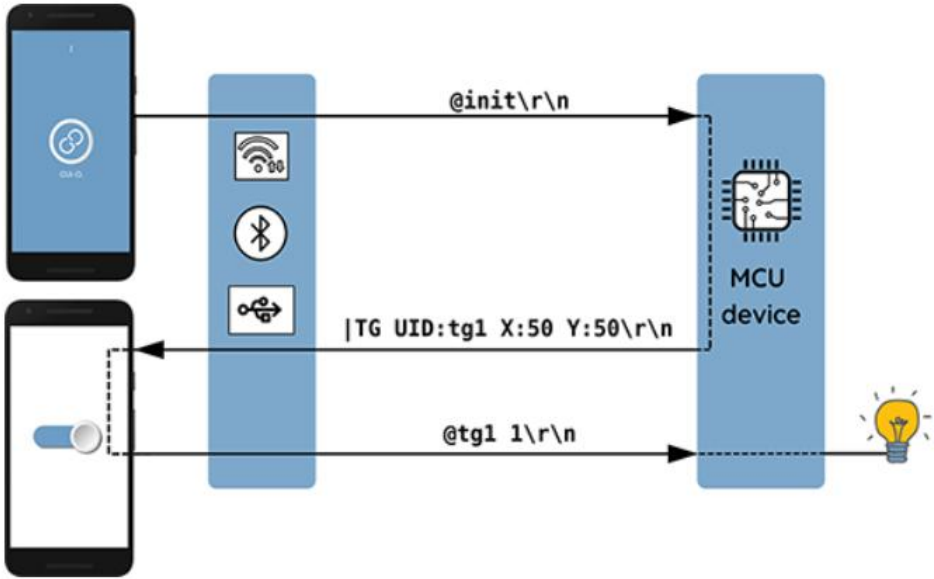
GUI-O Start

(avtomatsko)

> @init

odgovor<





www.gui-o.com

GUI-O objekti

- Labela
- Circular bar
- Button
- Toggle switch
- Image
- Video

...

HW komponente
(enak protokol)

- Accelometer
- Light sensor
- Magnetometer
- SMS
- GPS
- Camera
- Vibra, sound
- Files

...

www.gui-o.com

Kako deluje GUI-O

@init

|BSL UID:bslv X:13 Y:8 FGC:#0070e0 ROT:270 LEN:29 BTH:0.2

|BSL UID:bslf3 X:31 Y:63.7 FGC:#0070e0 ROT:270 LEN:3.7 BTH:0.2
|BSL UID:bslf4 X:40 Y:63.7 FGC:#0070e0 ROT:270 LEN:3.7 BTH:0.2
|BSL UID:bslf5 X:49 Y:63.7 FGC:#0070e0 ROT:270 LEN:3.7 BTH:0.2

|LB UID:lbx X:16 Y:15 ALP:1 SHE:1 ROT:0 FGC:#0070e0 FSZ:12 FFA:"font0" TXT:"X"
|LB UID:lby X:16 Y:35 ALP:1 SHE:1 ROT:0 FGC:#0070e0 FSZ:12 FFA:"font0" TXT:"Y"
|LB UID:lbz X:16 Y:55 ALP:1 SHE:1 ROT:0 FGC:#0070e0 FSZ:12 FFA:"font0" TXT:"Z"
|BT UID:btb X:88 Y:13 W:5 H:9 ROT:0 RAD:0.2 BGC:#696969 SBGC:#FFFFFF FGC:#000000 FSZ:4 BTH:0.25 TXT:"Inch" SVAL:"2"
|LB UID:lbxv X:38 Y:15 ALP:1 SHE:1 ROT:0 FGC:#000000 FSZ:9 FFA:"font2" TXT:"14.880„
...

@btb 2

@ni1 22,0

www.gui-o.com

GUI-O

Kontrola in upravljanje katerekoli naprave s pametnim telefonom oz. katero koli Android napravo

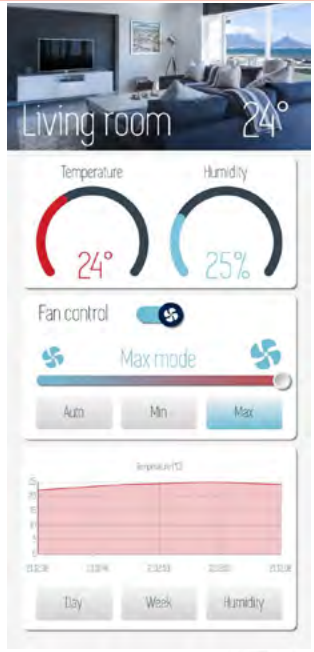
www.gui-o.com

GUI-O podpira Android naprave

- Pametni telefoni
- Tablice
- TV-BOX
- Avtoradiji
- Orange PI
- Industrijske Android naprave

... Vse naprave, ki uporabljajo operacijski sistem Android 5.1.1 in več

www.gui-o.com



//www.youtube.com/
?v=PfkWM3pAFNw

https://www.youtube.com/watch?v=sU3rJ2CZVCA

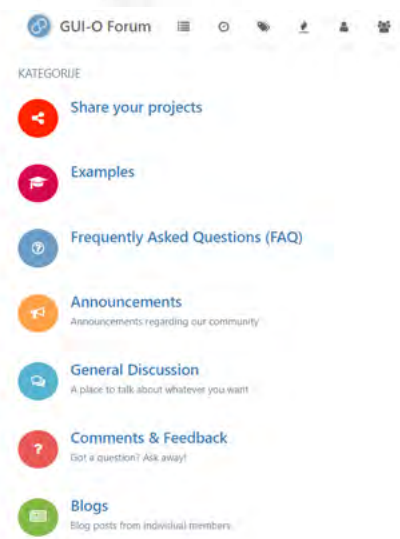
https://www.youtube.com/watch?v=8iPABwZyiAc

UI-O praktični delujoči primeri

www.gui-o.com

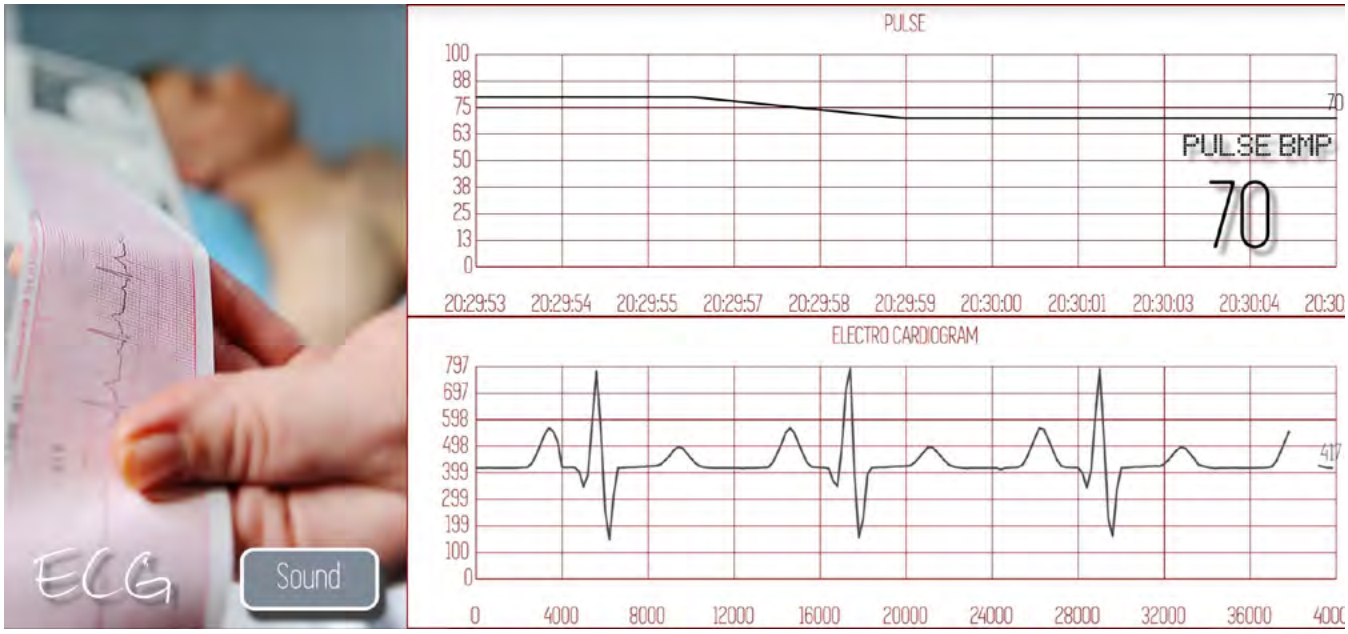
about
features
download
manuals
forum
contact
Let's start
Examples
ONE APP TO RULE THEM ALL
Connect . Create user interface . Control any device .
Google Play
Get .apk
GUI-O and ESP8266 pairing
GUI-O IoT HELLO example
GUI-O HELLO example

www.gui-o.com

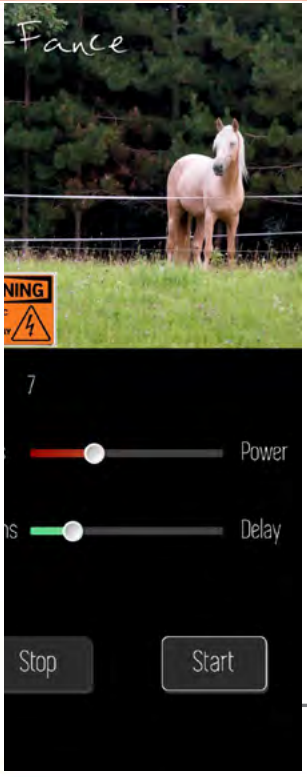


- https://forum.gui-o.com/

www.gui-o.com

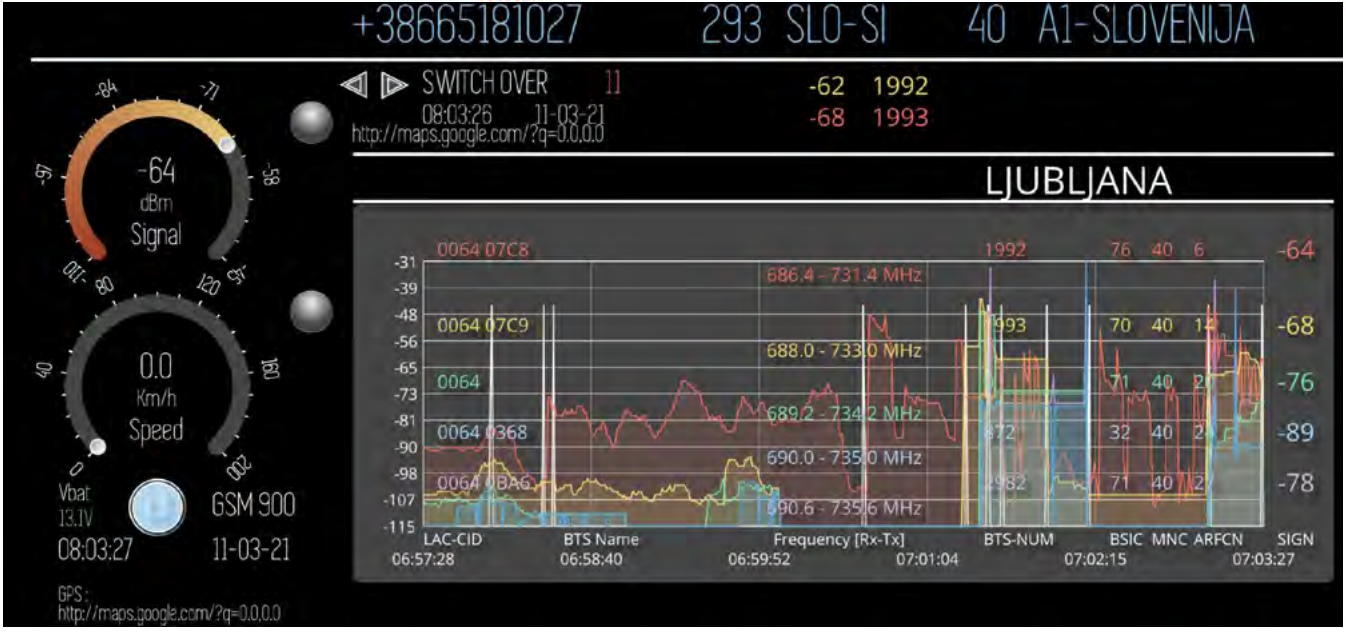

ECG
Sound
PULSE
100
88
75
63
50
38
25
13
0
70
PULSE BMP
70
20:29:53
20:29:54
20:29:55
20:29:57
20:29:58
20:29:59
20:30:00
20:30:01
20:30:03
20:30:04
ELECTRO CARDIOGRAM
797
697
598
498
399
299
199
100
0
417
0
4000
8000
12000
16000
20000
24000
28000
32000
36000

www.gui-o.com


Fance
7
Power
Delay
Stop
Start

My home door
Matjaz
21-04-28
8
08:51:40

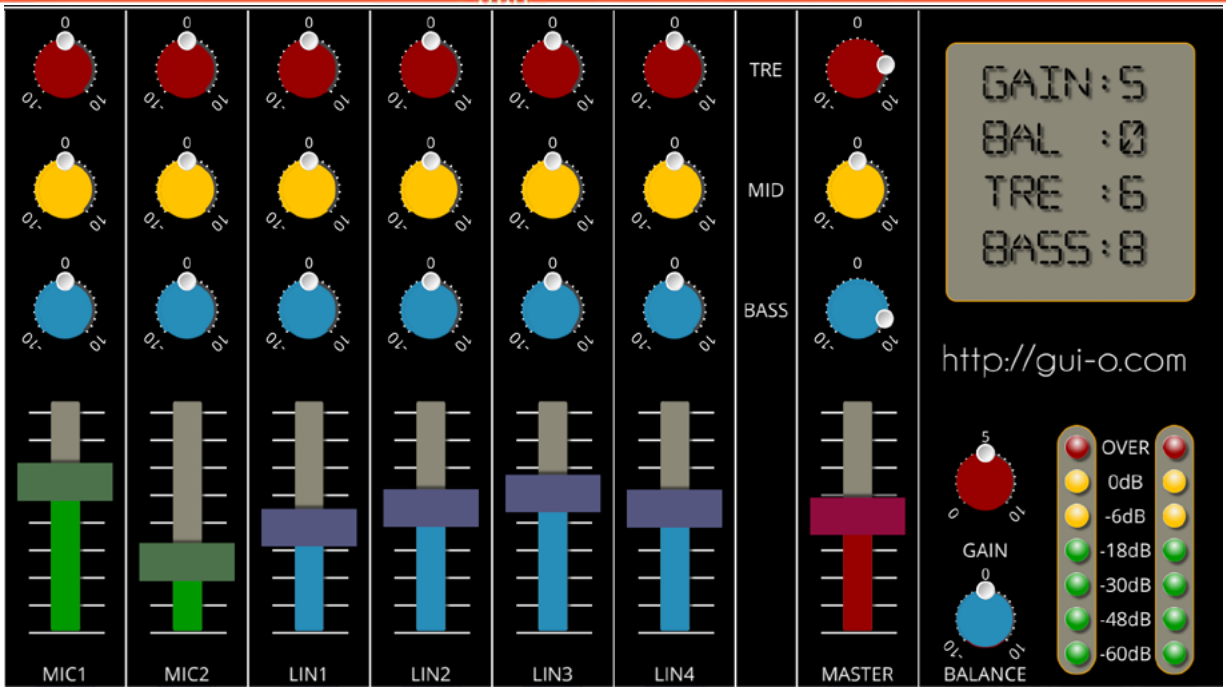
Plant waterer
Timer 25 min
25
25
Section-1
Section-2
Section-3
Cycle
22°C
55%


