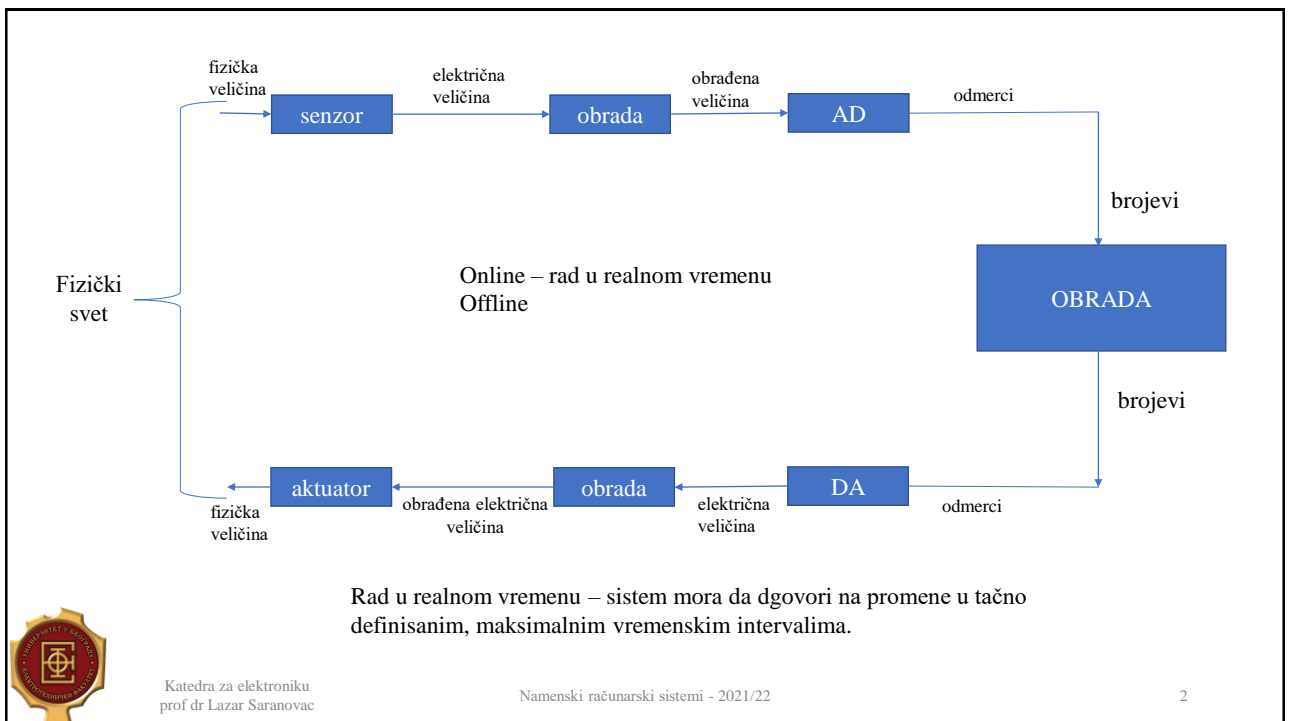


Namenski računarski sistemi



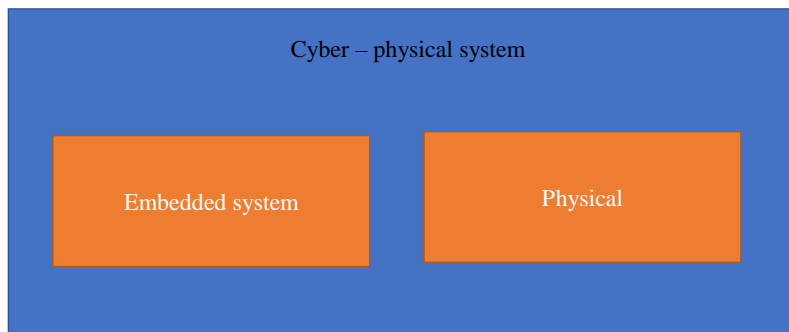
1



2

Cyber-Physical System

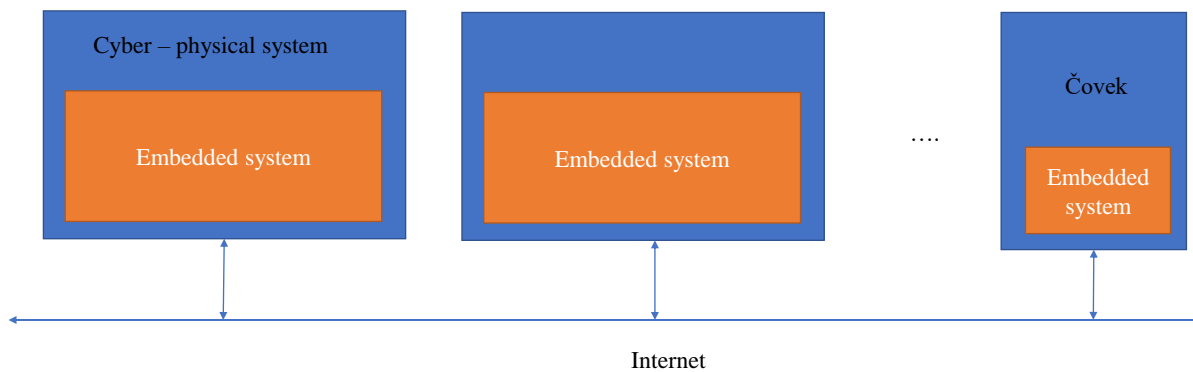
Integracija računara, mrežnih komunikacija i fizičkog procesa



3

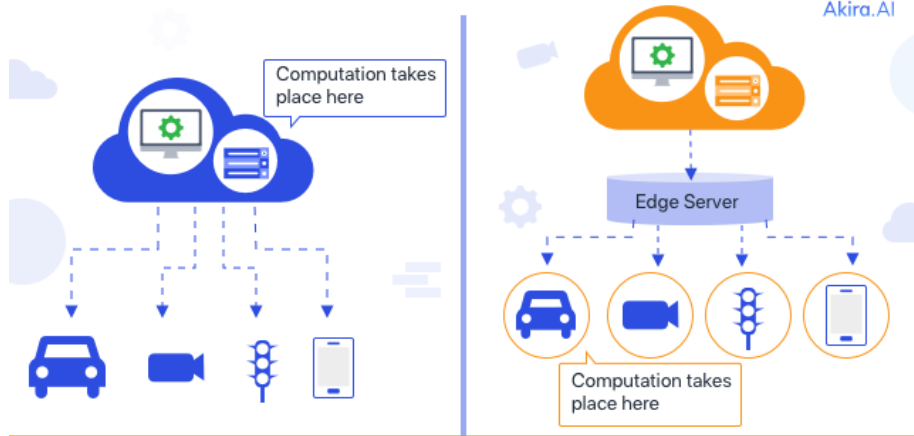
Internet of Things - IoT

Integracija različitih uređaja komunikacijom putem Interneta kako bi se ostvario zajednički cilj



4

Cloud Computing Vs Edge Computing



5

Location of Data Processing

- The Main Difference between edge computing, cloud computing, and fog computing is that edge computing is where data processing occurs.
- For Cloud computing, data is processed on the cloud server, located far away from the information source.
- Edge computing occurs most of the time our IoT sensors are connected.
- Fog Computing shifts the edge computing tasks connected to the LAN hardware or for LAN direct to be more distant to the sensors.



6

INDUSTRIAL IoT DATA PROCESSING LAYER STACK

CLOUD LAYER

Big Data Processing
Business Logic
Data Warehousing

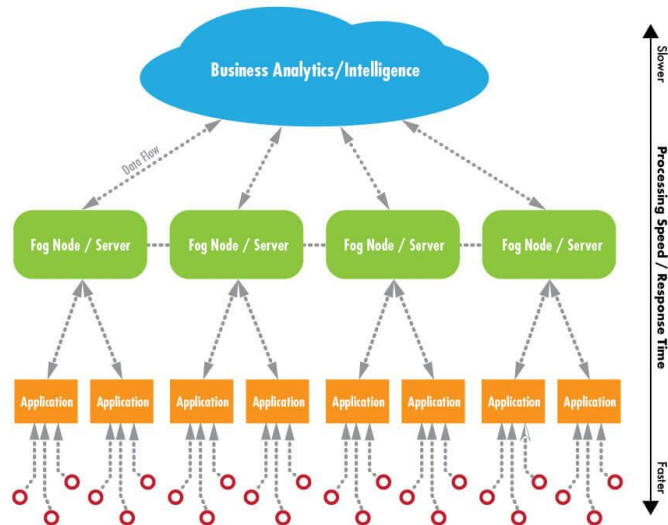
FOG LAYER

Local Network
Data Analysis & Reduction
Control Response
Virtualization/Standardization