+38665181027
293 SLO-SI
40 A1-SLOVENIJA
SWITCH OVER 11
08:03:26 11-03-21
http://maps.google.com/?q=0.0,0.0
-62 1992
-68 1993
LJUBLJANA
-64
dBm
Signal
0.0
Km/h
Speed
Vbat
13.1V
GSM 900
08:03:27
11-03-21
GPS:
http://maps.google.com/?q=0.0,0.0
0064 07C8
0064 07C9
0064
0064 0368
0064 0BAC
686.4 - 731.4 MHz
688.0 - 733.0 MHz
689.2 - 734.2 MHz
690.0 - 735.0 MHz
690.6 - 735.6 MHz
LAC-CID
BTS Name
Frequency [Rx-Tx]
BTS-NUM
BSIC MNC ARFCN
SIGN
06:57:28
06:58:40
06:59:52
07:01:04
07:02:15
07:03:27

www.gui-o.com

SIMPLEbake
AUTObake
PRObake
MYbake
EXTRA
aked Potatoes
Bread
Pizza
Cookies
Sponge Cake
15:16:01
28-11-20
https://www.gui-o.com

www.gui-o.com


TRE
MID
BASS
GAIN:5
BAL :0
TRE :6
BASS:8
http://gui-o.com
GAIN
BALANCE
OVER
0dB
-6dB
-18dB
-30dB
-48dB
-60dB
MIC1
MIC2
LIN1
LIN2
LIN3
LIN4
MASTER
www.gui-o.com

GUI-O application for Android devices

Matjaž Skubic

www.gui-o.com

Disadvantages of graphical user interface (GUI) programming

- GUI implementation is costly and time consuming
- Requires thoughtful selection of hardware (graphical display, touchscreen, etc.)
- Object-oriented programming requires relatively high expertise and knowledge

About GUI-O application

- GUI-O application is a fully developed graphical user interface design tool
- Simple ASCII protocol enables quick start: e.g., send **|TG UID:tg1 X:50 Y:50\r\n** to create a functional toggle button
- Numerous highly customizable widgets are available (toggle, slider, chart, image and video viewer, etc.)
- No additional tools or libraries required

www.gui-o.com

Advantages of GUI-O application

- Language agnostic – supports development in any programming language using a simple ASCII protocol
- Easy integration into any project, at any stage
- No Android programmin knowledge is required
- Universal and simple GUI development tool
- Reduces the development costs

www.gui-o.com

How to use?

- Any microcontroller (or other) device that support USB, Bluetooth, Bluetooth LE or internet connectivity. Devices without built-in support can use:
  - RS232
  - UART-USB
  - UART-Bluetooth
  - UART-Bluetooth BLE
  - UART-WiFi

www.gui-o.com

Supported devices

- up: Microchip ARM, STM ,PIC, AVR, 8051
- STM
- Arduino
- PLC
- Raspberry PI
- Orange PI
- Embeded PC
- PC Win, Linux, .

O offers much more than just touchscreen and display functionality!

www.gui-o.com

Development environments

- C++
- Arduino
- C#
- Delphy
- STM
- Pyton
- Bascom

...

www.gui-o.com

Getting started with GUI-O

- Install from:
  - https://www.gui-o.com/
  - https://play.google.com/store/apps/details?id=com.guio.guioapp

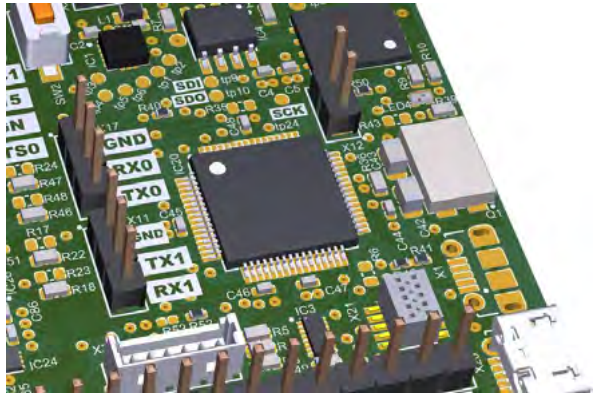
Google Play

GUI-O Settings Menu

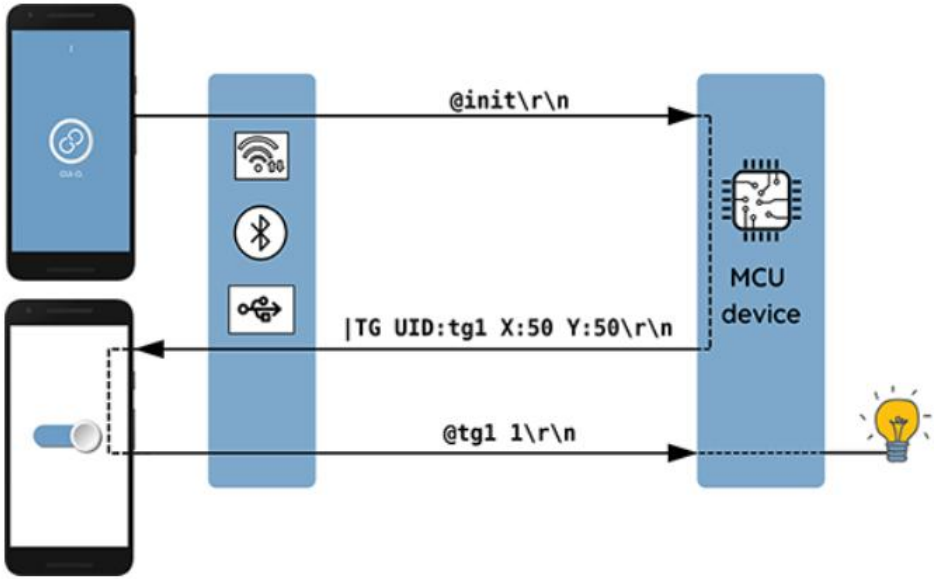
GUI-O Initialization

optional
autoconnect

> @init



response<



www.gui-o.com

GUI-O widgets

- Label
- Circular bar / dia
- Button
- Toggle
- Image
- Video

…

HW components
(using ASCII protocol)

- Accelometer
- Light sensor
- Magnetometer
- SMS
- GPS
- Camera
- Vibra, Sound
- File operations (save, display, send, etc.)

…

www.gui-o.com

An example

@init

|BSL UID:bslv X:13 Y:8 FGC:#0070e0 ROT:270 LEN:29 BTH:0.2

|BSL UID:bslf3 X:31 Y:63.7 FGC:#0070e0 ROT:270 LEN:3.7 BTH:0.2
|BSL UID:bslf4 X:40 Y:63.7 FGC:#0070e0 ROT:270 LEN:3.7 BTH:0.2
|BSL UID:bslf5 X:49 Y:63.7 FGC:#0070e0 ROT:270 LEN:3.7 BTH:0.2

|LB UID:lbx X:16 Y:15 ALP:1 SHE:1 ROT:0 FGC:#0070e0 FSZ:12 FFA:"font0" TXT:"X"
|LB UID:lby X:16 Y:35 ALP:1 SHE:1 ROT:0 FGC:#0070e0 FSZ:12 FFA:"font0" TXT:"Y"
|LB UID:lbz X:16 Y:55 ALP:1 SHE:1 ROT:0 FGC:#0070e0 FSZ:12 FFA:"font0" TXT:"Z"
|BT UID:btb X:88 Y:13 W:5 H:9 ROT:0 RAD:0.2 BGC:#696969 SBGC:#FFFFFF FGC:#000000 FSZ:4 BTH:0.25 TXT:"Inch" SVAL:"2"
|LB UID:lbxv X:38 Y:15 ALP:1 SHE:1 ROT:0 FGC:#000000 FSZ:9 FFA:"font2" TXT:"14.880„
...

@btb 2

@ni1 22,0

www.gui-o.com

GUI-O

Kontrola in upravljanje katerekoli naprave s pametnim telefonom oz. katero koli Android napravo

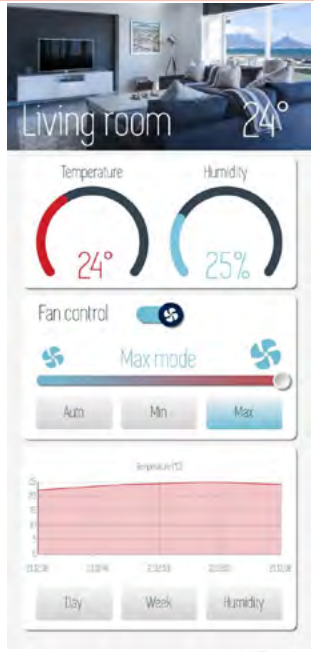
www.gui-o.com

Devices that support GUI-O

- Smart phones
- Tablets
- TV-BOX devices
- Car radios
- Orange PI devices
- Industrial Android devices (readers, etc.)

... All devices using Android 5.1.1 and above

www.gui-o.com



//www.youtube.com/
?v=PfkWM3pAFNw

https://www.youtube.com/watch?v=sU3rJ2CZVCA

https://www.youtube.com/watch?v=8iPABwZyiAc

UI-O real-life examples

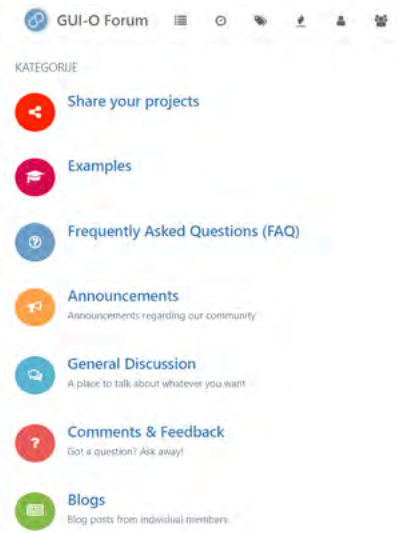
www.gui-o.com

about
features
download
manuals
forum
contact
Let's start
Examples
ONE APP TO RULE THEM ALL
Connect . Create user interface . Control any device .
Google Play
Get .apk
GUI-O and ESP8266 pairing
GUI-O IoT HELLO example
GUI-O HELLO example

www.gui-o.com

GUI-O Forum

- https://forum.gui-o.com/



International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

Comprehensive EMS and ODM solutions:
FROM CONCEPTUAL DESIGN TO PRODUCTION

EMS PLACE

Presented by:
Matjaž Hribar
EMA d.o.o.

Who we are

Industrial marking, coding and engineering market leader in Slovenia

www.ema.si

EMS, ODM and DFM provider

www.emsplace.eu

Developer and manufacturer of **telematic products & solutions** (BlueTraker)

www.bluetraker.com

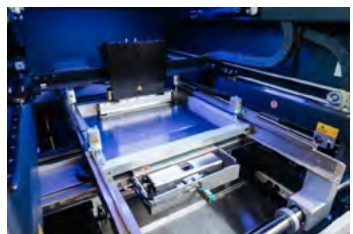
What is EMSplace and the "why" behind its launch

- **EMSplace** consists of both **EMS** (Electronic Manufacturing Services) and **ODM** (Original Design Manufacturing) solutions.
- Combining **modern automation** equipment and **highly skilled employees**, thus achieving the **best combination of quality, cost and speed**.
- **Three main reasons for launching EMSplace**:
  1. The lack of EMS and ODM solutions that would shorten the time of manufacturing process;
  2. Unsatisfactory quality of electronic modules assembling;
  3. Non-agile customer support.

EMS production segments we cover

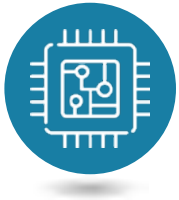
Electronic circuits for:

- energy information systems;
- bee-keeping scales;
- pigeon tracking devices;
- remote monitoring;
- e-bikes;
- LED modules and power supply for LEDs;
- electricly powered motors;
- mobile terminals;
- consumer electronics; etc.



Our competitive advantages

Flexibility of assembling



Wide array of full EMS services

Monitoring mechanical firmness of electronic components

In house development of electronic compounds, test devices, etc.

Matjaž Hribar

Production Manager for
EMSplace at EMA d.o.o.

www.emsplace.eu

+386 (0)3 428 48 00 | sales@emsplace.eu

EMA d.o.o., Teharje 7b, 3000 Celje, Slovenija

International Conference for ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

Operations != Response

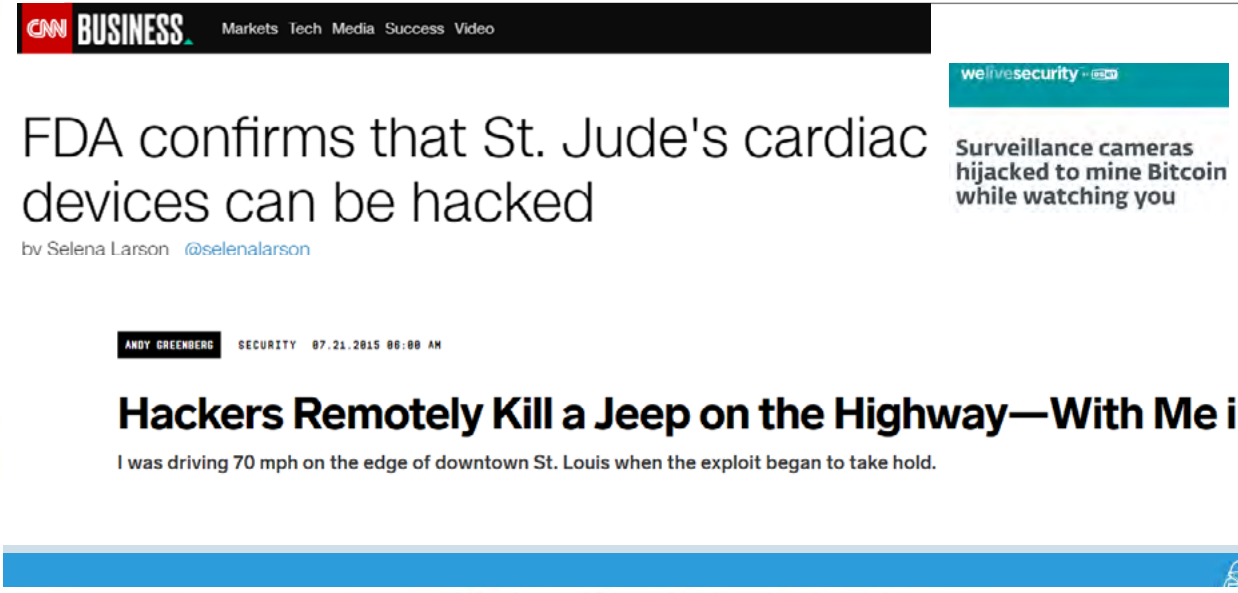
@ gregorspagnolo

About me

- SSRD owner (https://ssrd.io)
- Maker
- Breaker

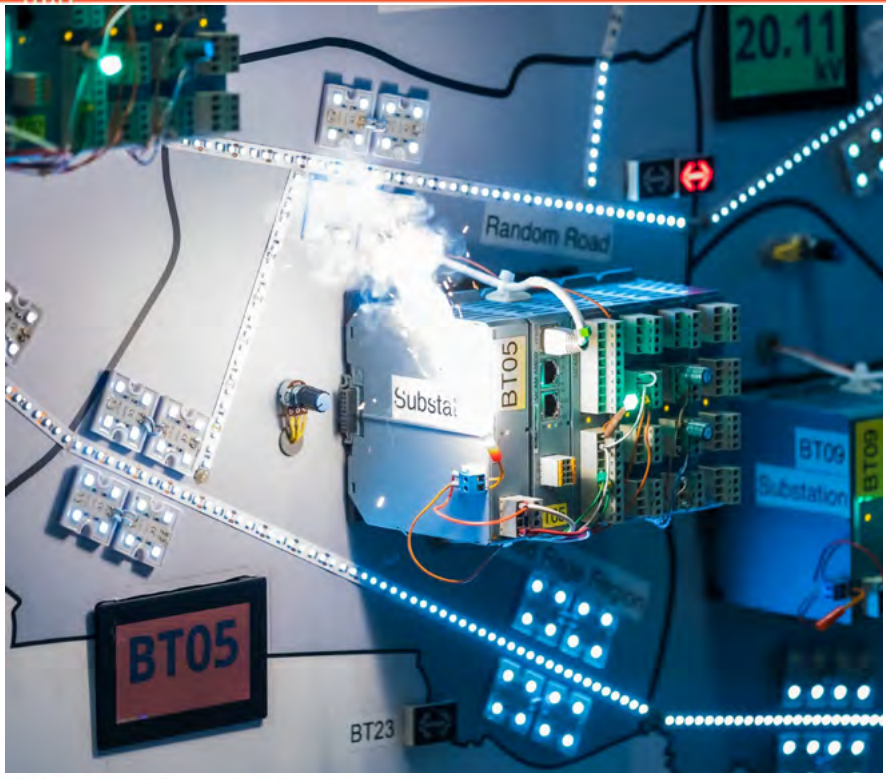
Security?

Security


CNN BUSINESS
Markets Tech Media Success Video
FDA confirms that St. Jude's cardiac devices can be hacked
by Selena Larson @selenalarson
welivesecurity
Surveillance cameras hijacked to mine Bitcoin while watching you
ANDY GREENBERG
SECURITY 07.21.2015 06:00 AM
Hackers Remotely Kill a Jeep on the Highway—With Me in It
I was driving 70 mph on the edge of downtown St. Louis when the exploit began to take hold.
SSRD

Locked Shields 2021

- World´s Largest International Live-Fire Cyber Exercise
- Live-fire = real-time Red Team vs. Blue Team exercise
- Involves regular business IT, critical infrastructure and military systems
- Integrates technical and strategic decision-making exercise
- More than 2000 cyber defence experts from nearly 30 nations



Teams

Blue Team

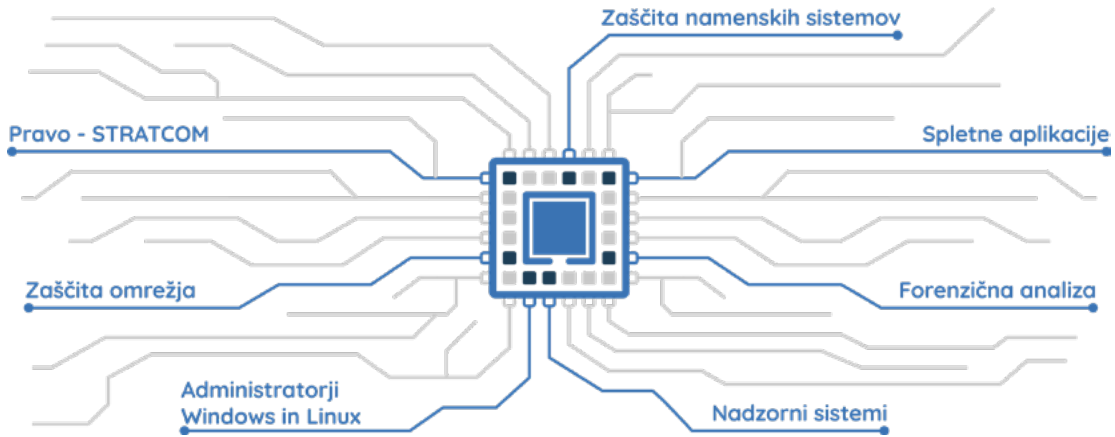
Red Team

White Team

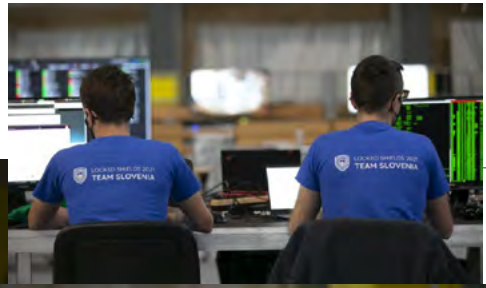
Green Team

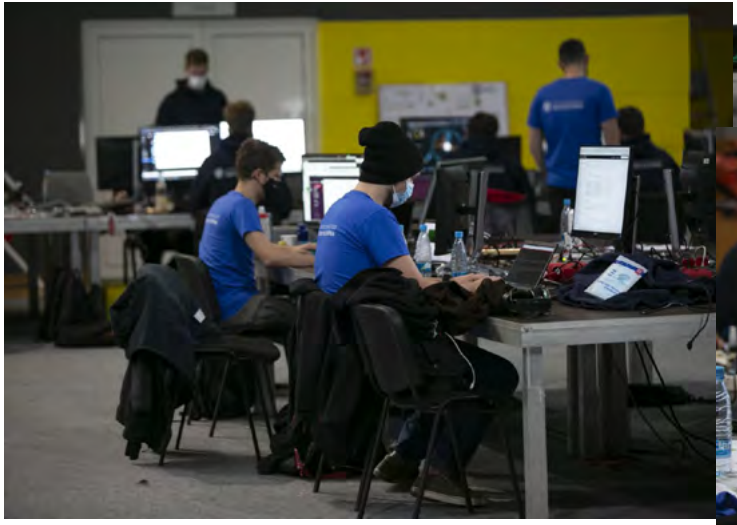
Preparations

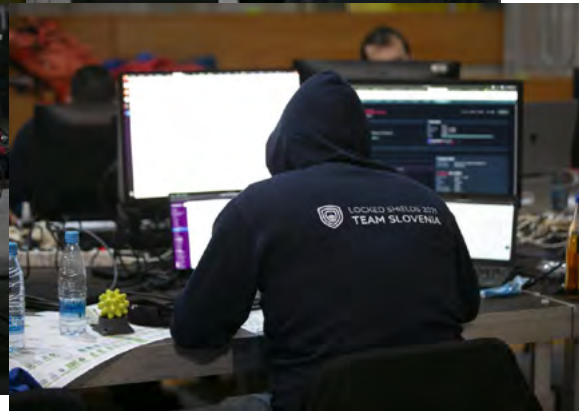
Blue team (Slovenija)



Insights







Lessons learned

- Scoring
- How it works
- **Operations != Response**
- Communication

Lead by example

Thank you!

gregorspagnolo

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

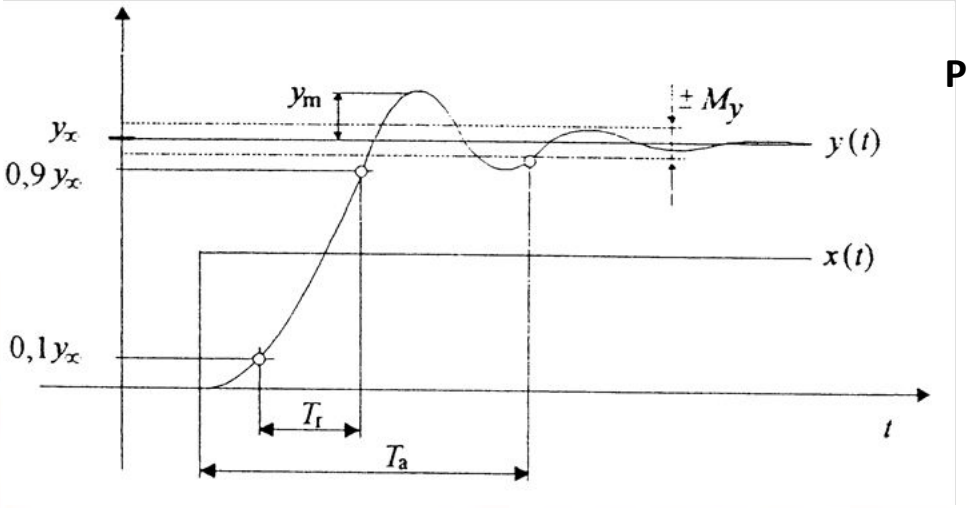
konferenca IKT EM

Dinamične merilne lastnosti osciloskopov

Mirko Ivančič, Amiteh d.o.o.

Odziv merilne naprave na hipno spremembo vhodne veličine

Tipična karakteristika **pri hipni spremembi** vhodne veličine:



Prehodna funkcija:

$$h(t) = \frac{y(t)}{x(t)}$$

T_a – odzivni čas

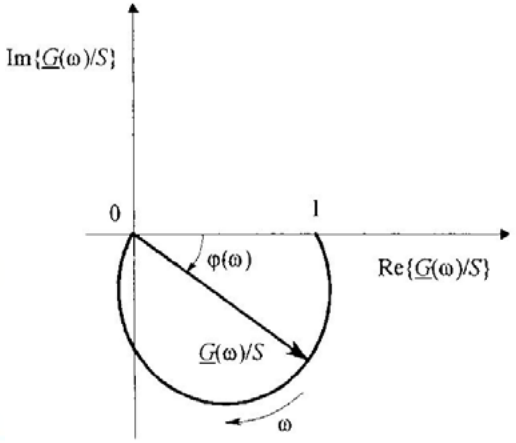
T_r – dvižnini čas

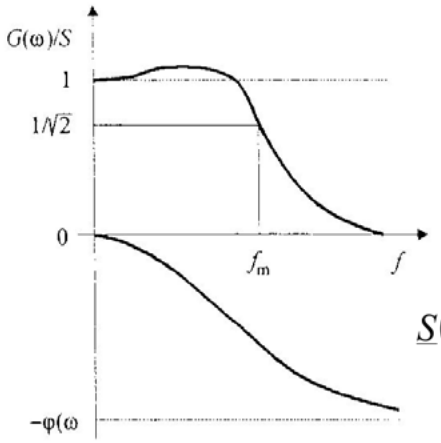
y_m – prenihanje

Odzivanje merilne naprave na **sinusno obliko**

Amplituda in **fazni kot** sta odvisna od frekvence

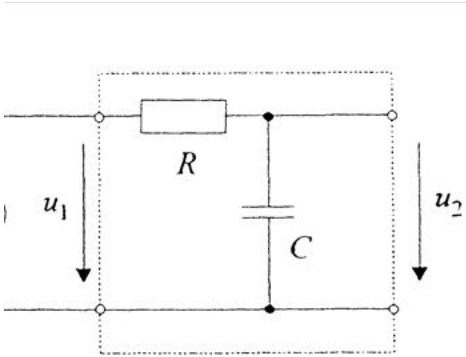
Frekvenčna karakteristika: $\underline{G}(\omega)=\dfrac{Y(\omega)}{X(\omega)}=|\underline{G}(\omega)|\,\mathrm{e}^{\mathrm{j}\varphi(\omega)}=G(\omega)\mathrm{e}^{\mathrm{j}\varphi(\omega)}$

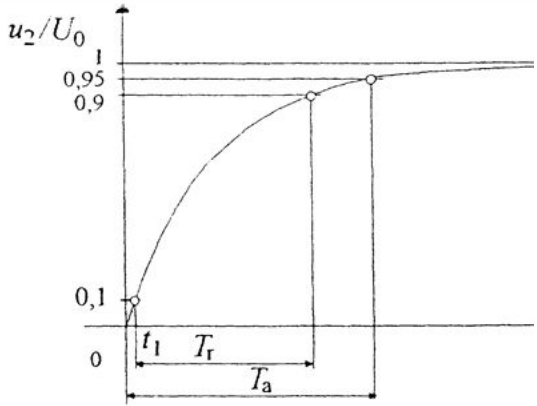




$\underline{S}(\omega)$ – kompleksna občutljivost

Povezava odzivnega časa in mejne frekvence





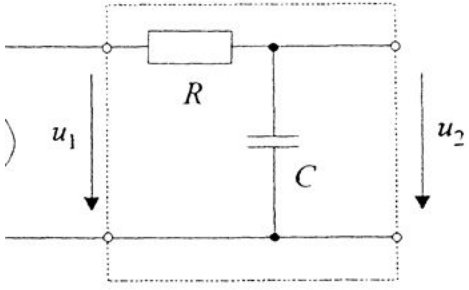
odziv na stopnico: $u_2 = U_0\left(1 - \mathrm{e}^{-t/\tau}\right) \quad \tau = RC$

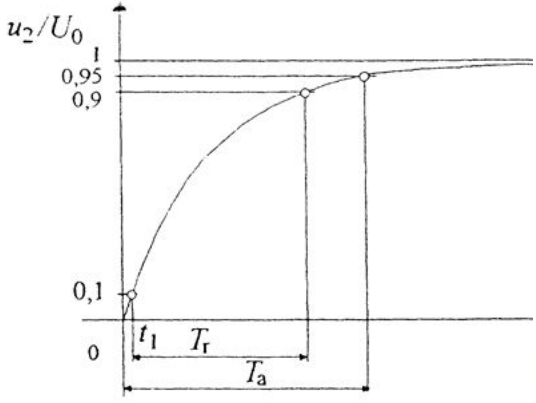
narast signala do 95% : $0{,}95U_0 = U_0\left(1 - \mathrm{e}^{-T_a/\tau}\right) \Rightarrow \quad T_a = \tau \ln 20 \approx 3\tau$

Povezava odzivnega časa in mejne frekvence

Med odzivnim časom ($M = \pm 5\%$) in zgornjo frekvenčno mejo ($1/\sqrt{2}$) obstaja povezava:

$$T_a \approx \frac{1}{2 f_m}$$





Povezava mejne frekvence in dvižnega časa

spodnji prag: $0{,}1U_0 = U_0\left(1 - \mathrm{e}^{-t_1/\tau}\right)$

zgornji prag: $0{,}9U_0 = U_0\left(1 - \mathrm{e}^{-(t_1+T_\mathrm{r})/\tau}\right)$

povezava **dvižnega časa** in **časovne konstante**: $T_\mathrm{r} = \tau \ln 9 = 2{,}2\,\tau$

povezava mejne frekvence in dvižnega časa: $f_\mathrm{m} = \dfrac{1}{2\pi\left(T_\mathrm{r}/\ln 9\right)} = \dfrac{0{,}35}{T_\mathrm{r}}$

Prevajalna funkcija sistema

Pogosto prevajalno funkcijo podajamo s frekvenco v razmerju proti mejni frekvenci:

$$\frac{\underline{U}_2}{\underline{U}_1} = \frac{1}{1 + \mathrm{j} f / f_\mathrm{m}} \quad \Rightarrow \quad \frac{\hat{u}_2}{\hat{u}_1} = \frac{1}{\sqrt{1 + \left(f / f_\mathrm{m}\right)^2}}$$

Če sta v verigo (**kaskado**) zaporedno vezana dva člena, se frekvenčna odziva se množita:

$$\frac{1}{\sqrt{1 + \left(f / f_{\mathrm{m}1}\right)^2}} \cdot \frac{1}{\sqrt{1 + \left(f / f_{\mathrm{m}2}\right)^2}} = \frac{1}{\sqrt{1 + \left(f / f_{\mathrm{ms}}\right)^2}}$$

Prevajalna funkcija sistema

Pri vzbujanju z $f = f_{ms}$ velja :

$$\left[1+\left(f_{ms}/f_{m1}\right)^2\right]\left[1+\left(f_{ms}/f_{m2}\right)^2\right] = 2$$

Po malo preoblikovanja in upoštevanju

$$\text{if } f_{ms}/f_{m1} < 1 \qquad f_{ms}/f_{m2} < 1$$

dobimo znano povezavo

$$\frac{1}{f_{ms}^2} = \frac{1}{f_{m1}^2} + \frac{1}{f_{m2}^2}$$

izraženo z dvižnim časom pa:

$$T_{rs}^2 = T_{r1}^2 + T_{r2}^2$$

Primeri izračunov skupnega dvižnega časa

osciloskop	dviži čas	sonda		sonda		sonda		sonda		sonda	
BW [MHz]	tr [ns]	10 MHz		100 MHz		350 MHz		500 MHz		1 GHz	
		skupni dvižni čas /pasovna širina									
		[ns]	[MHz]	[ns]	[MHz]	[ns]	[MHz]	[ns]	[MHz]	[ns]	[MHz]
10	35,00	49,5	7,1	35,17	10,0	35,01	10,0	35,01	10,0	35,00	10,0
100	3,50	35,2	10,0	4,95	70,7	3,64	96,2	3,57	98,1	3,52	99,5
350	1,00	35,0	10,0	3,64	96,2	1,41	247,5	1,22	286,7	1,06	330,4
500	0,70	35,0	10,0	3,57	98,1	1,22	286,7	0,99	353,6	0,78	447,2
1000	0,35	35,0	10,0	3,52	99,5	1,06	330,4	0,78	447,2	0,49	707,1

Hvala za pozornost!