EDGE LAYER

Large Volume Real-time Data Processing
At Source/On Premises Data Visualization
Industrial PCs
Embedded Systems
Gateways
Micro Data Storage

Sensors & Controllers (data origination)



7

What Is an Embedded System?

- “Any electronic device which uses a computer to perform a dedicated function” [1].
- A computer that is a component of a larger system [2].
- “Computer on a chip” [3].
- A not highly user programmable, application specific system [4].



8

Embedded systems

Namenski računarski sistemi

Embedded system – računarski sistem čija je svrha obavljanje specifičnog posla

Real-Time Embedded Systems

Soft Real Time Embedded Systems

Hard Real-Time Embedded Systems

Stand Alone Embedded Systems

Networked Embedded Systems

Mobile Embedded Systems



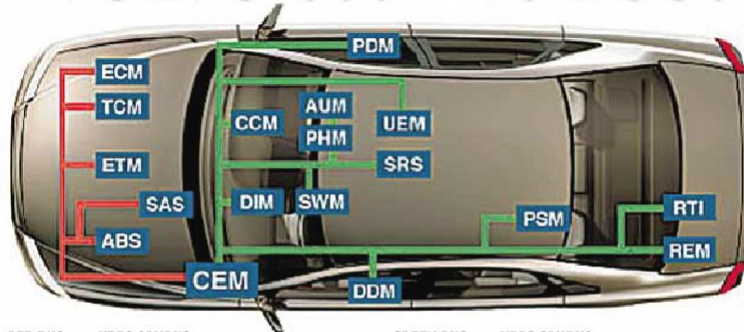
Katedra za elektroniku
prof dr Lazar Saranovac

Namenski računarski sistemi - 2021/22

9

9

VOLVO S80 – 18 ECUs



RED BUS=250-KBPS CANBUS.
ABS=ANTILOCK-BRAKING SYSTEM.
ECM=ENGINE-CONTROL MANAGEMENT.
ETM=ELECTRONIC TRANSMISSION CONTROL.
SAS=STEERING-ANGLE SENSOR.
TCM=THROTTLE-CONTROL MANAGEMENT.
GATEWAY: CEM=CENTRAL ELECTRONIC MODULE.

GREEN BUS=125-KBPS CANBUS.
AUM=AUDIO MODULE.
CCM=CLIMATE-CONTROL MODULE.
DDM/PDM=DRIVER-DOOR MODULE/PASSENGER-DOOR MODULE.
PHM=PHONE MODULE.
PSM=POWER-SEAT MODULE.
REM=REAR-ELECTRONICS MODULE.
RTI=ROAD-TRAFFIC INFORMATION.
SRS=SAFETY-RESTRAINT SYSTEM
SWM=STEERING-WHEEL MODULE.
UEM=UPPER ELECTRONIC MODULE.



Katedra za elektroniku
prof dr Lazar Saranovac

Namenski računarski sistemi - 2021/22

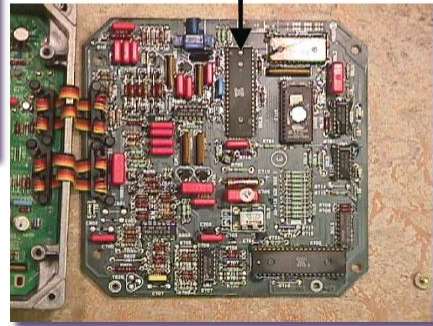
10

10

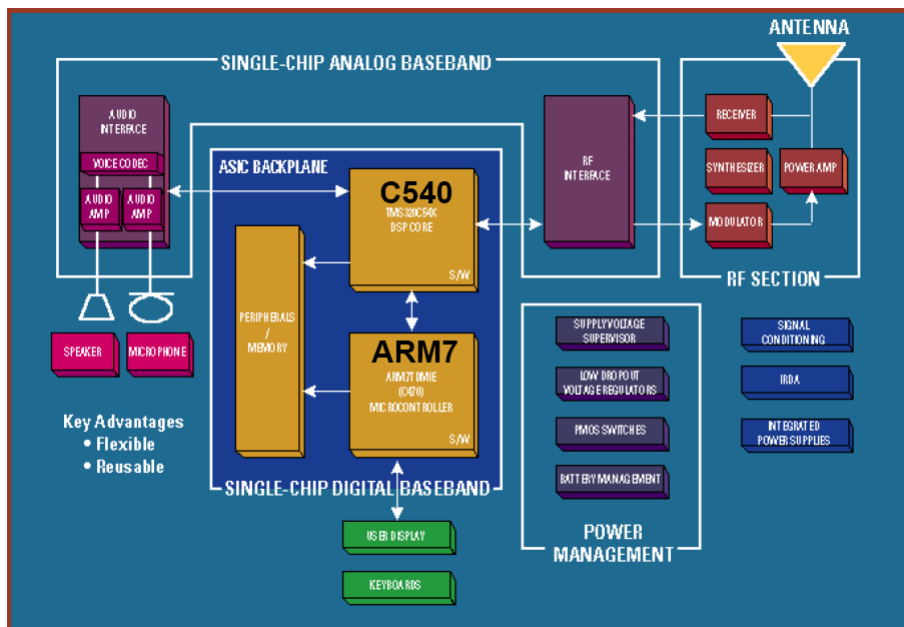
VOLVO Engine-Control ECU



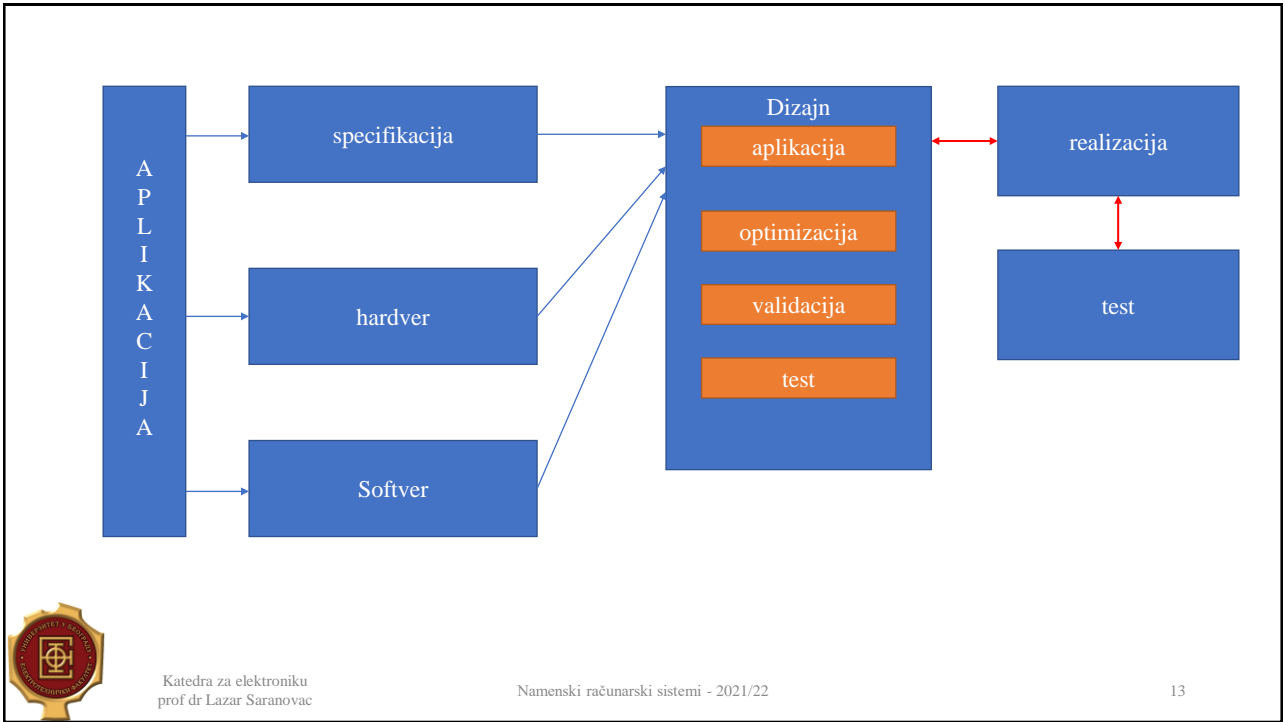
8-bit μ -processor



11



12



13

MIKROKONTROLER

System on Chip - SoC

- RAČUNAR REALIZOVAN U JEDNOM ČIPU
 - CPU
 - ROM – program (podaci)
 - RAM – podaci (program)
 - STANDARDNE PERIFERIJE
 - Paralelni portovi
 - Serijski portovi
 - Brojači
 -