LINUX VIRTUALIZATION

Presentation for the international conference IKTEM

Žiga Lausegger, prof. fizike in tehnike
Pistam d.o.o.
ziga@pistam.com

Keywords: Linux, hypervisor, virtual machine, client, remote, local

Ljubljana, June 2021

1 ACRONYMS

OS operating system ∞

VM virtual machine ∞

HDD hard disk drive ∞

SSD solid state drive ∞

SSH secure shell protocol ∞

IP internet protocol address ∞

RSA Rivest–Shamir–Adleman encryption ∞

GUI graphical user interface ∞

CLI command line interface ∞

CPU central processing unit ∞

Slide 2

2 INSTALLING DEBIAN 11 ON THE SERVER

Debian installation is not part of this presentation, but here are some tips.

- (OS) Debian 11 (*stable*) will release around september 2021.
- Currently OS is in *testing* phase but it's installation medium can be obtained online. ∞
- We download it and install it (*no desktop*) on machine i.e. `ziga--hypervisor`.
- During installation we create two users:
  - `ziga` (*normal user*),
  - `root` (*privileged user*).
- We also set up two SSD:
  - 1st for OS
  - 2nd for storing VM.

When installation is finished we reboot the `ziga--hypervisor`.

3 USER

- When installation finishes we localy login on `ziga--hypervisor` with user `root`.
- User `ziga` will manage (VM) and needs elevated privileges!

```
root@ziga--hypervisor:~# apt install sudo
root@ziga--hypervisor:~# echo "ziga ALL=(ALL:ALL) NOPASSWD:ALL" >> /etc/sudoers
root@ziga--hypervisor:~# exit
```

- We log out and continue as user `ziga`.

4 SSH -- INSTALLATION & CONFIGURATION

- We need a capable text editor.

```
ziga@ziga--hypervisor:~$ sudo apt install neovim
```

- SSH *client* is already installed.
- We install SSH *server* and edit it's configuration file.

```
ziga@ziga--hypervisor:~$ sudo apt install openssh-server
ziga@ziga--hypervisor:~$ sudo nvim /etc/ssh/sshd_config
```

Uncomment two lines:

```
Port 22
PermitRootLogin prohibit-password
```

- Restart SSH *daemon*:

```
ziga@ziga--hypervisor:~$ sudo systemctl restart sshd.service
```

5 SSH -- PREREQUISITES

- Check the `ziga--hypervisor`'s IP.

```
ziga@ziga--hypervisor:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eno1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether b4:2e:99:c6:b4:1e brd ff:ff:ff:ff:ff:ff
    altname enp0s31f6
    inet 192.168.64.104/24 brd 192.168.64.255 scope global dynamic eno1
       valid_lft 83082sec preferred_lft 83082sec
    inet6 fe80::b62e:99ff:fec6:b41e/64 scope link
       valid_lft forever preferred_lft forever
```

6 SSH -- PASSWORD AUTHENTICATION

- Test the SSH connection from our Linux *client* `ziga--workstation` using the *password authentication*.

```
ziga@ziga--workstation:~$ ssh ziga@192.168.64.104

The authenticity of host '192.168.64.104 (192.168.64.104)' can't be establish
ECDSA key fingerprint is SHA256:fyzFUfxuFceT2xHE++Ftv5HQl8gw1vt2hLRjpS2jZNk.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.64.104' (ECDSA) to the list of known hosts.
ziga@192.168.64.104's password: ************

ziga@ziga--hypervisor:~$
```

- However *password authentication* is insufficient for virtualization!
- And we set it not to work for user `root`.

```
ziga@ziga--workstation:~$ ssh root@192.168.64.104
root@192.168.64.104's password: ************
Permission denied, please try again.
```

Slide 7

7 SSH -- KEY-PAIR AUTHENTICATION

- SSH *key-pair authentication* enables us not to write passwords when remotely connecting over SSH.
- SSH *key-pair* is *client* based i.e. `ziga--workstation` has one *public key* which it deploys on multiple *servers*! He also has a *private key* that he keeps for himself and uses it to authenticate with deployed *public keys*!

7.1 CREATE & DEPLOY KEY-PAIR

- We first create an RSA *key-pair* on *client* `ziga--workstation`.

```
ziga@ziga--workstation:~$ ssh-keygen -t rsa
```

- Copy *public key* `~/.ssh/id_rsa.pub` to *server* `ziga--hypervisor` and copy it's content to `~/.ssh/authorized_keys`.

```
ziga@ziga--workstation:~$ scp ~/.ssh/id_rsa.pub ziga@192.168.64.104:/home/ziga
ziga@ziga--workstation:~$ ssh ziga@192.168.64.104
ziga@ziga--hypervisor:~$ mkdir ~/.ssh && touch ~/.ssh/authorized_keys
ziga@ziga--hypervisor:~$ cat id_rsa.pub >> ~/.ssh/authorized_keys && rm id_rsa.pub
ziga@ziga--hypervisor:~$ chmod -R 700 ~/.ssh
ziga@ziga--hypervisor:~$ chmod -R 600 ~/.ssh/authorized_keys
```

7.2 TEST KEY-PAIR AUTHENTICATION

- Now we can connect to the *server* `ziga--hypervisor` from *client* `ziga--workstation` without password, using only *key-pair authentication*!

```
ziga@ziga--workstation:~$ ssh ziga@192.168.64.104
ziga@ziga--hypervisor:~$
```

- This also works for user `root`.

```
ziga@ziga--workstation:~$ ssh root@192.168.64.104
root@ziga--hypervisor:~#
```

8 HYPERVISOR SETUP

- *Hypervisor* is a *server* program that can host VM.

8.1 INSTALLING THE PACKAGES

- We connect to the *server* `ziga--hypervisor` and install packages:

```
ziga@ziga--hypervisor:~$ sudo apt install \
qemu \
virt-manager \
virt-viewer \
xserver-xorg-core \
xserver-xorg-video-intel \
xinit \
libvirt-daemon
```

- We start the *daemon* needed by GUI program `virt-manager`.

```
ziga@ziga--hypervisor:~$ sudo systemctl enable libvirtd.service
ziga@ziga--hypervisor:~$ sudo systemctl start libvirtd.service
```

Slide 10

8.2 ADDING USER IN PROPER GROUPS

- If *server's* user `ziga` wants to start `virt-manager` without password he needs to be in group `libvirt`.

```
ziga@ziga--hypervisor:~$ sudo usermod -a -G libvirt ziga
```

- We disconnect & reconnect to the *server* `ziga--hypervisor` in order for group to apply.

8.3 GUI TEST -- WINDOWS

- Linux *clients* with X graphical server & SSH *client* installed can now execute command to open *server's* `virt-manager` and transfer it's GUI over network, figure 1.

```
ziga@ziga--workstation:~$ ssh -Y ziga@192.168.4.104 virt-manager
```

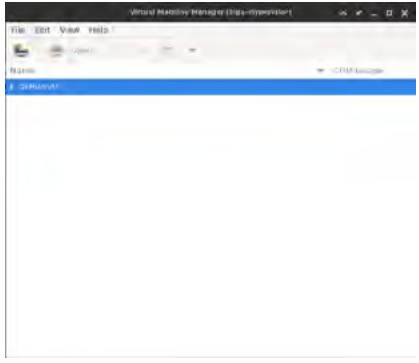


Figure 1: GUI of `virt-manager` transfered from *server* `ziga--hypervisor` to *client* `ziga--workstation` over network.

Slide 12

8.4 GUI TEST -- WINDOWS

- Windows *clients* natively don't have X graphical server installed, but we can install it with package `vcxsrv`. ∞
- We start program `xlaunch` from Windows start menu. We then select *multiple windows* and click Next. Then we select *start no client* and click Next twice and then Finish. X server will start running on our Windows *client*!
- Install and open program `Putty` ∞.
  - Navigate to the tab *SSH* and *X11*. Put check mark in field *Enable X11 forwarding*.
  - Navigate to the tab *Session*, set field *Host name* to `192.168.64.104` and click Open.
  - We insert a password and Windows *client* will login to the *server*.
- We can now run application `virt-manager` in order to see it's GUI being transfered over network to our Windows *client*. It will look the same as on the Linux *client*, figure 1.

8.5 CREATING HYPERVISOR'S BRIDGE NETWORK

- Linux network interfices i.e. `eno1` can only be used by one device.
- First VM to use `eno1` gets access to network. Others dont!
- We need a *bridge* that will split acces to the `eno1` between multiple VM and therefore connect:
  - VM between each other,
  - VM to the *server* `ziga--hypervisor`,
  - VM to the machines on physical network of the *server*,
  - VM to the internet.

8.5.1 INSTALLING NETWORK MANAGER

- We will use *network manager* named `network-manager` and it's strongest CLI frontend `nmcli`.

```
ziga@ziga--hypervisor:~$ sudo apt install network-manager
```

- Note that initially `network-manager` can't manage network interface `eno1`.

```
ziga@ziga--hypervisor:~$ nmcli device
DEVICE  TYPE      STATE      CONNECTION
eno1    ethernet  unmanaged  --
lo      loopback  unmanaged  --
```

- Even explicitly commanding `network-manager` to manage `eno1` fails.

```
ziga@ziga--hypervisor:~$ sudo nmcli device set eno1 managed yes
ziga@ziga--hypervisor:~$ nmcli device
DEVICE  TYPE      STATE      CONNECTION
eno1    ethernet  unmanaged  --
lo      loopback  unmanaged  --
```

- This is because `eno1` is already managed by Debian's default *network manager*.

Slide 15

- Debian's default *network manager* uses a configuration file `/etc/network/interfaces`. We open it and comment out lines containing `eno1`, listing 1.

```
1  source /etc/network/interfaces.d/*
2
3  auto lo
4  iface lo inet loopback
5
6  #allow-hotplug eno1
7  #iface eno1 inet dhcp
```

Listing 1: `/etc/network/interfaces`

- We can now restart the `network-manager`'s *daemon* and it will start managing the `eno1`.

```
ziga@ziga--hypervisor:~$ sudo systemctl restart NetworkManager.service
ziga@ziga--hypervisor:~$ nmcli device
DEVICE  TYPE      STATE                   CONNECTION
eno1    ethernet  connected (externally)  eno1
lo      loopback  unmanaged
```

8.5.2 CREATING A BRIDGE

- We add a *connection* `virtual_bridge_connection` of type *bridge* to the device `virtual_bridge`. This device does not yet exist and is created alongside the *connection*.

```
ziga@ziga--hypervisor:~$ sudo nmcli connection \
   add ifname virtual_bridge \
   type bridge \
   con-name virtual_bridge_connection
```

- We add another *connection* `virtual_bridge_slavery` to the interface `eno1`. This *connection* enslaves interface `eno1` to it's master i.e. `virtual_bridge`.

```
ziga@ziga--hypervisor:~$ sudo nmcli connection \
   add ifname eno1 \
   master virtual_bridge \
   type bridge-slave \
   con-name virtual_bridge_slavery
```

Slide 17

- Now we have to shut down the connection `virtual_bridge_slavery` and start the connection `virtual_bridge_connection` that will enslave interface `eno1`.
- To do this we will use a `bash` script, listing 2, that establishes a static IP for `virtual_bridge_connection`.

```
#!/bin/bash
nmcli connection down virtual_bridge_slavery
nmcli connection modify virtual_bridge_connection ipv4.addresses 192.168.64.104/24
nmcli connection modify virtual_bridge_connection ipv4.gateway 192.168.64.1
nmcli connection modify virtual_bridge_connection ipv4.dns 8.8.8.8
nmcli connection modify virtual_bridge_connection ipv4.method manual
nmcli connection up virtual_bridge_connection
```

Listing 2: `~/restart_interface.bash`

- We make script executable and execute it as `root` user.

```
ziga@ziga--hypervisor:~$ sudo chmod +x ./restart_interface.bash
ziga@ziga--hypervisor:~$ su
Password: ************
root@ziga--hypervisor:~# bash ./restart_interface.bash
```

- We will loose the connection with the *server* but when *server* is back online we can again connect to it using SSH.

- We can now confirm a working status of the *bridge* `virtual_bridge`.

```
ziga@ziga--hypervisor:~$ nmcli device
DEVICE          TYPE      STATE      CONNECTION
virtual_bridge  bridge    connected  virtual_bridge_connection
eno1            ethernet  connected  virtual_bridge_slavery
lo              loopback  unmanaged  --
```

- VM will not access `eno1` directly anymore, but indirectly through it's master `virtual_bridge`. This will enable all VM to simultaneously access the network as if they were separate physical machines!