Embedded processors

Signal processors

Mixed signal processors

Mixed signal controller

Katedra za elektroniku
prof dr Lazar Saranovac

Namenski računarski sistemi - 2021/22

14

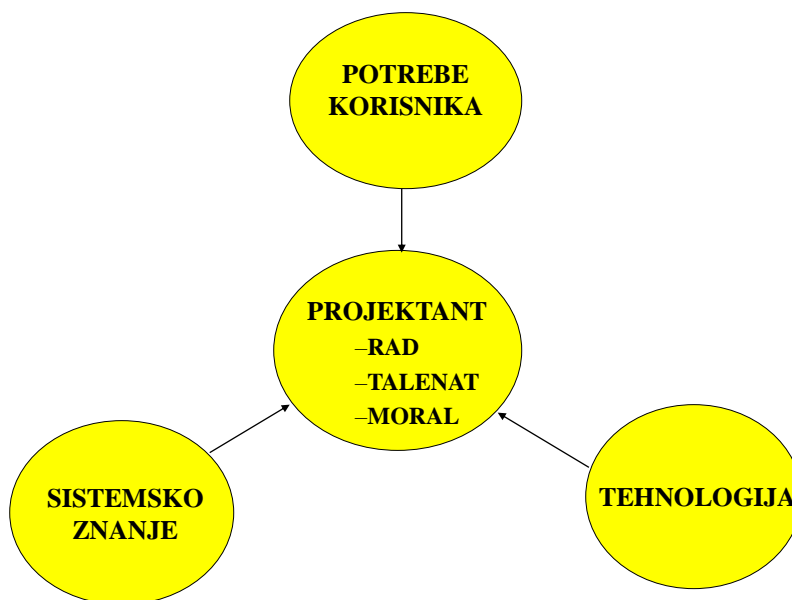
14

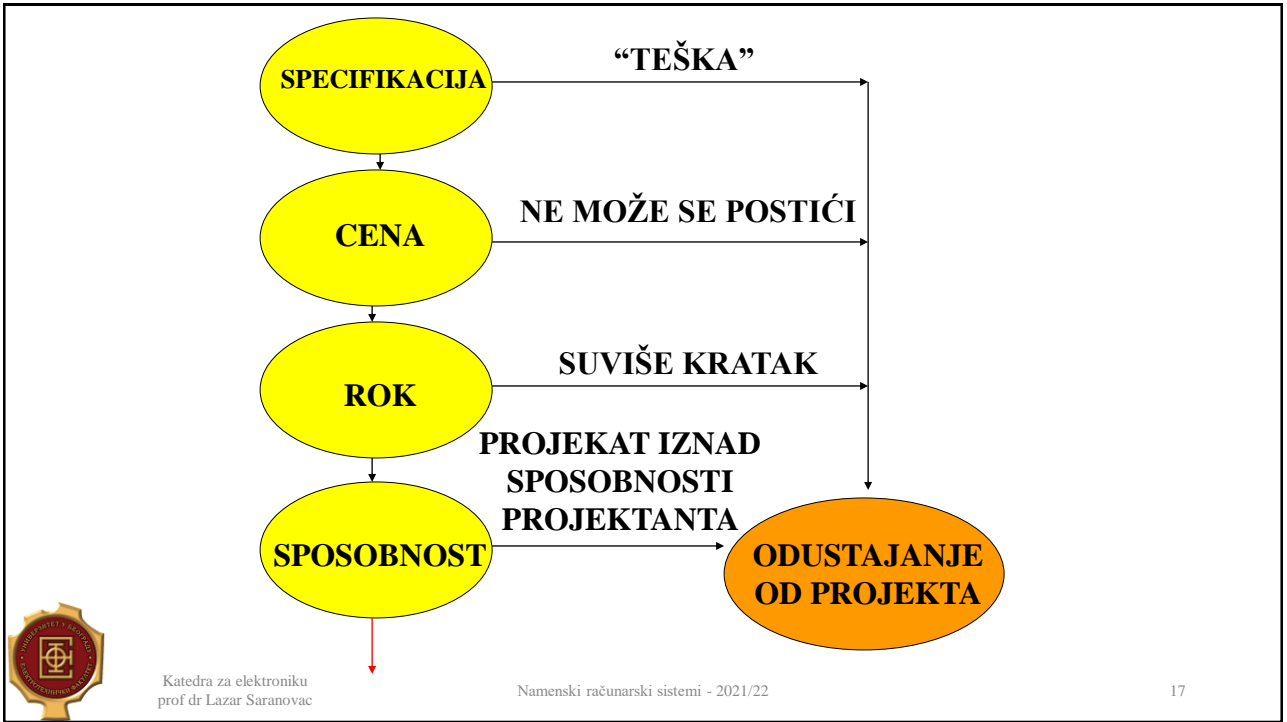
PROJEKTOVANJE

- **ZA POTREBE KORISNIKA**
 - POZNATI KORISNIK
 - NEPOZNAT KORISNIK
- **ZA POTREBE PROJEKTANTA**
 - PARE
 - POSLOVNA, STRUČNA, NAUČNA AFIRMACIJA
- **PROJEKTOVANJE**
 - SISTEMSKO ZNANJE
 - TEHNOLOGIJA
 - ISKUSTVO
 - “SREĆA”