9 VIRTUAL DISK IMAGE CREATION

- We create an empty virtual disk image in `.qcow2` format.

```
ziga@ziga--hypervisor:~$ mkdir ~/vm
ziga@ziga--hypervisor:~$ qemu-img create -f qcow2 ~/vm/disk_image.qcow2 40G
```

- We download some installation image in `.iso` format.

```
ziga@ziga--hypervisor:~$ mkdir ~/iso
ziga@ziga--hypervisor:~$ wget -P ~/iso https://example_page/example_operating_system.iso
```

10 VM MANAGEMENT USING GUI

- Let's demonstrate the VM management through `virt-manager`'s GUI (*hosted over network*)…

11 TAKEAWAYS

- There is no more need to invest money in `vmware` …
- Debian 11 runs on ARM CPU… ∞
- ARM CPU currently include up to 128 cores… ∞
- ARM *servers* already exist in a multi CPU configurations… ∞
- ARM *servers* are adopted by large manufactureres like Gigabyte… ∞

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

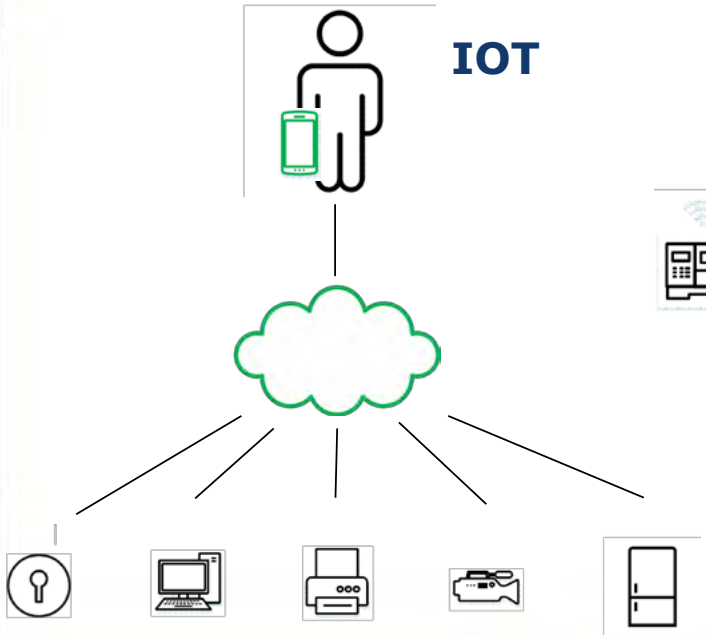
konferenca IKT EM

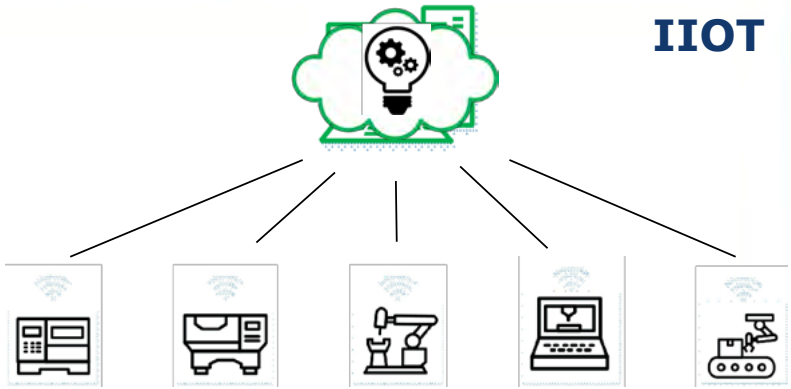
IoT and Digital Twin Production Guiding Concept

Jernej Protner, Niko Herakovič

University of Ljubljana, Faculty of Mechanical Engineering,
Laboratory LASIM

CONTROL STRUCTURE

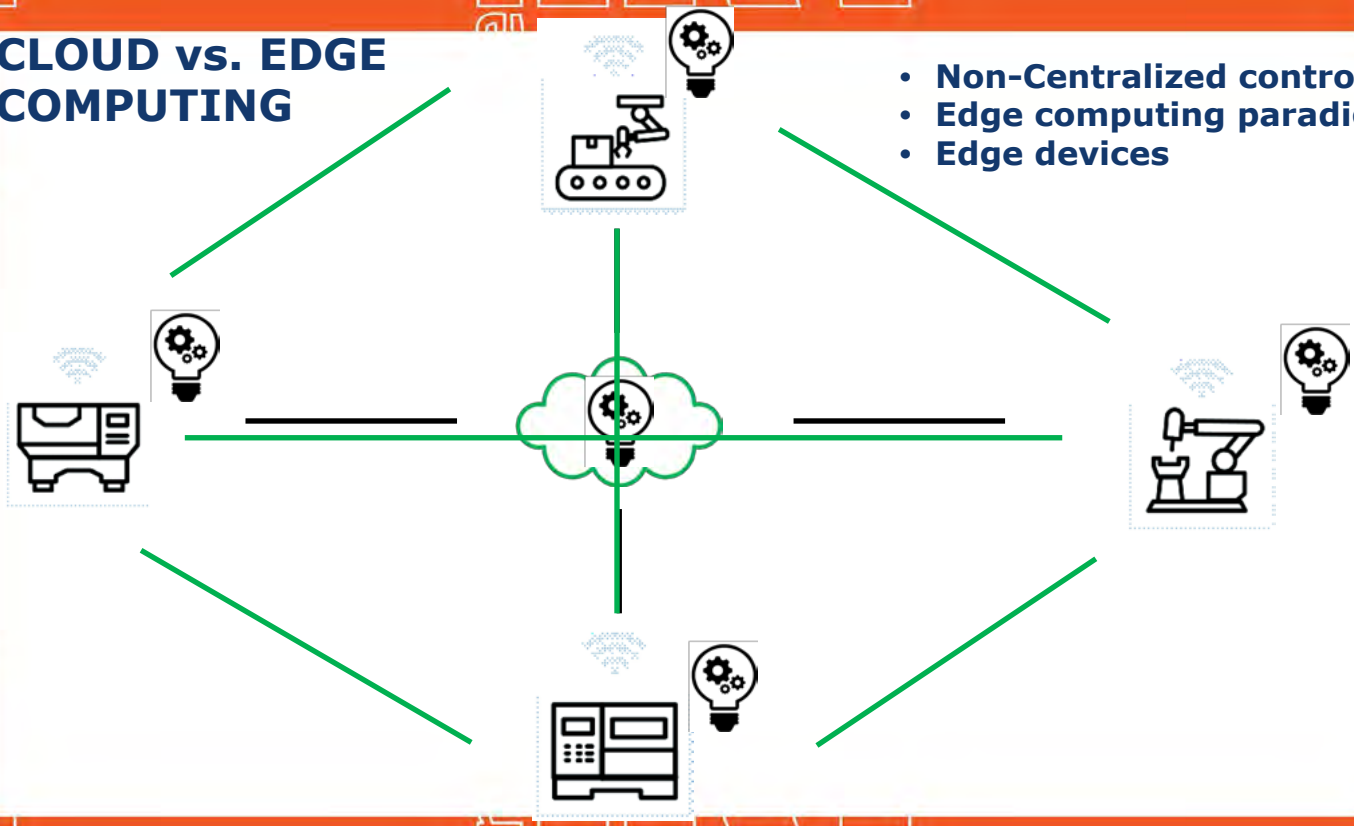




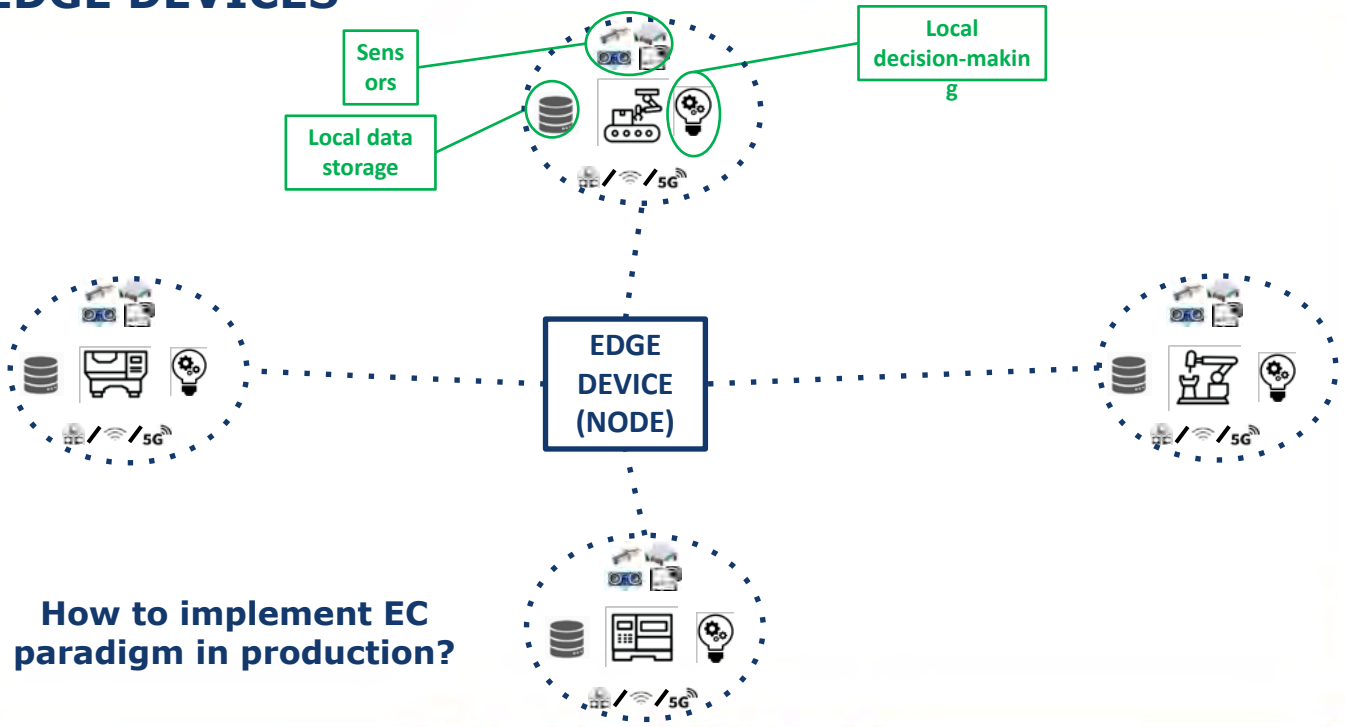
- Centralized control
- Higher computational power ☐ Cloud computing
- Higher latency, delays
- Real-time decision making

CLOUD vs. EDGE COMPUTING

- Non-Centralized control
- Edge computing paradigm
- Edge devices



EDGE DEVICES



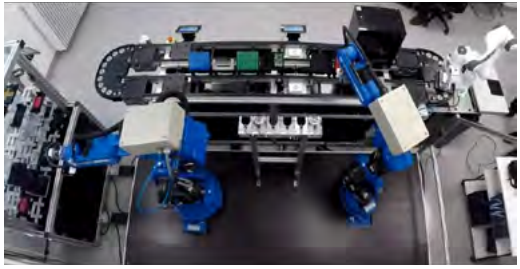
How to implement EC paradigm in production?

DIGITAL TWIN

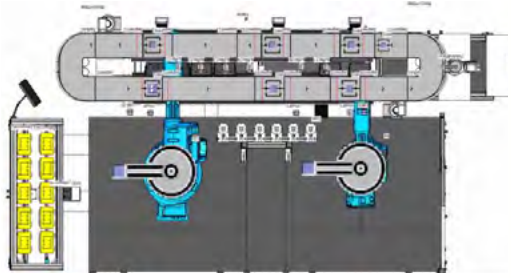
Digital model: A digital mapping of a physical system and its processes into a virtual environment.

Digital twin: Bi-directional connection of the physical system and the digital model by a feedback control loop.

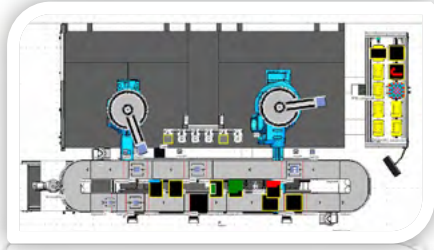
PHYSICAL SYSTEM



DIGITAL MODEL
VIRTUAL ENVIRONMENT



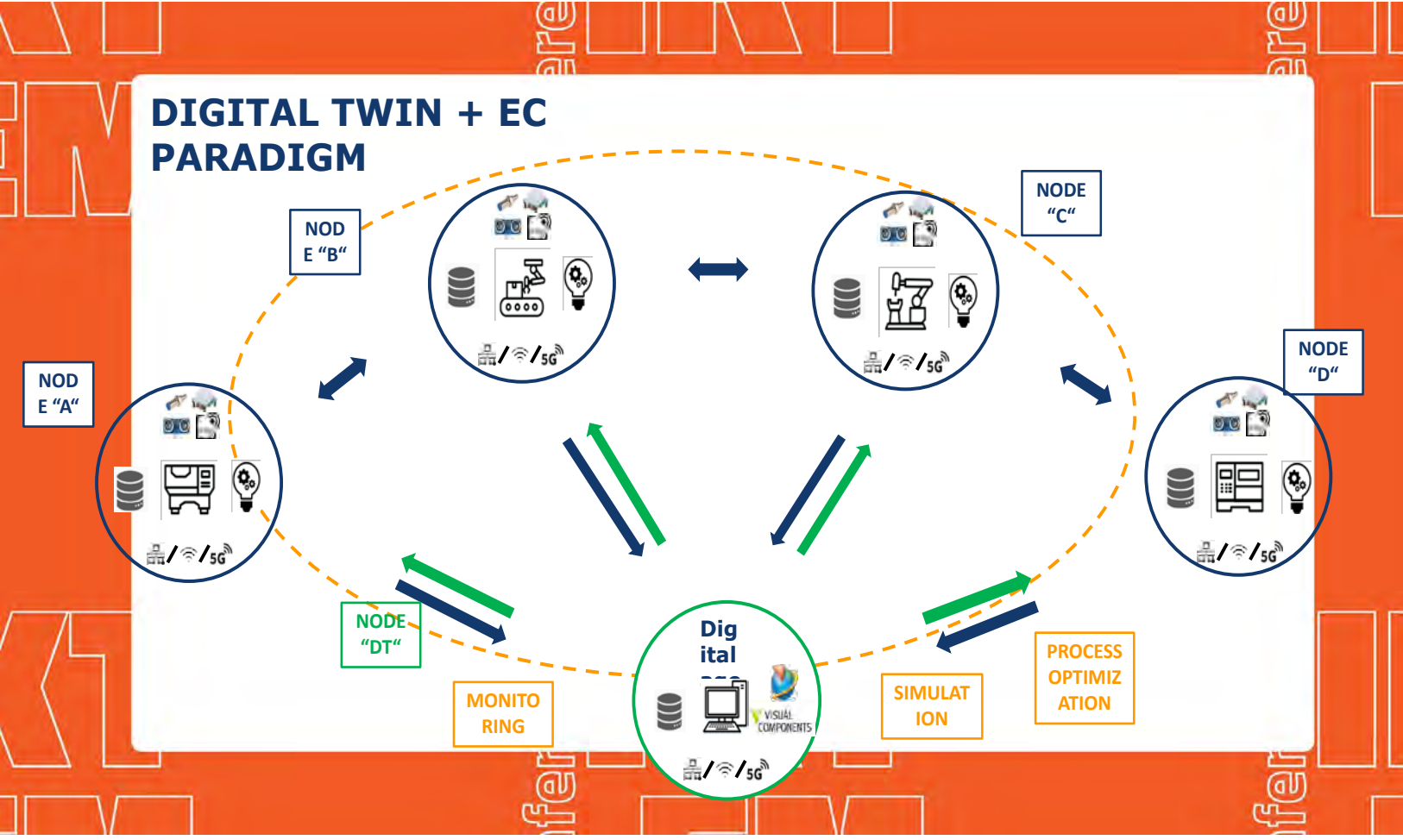
- **Simulation (DES)**
- **What-if scenarios**
- **Optimization**



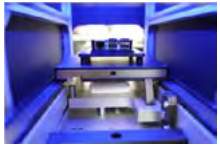
VISUAL COMPONENTS

SIEMENS

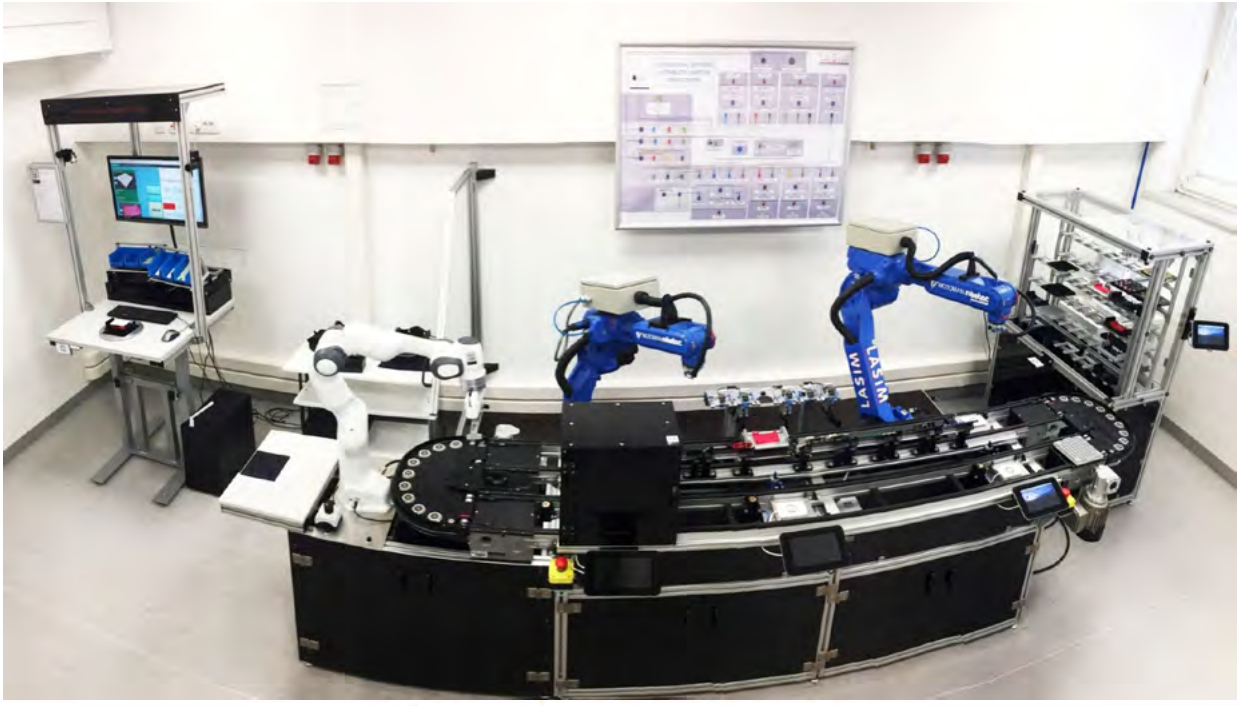
TECNOMATIX
Plant Simulation


DIGITAL TWIN + EC PARADIGM
NOD E "A"
NOD E "B"
NODE "C"
NODE "D"
NODE "DT"
Dig ital
VISUAL COMPONENTS
MONITO RING
SIMULAT ION
PROCESS OPTIMIZ ATION

Concept implementation in laboratory environment of the Demonstration Center Smart Factory Lasim



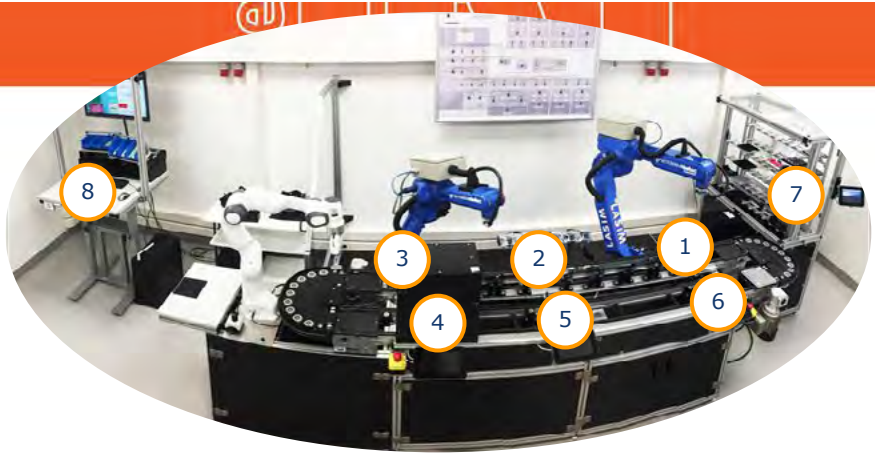
CONCEPT IMPLEMENTATION

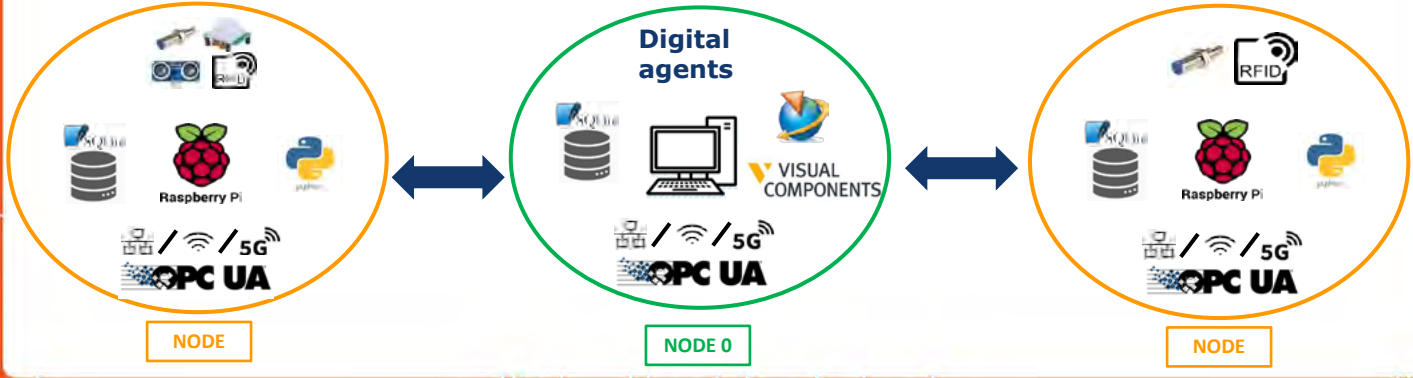


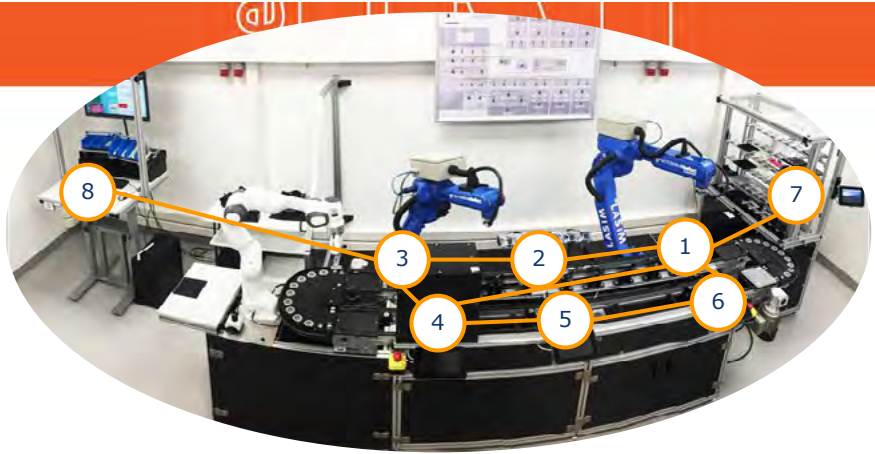
- Global digital agent (DA)
- DA for init state
- DA for order checking
- DA for order distribution on AS
- DA for robot task generation
- DA for disturbance prevention/elimination
- DA for order sequence optimization (FI algorithm)

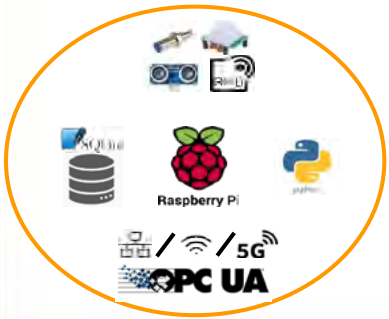
Products

NODE 0

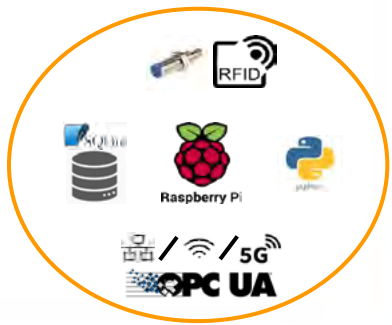

8
7
3
2
1
6
4
5


Raspberry Pi
5G
OPC UA
NODE
Digital agents
VISUAL COMPONENTS
5G
OPC UA
NODE 0
RFID
Raspberry Pi
5G
OPC UA
NODE

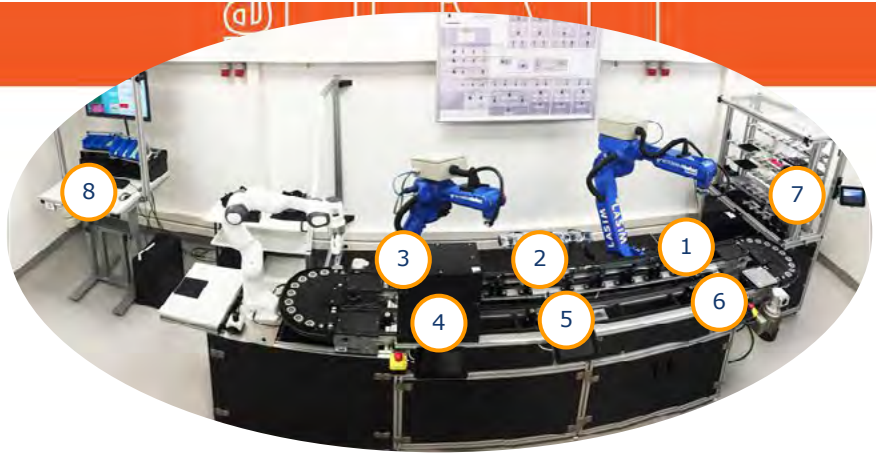


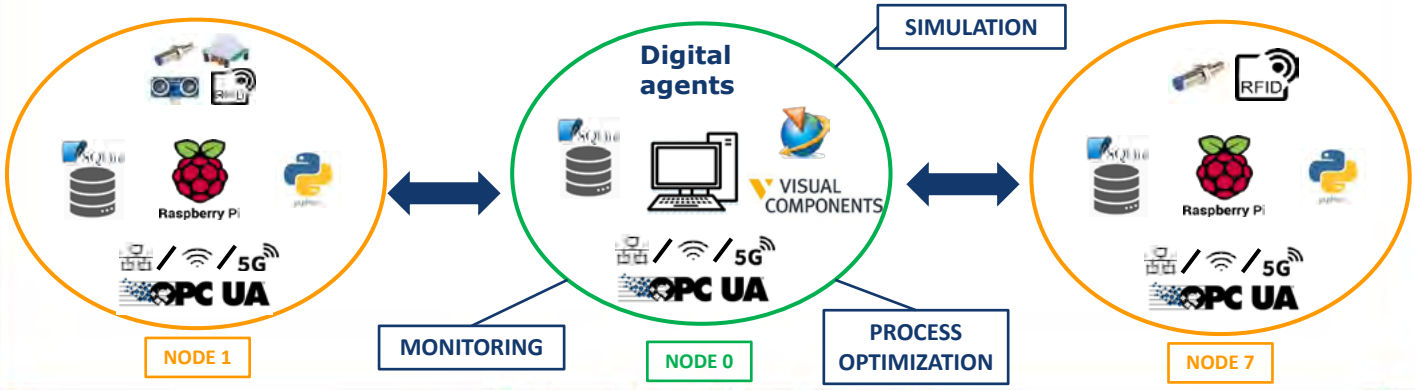


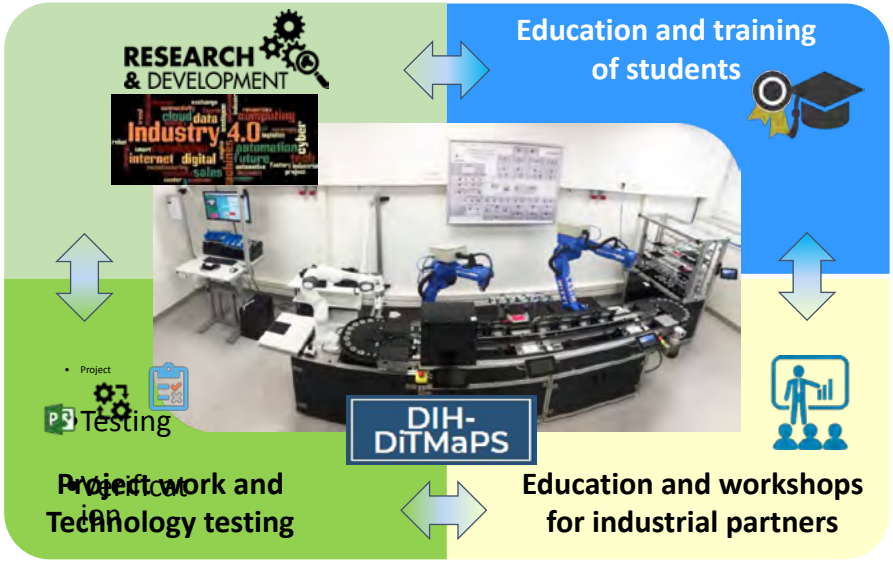
NODE 1



NODE 7


8
7
3
2
1
6
4
5


Raspberry Pi
5G
OPC UA
NODE 1
MONITORING
Digital agents
SIMULATION
VISUAL COMPONENTS
5G
OPC UA
NODE 0
PROCESS OPTIMIZATION
RFID
Raspberry Pi
5G
OPC UA
NODE 7



Thank you!

Jernej Protner
jernej.protner@fs.uni-lj.si

Niko Herakovič
niko.herakovic@fs.uni-lj.si

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

3D printing for the win

Jure Pigac

UNI MB GPE - Fakulteta za strojništvo, Univerza v Mariboru

FS Fakulteta za strojništvo

Univerza v Mariboru

UNI Maribor GPE Grand Prix Engineering

Content

- Formula Student
- 3D printing
- FDM
- DMLS
- Sand 3D printing
- SLA

Formula Student – UNI MB GPE

- International student competitions
- Goal: design, build and race with a formula style race car
- Static and dynamic disciplines
- Combustion, electric and driverless classes
- GPE – 10 years in formula student combustion

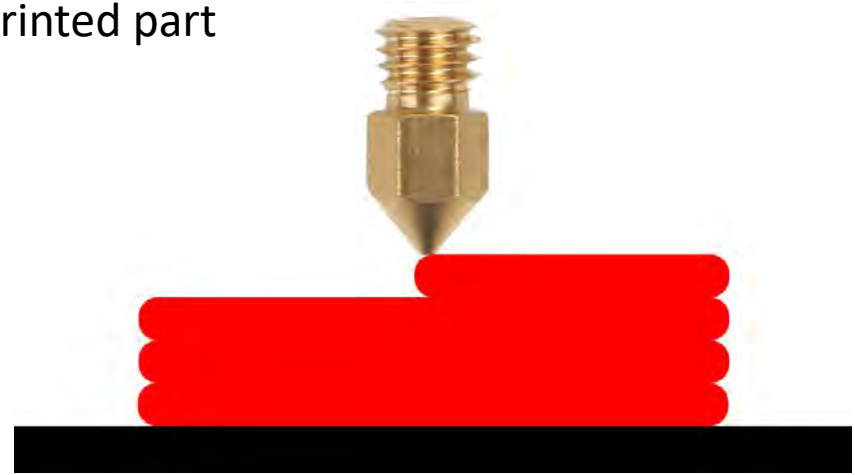
Formula Student – UNI MB GPE

Why 3D printing?