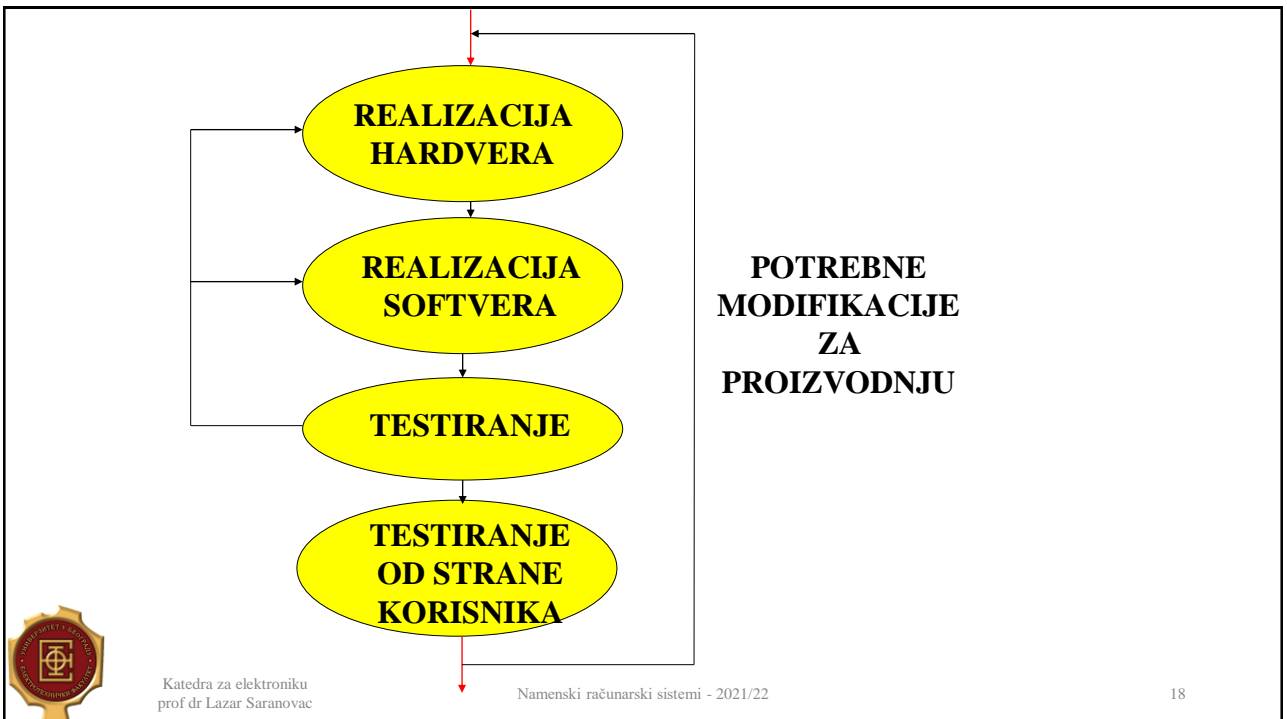


PROJEKTOVANJE

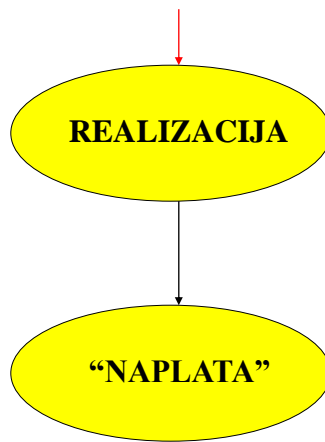




17



18



TEHNOLOGIJA REALIZACIJE

- LOGIČKA KOLA I “DISKRETNE” DIGITALNE KOMPONENTE
- PLD - Programmable Logic Device
 - PLD kombinacija logičkih komponenti i memorije
 - osigurači, SRAM, EPROM, EEPROM, FLASH EEPROM ROM
- PAL - Programmable Array Logic (MMI -> AMD)
- PLA - Programmable Logic Array
- GAL - Generic Array Logic (Lattice Semiconductor Inc)
 - moguće ih reprogramirati
 - PEEL (programmable electrically erasable logic) (ICT)
- CPLD - Complex PLDs
- FPGA – Field Programmable Gate Array
- RAČUNAR



KORISTIMO PROGRAMABILNE KOMPONENTE

ZAŠTO?

DIGITALNI SISTEM JE MOGUĆE REALIZOVATI I

- diskretnim komponentama sa opštenamenskim čipovima
- namenskim čipovima (čipom)

“NEDOSTACI”

- **Fleksibilnost – fiksna realizacija**
- **Cena...**



Šta nude firme koje proizvode programabilne komponente?

HARDVER – komponente

SOFTVER – programski alati za projektovanje

“POMOĆ”

emulatori, razvojni hardver,
simulatori,
programatori,
gotovi projekti

Third Party Companies



TESTIRANJE

EMULACIJA – kontrolisano izvršavanje softvera u