- For rapid prototyping and small-scale production
- Affordable
- Can create complex shapes

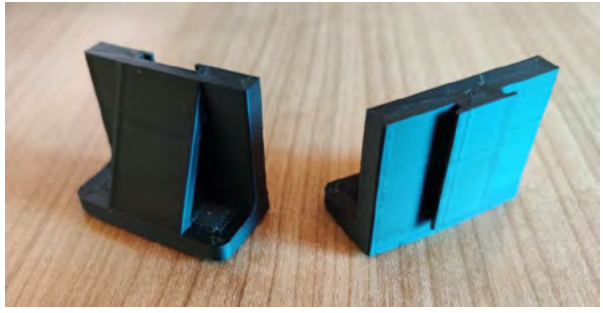
3D printing

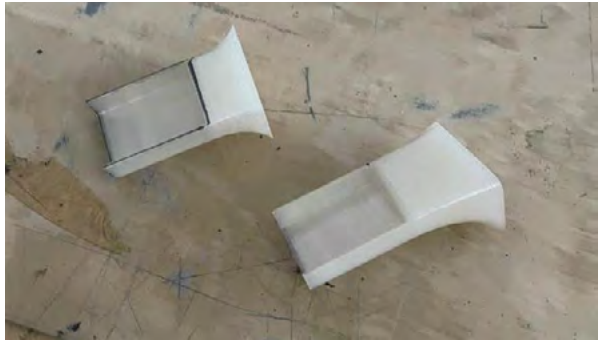
- 3D printing - additive manufacturing
- Adding material layer by layer
- CAD -> G-code -> Printed part
- Different materials



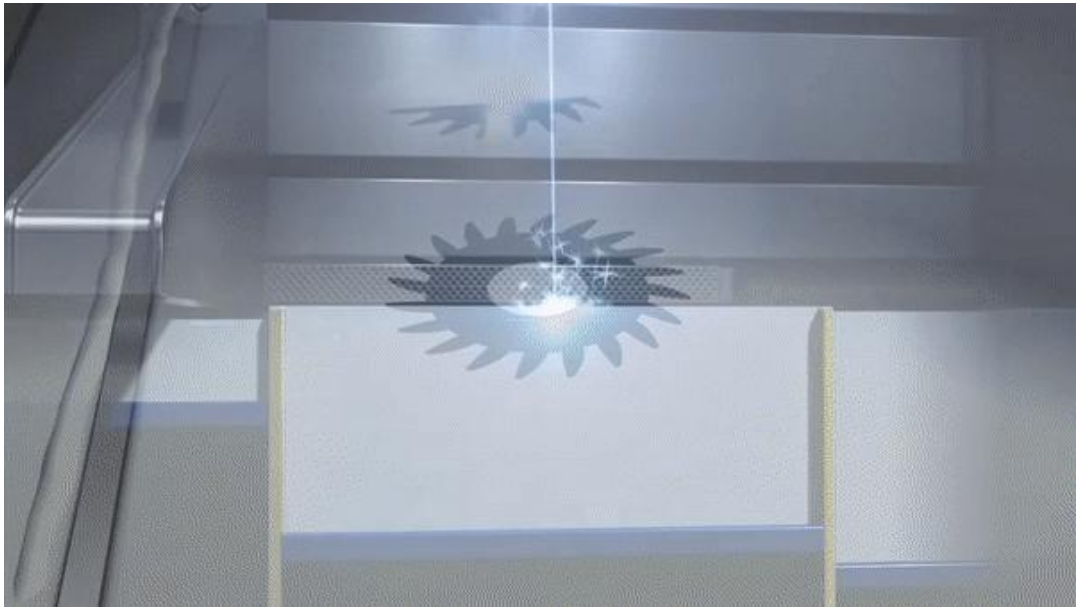
FDM - fused deposition modeling

- What?
  - Brackets
  - Housings
- Why?
  - Custom made parts
  - Very affordable
  - Fast and easy
- How?
  - Creality Ender 3
  - PLA & HTPLA





DMLS -Direct Metal Laser Sintering



DMLS -Direct Metal Laser Sintering

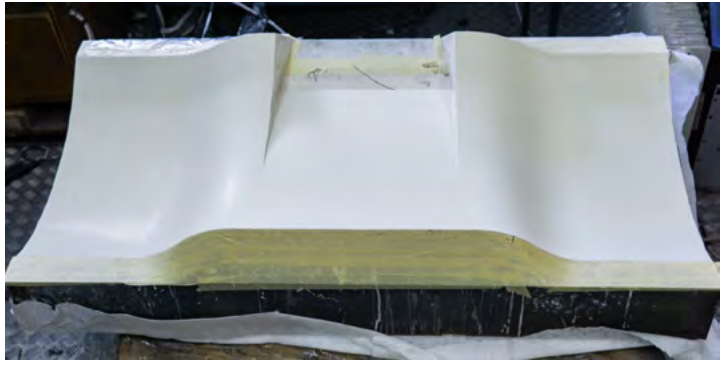
- What?
  - Brackets
  - Steering mechanism
- Why?
  - Complex geometry
- How?
  - MARSi group
  - Stainless steel

Sand 3D printing

- What?
  - Molds
- Why?
  - Complex geometry
  - Desired thermal properties
- How?
  - Roto Group

Sand 3D printing

Sand molds for composite parts

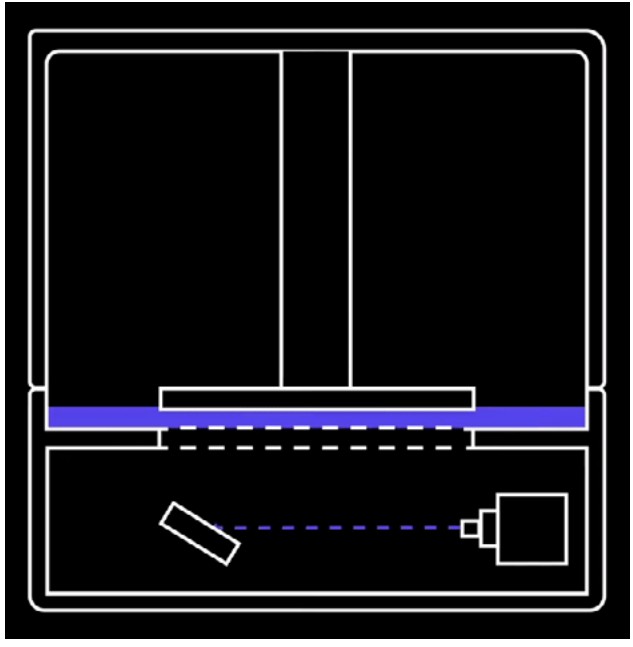


Sand 3D printing

Used for:

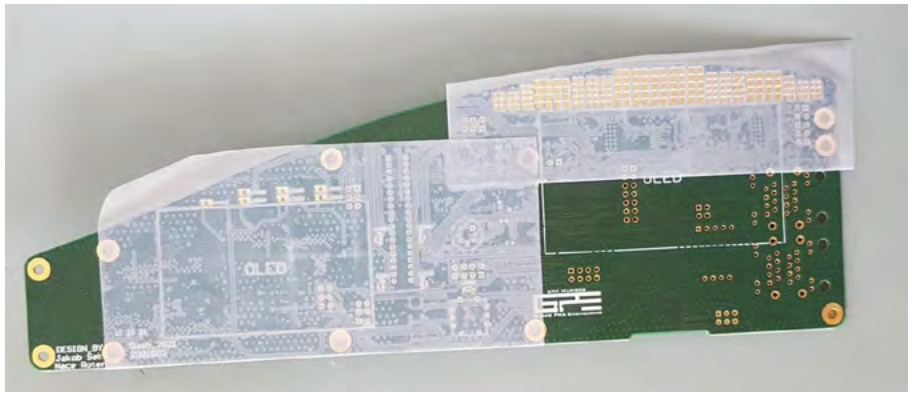
- Aerodynamics
- Chassis
- Powertrain

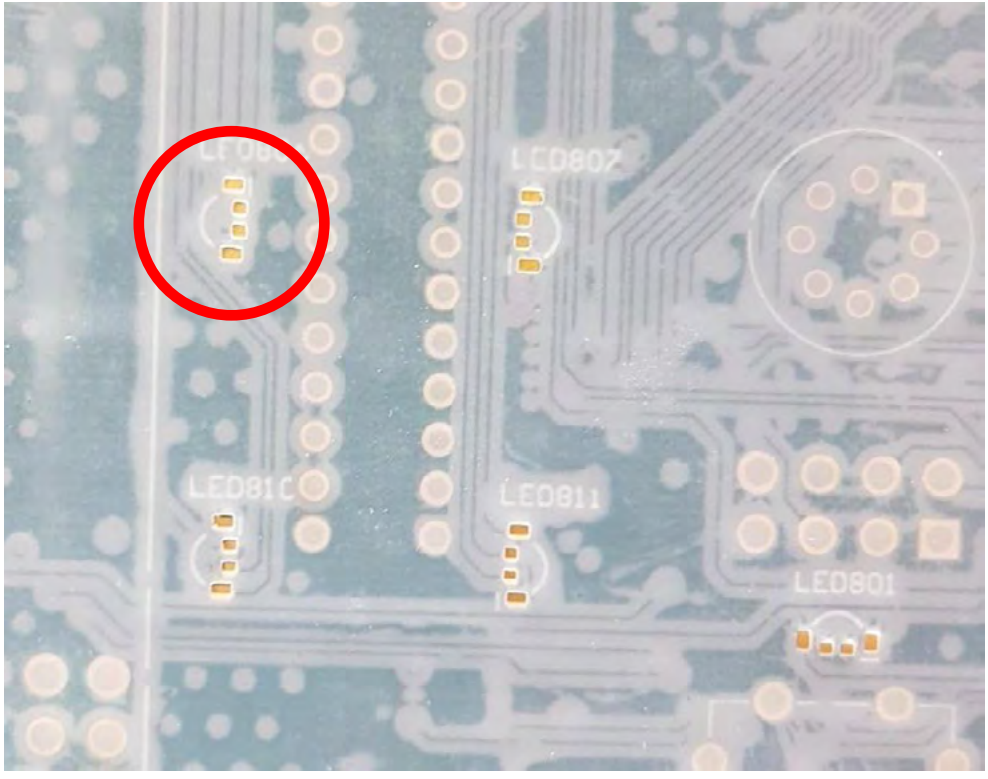
SLA - Stereolithography



SLA - Stereolithography

- What?
  - PCB stencils
- Why?
  - High accuracy
  - Affordable
  - Fast and easy
- How?
  - Auralix
  - Anycubic Mono SE
  - 3D Jake resin
  - No bed, 2 s exposure




LED807
LED81C
LED811
LED801

Thank you for your attention!

gpe.uni.mb

@unimbgpe

http://gpe.fs.um.si/sl/

formula.student@um.si

International Conference for
ICT, Electronics & Mechatronics IKTEM 2021

konferenca IKT EM

MECANUM Electric Vehicles MB-1/2020

mag. Marjan Bezjak
Maribor, 17. 6. 2021

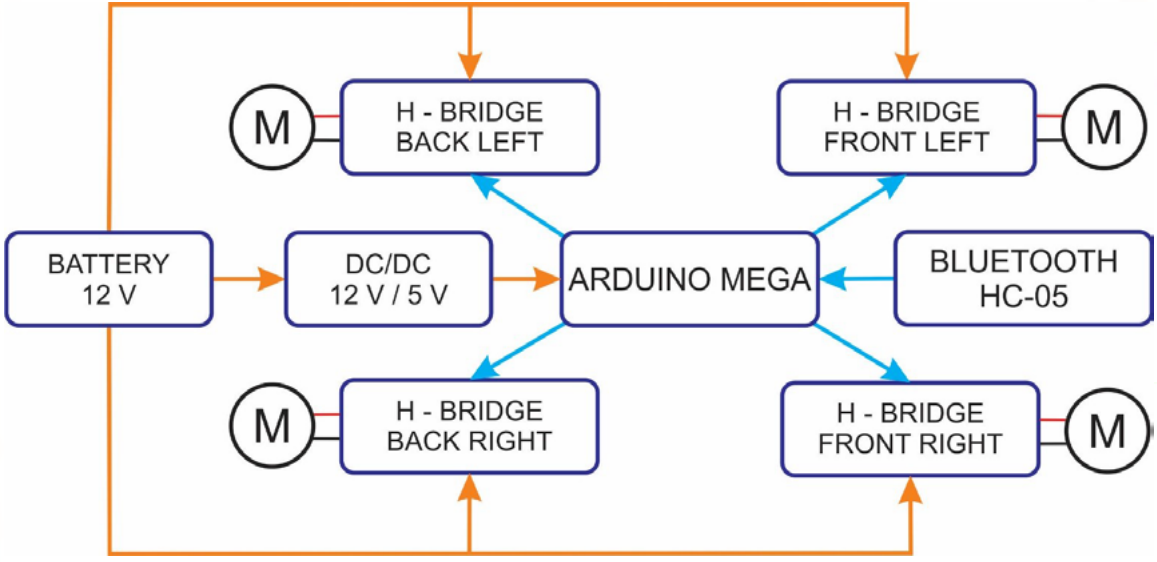
tehniški šolski center maribor TŠC

ARS AVTOMATIZACIJA RAZVOJ SVETOVANJE
Marjan Bezjak, s. p.

CONTENT

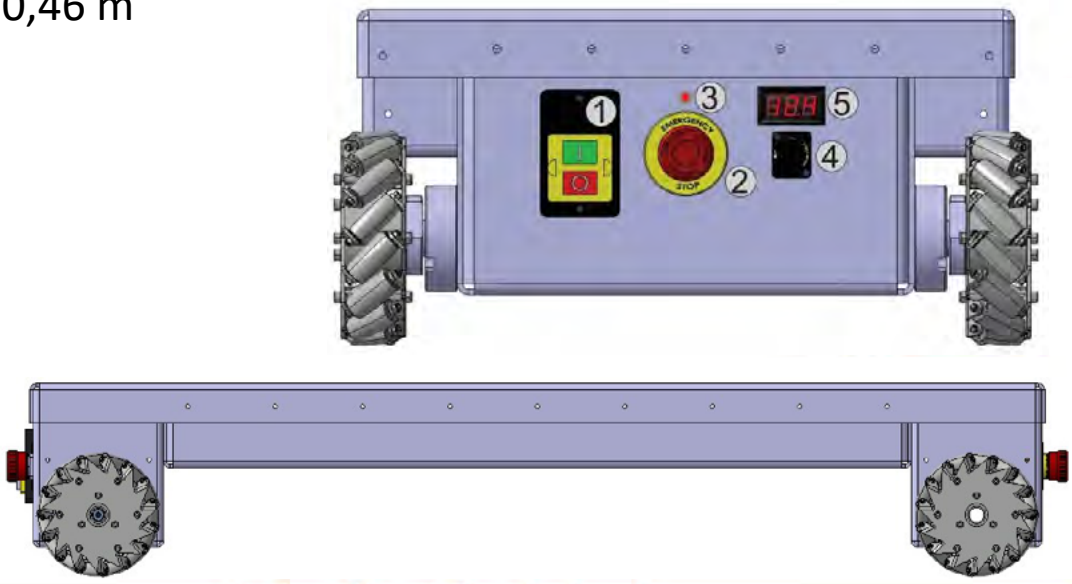
- BLOCK DIAGRAM
- CONSTRUCTION
- MECANUM WHEEL
- ANDROID APP
- ELECTRICAL PLAN
- DRIVE – CALCULATION
- ELECTRIC MOTORS
- H-BRIDGE: BTS7960
- SOFTWARE SOLUTION – ARDUINO
- PERFORMANCE TESTING
- PROTOTYPE WITH STEPPER MOTORS
- HUMAN MOTION TRACKING SENSOR
- QUESTIONS

BLOCK DIAGRAM



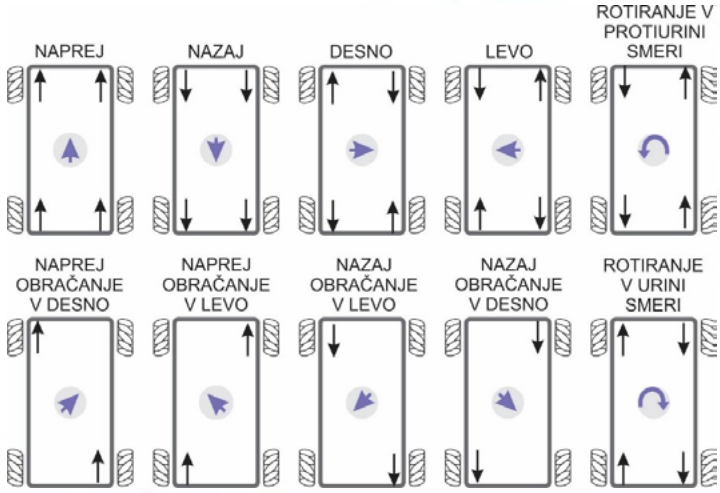
CONSTRUCTION

- 1,25 m x 0,46 m



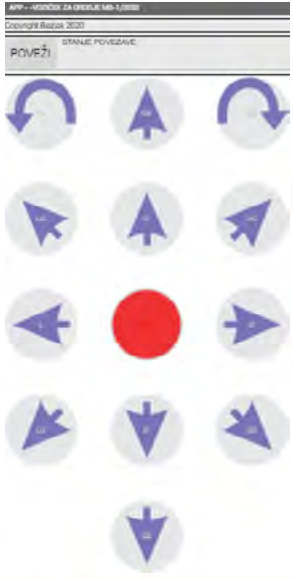
MECANUM WHEEL

- RobotShop.com
- 152 mm Mecanum Wheel Set
- Load capacity: 15 kg



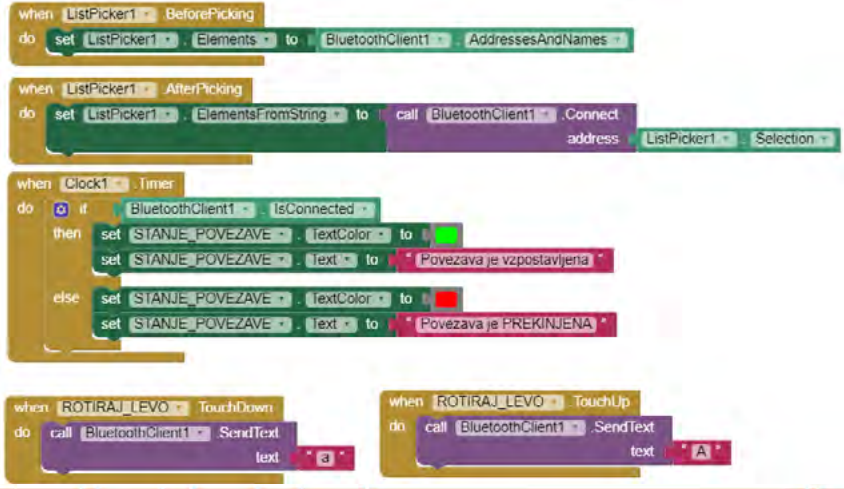
ANDROID APP / Designer

- MIT App Inventor
- Designer
  - Table
    - Create Buttons & Import
- Blocks

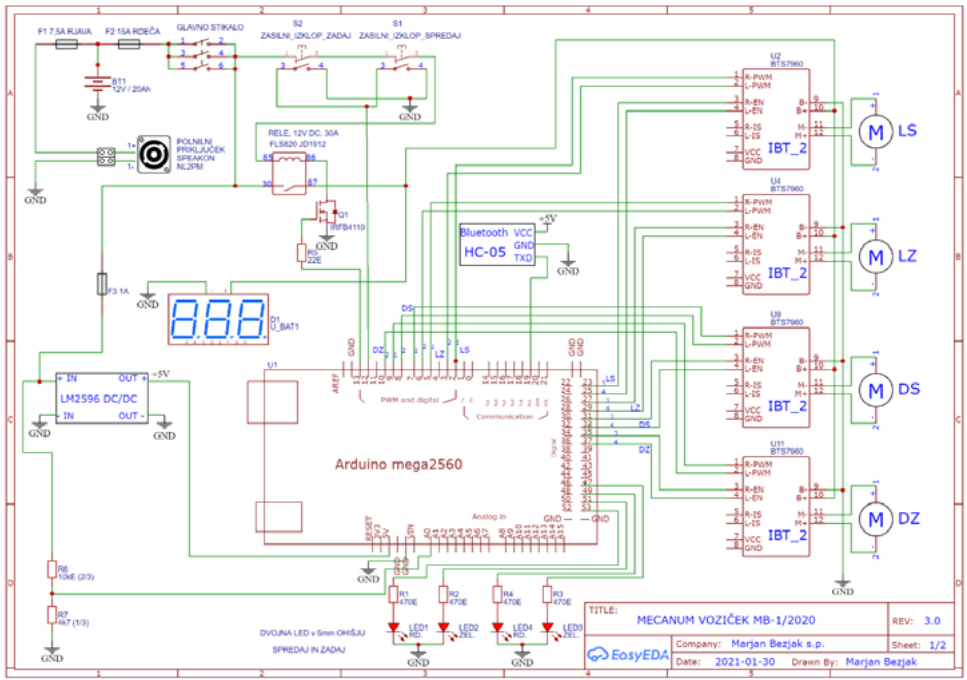


ANDROID APP / Blocks

- Bluetooth connection
- TouchDown / TouchUp
  - SendText

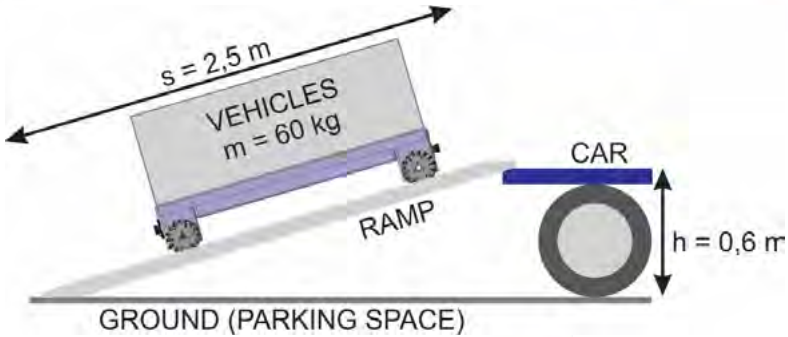


ELECTRICAL PLAN



DRIVE - CALCULATION

- Weight: *60 kg*
- Ramp slope
- Driving speed: *2 km/h*
- Friction μ



- <u>Power of electric motors</u> → → → →

$$P = F_d \cdot v = 145\ N \cdot 0,42 \frac{m}{s} = 60\ W$$

$$F_{tr} = F_s \cdot \mu = 582\ N \cdot 0,3 = 174\ N$$

$$P = F \cdot v = 319\ N \cdot 0,42 \frac{m}{s} = 134\ W$$

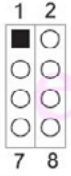
ELECTRIC MOTORS

- Brushed DC electric motor with worm gear
- Use: front windscreen wiper drive
- 60 RPM, P = 40 W (4 x … = 160 W)

- It is necessary to disconnect from housing!

H-BRIDGE: BTS7960

- **IBT_2**: BTS7960
- 43 A
- 6 V – 27 V
- PWM to 25 kHz



1、RPWM :Forward level or PWM signal input, active high
2、LPWM :Inversion level or PWM signal input, active high
3、R_EN :Forward drive enable input , high enable , low close
4、L_EN :Reverse drive enable input , high enable , low close
5、R_IS :Forward drive −side current alarm output
6、L_IS :Reverse drive −side current alarm output
7、VCC :+5 V power input,connected to the microcontroller 5V power supply
8、GND :Signal common ground terminal

SOFTWARE SOLUTION - ARDUINO

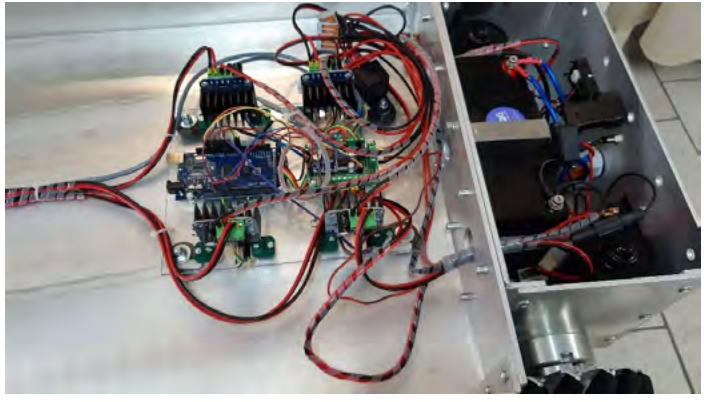
- ARDUINO MEGA
- Bluetooth HC-05

```
//Serijska komunikacija:
Serial.begin(9600);  // Komunikacija za izpis na serijski monitor (biti/s)
Serial1.begin(9600); // priklop Bluetooth modula HC-05 na Rx1 in Tx1 (biti/s)


// zacetne nastavitve v programu:
cas_za_PWM = 1;          // cas med povecevanjem in zmanjsevanjem PWM [milisekunde]
pristevamo = 2;          // uporabljamo za pristevanje k PWM (hitrost mehkega zagona)
odstevamo = 10;          // uporabljamo za odstevanje k PWM (hitrost mehkega pojemanja)
PWM_MAX_manjsi = 150;    // omogoca spreminjanje najvisje hitrosti za manjso hitrost
PWM_MAX_vecji = 255;     // omogoca spreminjanje najvisje hitrosti za vecjo hitrost
PWM_izklop_sp_meja = 30;// pri upocasnjevanju izklopi izpisovanje PWM in da PWM=0
```

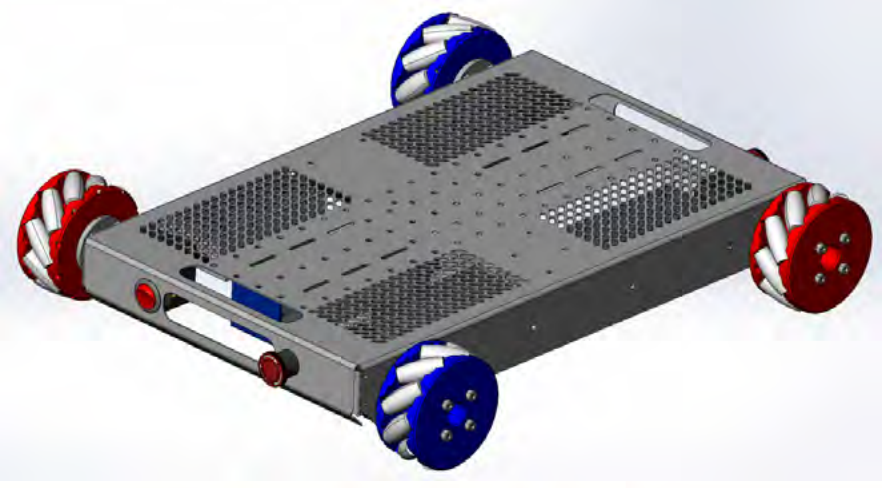
PERFORMANCE TESTING

- VIDEO: https://www.youtube.com/watch?v=0N5tnWIFPIE



PROTOTYPE WITH STEPPER MOTORS

- VIDEO: https://youtu.be/w8Mb9-96KCE



HUMAN MOTION TRACKING SENSOR

- VIDEO: https://youtu.be/ZbxVmMI_iHE
- AMG8833
  - IR 8x8 Thermal Imager Array Temperature Sensor Module

QUESTIONS ? ? ?

konferenca IKT EM

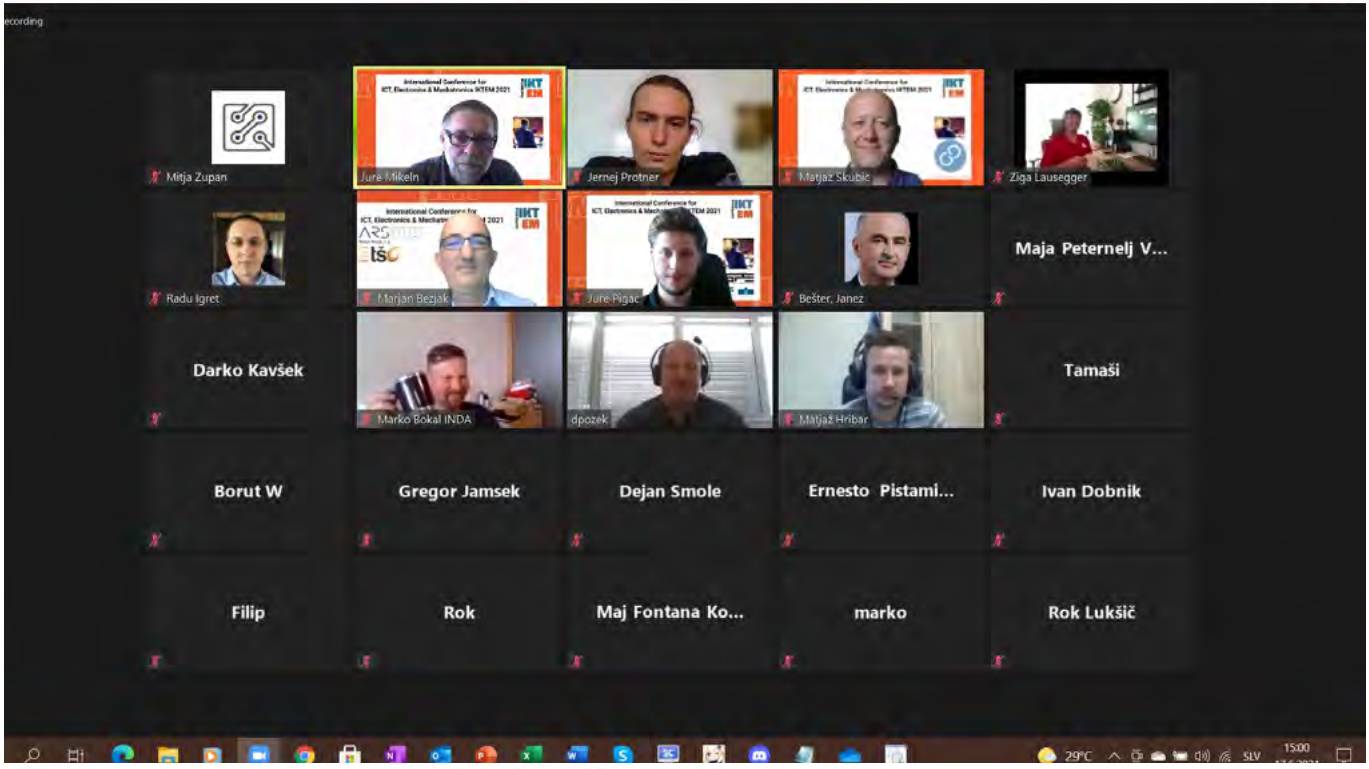
tehniški šolski center maribor

AVTOMATIZACIJA RAZVOJ SVETOVANJE

Marjan Bezjak, s. p.

marjan.bezjak@tscmb.si

marjan.bezjak@gmail.com


Mirja Zupan
Jure Mikeln
Jernej Protner
Matjaz Skubic
Ziga Lausegger
Radu Igret
Marjan Bezjak
Jure Pigac
Bešter, Janez
Maja Peternelj V...
Darko Kavšek
Marko Bokal INDA
dpozek
Matjaž Hribar
Tamaši
Borut W
Gregor Jamsek
Dejan Smole
Ernesto Pistami...
Ivan Dobnik
Filip
Rok
Maj Fontana Ko...
marko
Rok Lukšič

Sponzorji IKTEM 2021 konference

konferenca IKT EM

Zlati sponzor

Embedded system solutions
EmSiSo

Srebrni sponzorji

ATEA · A1 · QUECTEL · TIVTEC

Bronasti sponzorji

ADDProS · AMTEH

Sponzorji in partnerji konference

iCm · Gospodarska zbornica Slovenije · LTFE · LMMFE · IKT · ULJO · ELEKTRONIKE SVET · MEHATRONIKE SVET · VENTIL · FERI · ICTK · Računalniške novice · interreg CENTRAL EUROPE · Monitor · ellla · AX ELECTRONICA

Organizer:
AX elektronika d.o.o.
Depala vas 39
1230 Domžale / Slovenia
https://svet-el.si
00386 1 549 14 00

In collaboration with magazines:
Svet elektronike
&
Svet mehatronike