veštački stvorenom HARDVERSKOM okruženju

SIMULACIJA – kontrolisano izvršavanje softvera u
veštački stvorenom SOFTVERSKOM okruženju



Provera hardverskog dela projekta

Napajanja

Kompatibilnost naponskih nivoa

Strujni kapaciteti izlaza

Kapacitivno opterećenje izlaza

Vremenski parametri – najgori slučaj

Terminacije linija

Distribucija takta

Distribucija napajanja i mase

Reset

Elektromagnetna kompatibilnost



IZBOR MIKROKONTROLERA, SoC-a

- CPU – arhitektura i brzina
- ROM – količina i tip, način, programiranja
- RAM – količina
- PERIFERIJE
- NAPAJANJE, POTROŠNJA
- EMC
- PAKOVANJE
- PODRŠKA



- **Product Overview**
- **Data Sheets**
- **Manuals, User manual, Programmer reference**
- **Application Notes**
- **Code Examples**
- **Knowledge Base**
- **Technical Articles**
- **IC Anomalies, Errata**
- **Tools Anomalies**
- **Complementary Parts Guide**
- **Quality** (RoHS Compliance, Quality Certificates, Reliability Data and more)
- **Third Party List**

The **RoHS** Directive stands for "the restriction of the use of certain hazardous substances in electrical and electronic equipment".

