



Sveučilište J. J. Strossmayera u Osijeku
Fakultet elektrotehnike, računarstva i informacijskih tehnologija

Kneza Trpimira 2b, 31 000 OSIJEK
Tel. 031 224 600 - Fax. 031 224 605
<http://www.etfos.hr>

Komunikacije i informatika

- predstavljanje kolegija



Osijek, rujan 2020.



Predstavljanje

SADRŽAJ

- Multimedijски sustavi
- Mobilne komunikacije
- Komunikacijski sustavi
- Optoelektroničke komunikacije
- Kodovi i kodiranje
- Sigurnost računalnih sustava i mreža





Predstavljanje kolegija



Multimedijski sustavi



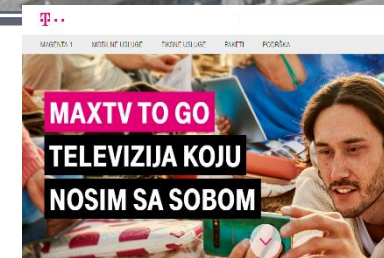
Multimedijski sustavi

Cilj kolegije je upoznati studente s:

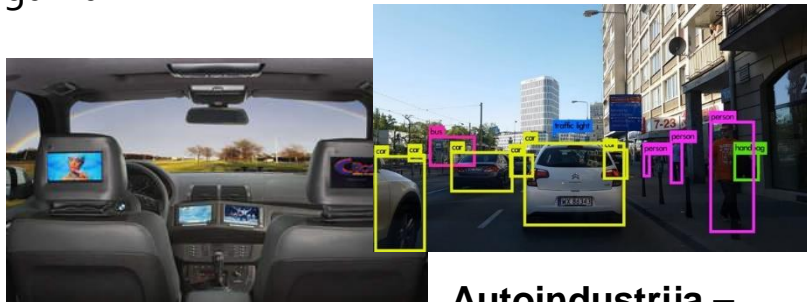
- karakteristikama analognih signala kojima se predstavljaju različiti tipovi medija;
- karakteristikama ljudskog audio-vizualnog sustava;
- principima digitalizacije pojedinih signala;
- naprednim algoritmima za kompresiju slike, audia i videa;
- mrežnim protokolima i zahtjevima na kvalitetu kod prijenosa multimedije

sa svrhom primjene stečenog znanja u projektiranju, implementaciji i održavanju sustava sa multimedijskim i interaktivnim uslugama.

Videokonferencije



Digitalna televizija



Autoindustrija – 4 „infotainment”, ADAS sustavi

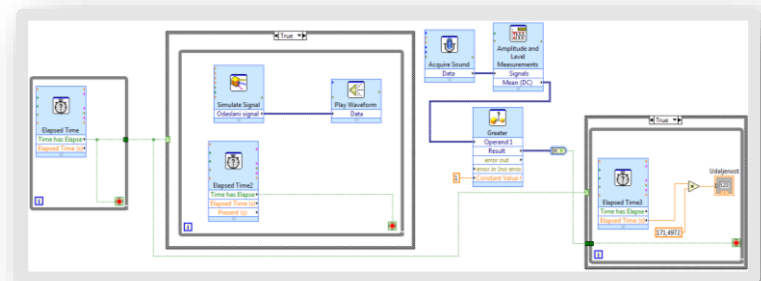
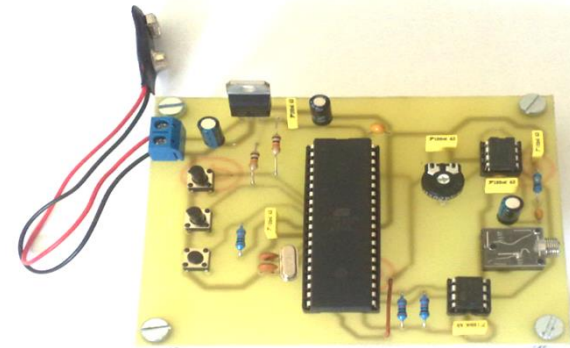


Videostrujanje, video na zahtjev



Multimedijski sustavi

- Diplomski studij, DKA i DKB izborni blok, 2. semestar
- Predavanja 45 sati, LV 15 sati, KV 15 sati
- Izrada projekta u okviru KV
 - Primjeri:
 - OCR algoritam za prepoznavanje registracijskih oznaka automobila
 - Mikrokontrolerski R2R dekodirani digitalizirani zapis u EEPROM memoriji
 - Algoritmi za detekciju lica u sceni
 - Otkrivanje pogrešaka u videu nastalih zbog prijenosa mrežom





Predstavljanje kolegija

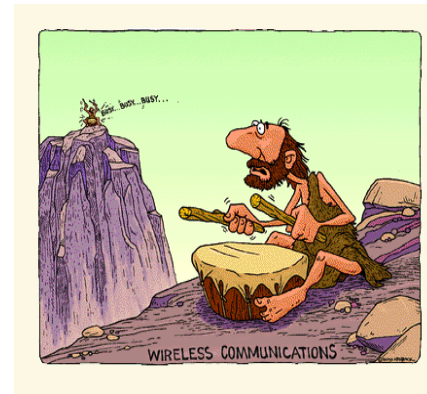


Mobilne komunikacije



Mobilne komunikacije

- Diplomski studij, 3. semestar
- 45 sati predavanja, 15 sati AV, 15 sati LV
- Cilj kolegija je upoznati studente s:
 - modeliranjem mobilnog komunikacijskog kanala i utjecajem uvjeta propagacije na dizajn mobilnih mreža;
 - značajkama celularnih mreža;
 - proračunom osnovnih parametara radijskog sučelja na temelju propagacijskih modela;
 - mobilnim 2G, 3G, 4G i 5G mrežama;
 - primjenom Restcomm open source platforme za razvoj telekomunikacijskih rješenja.

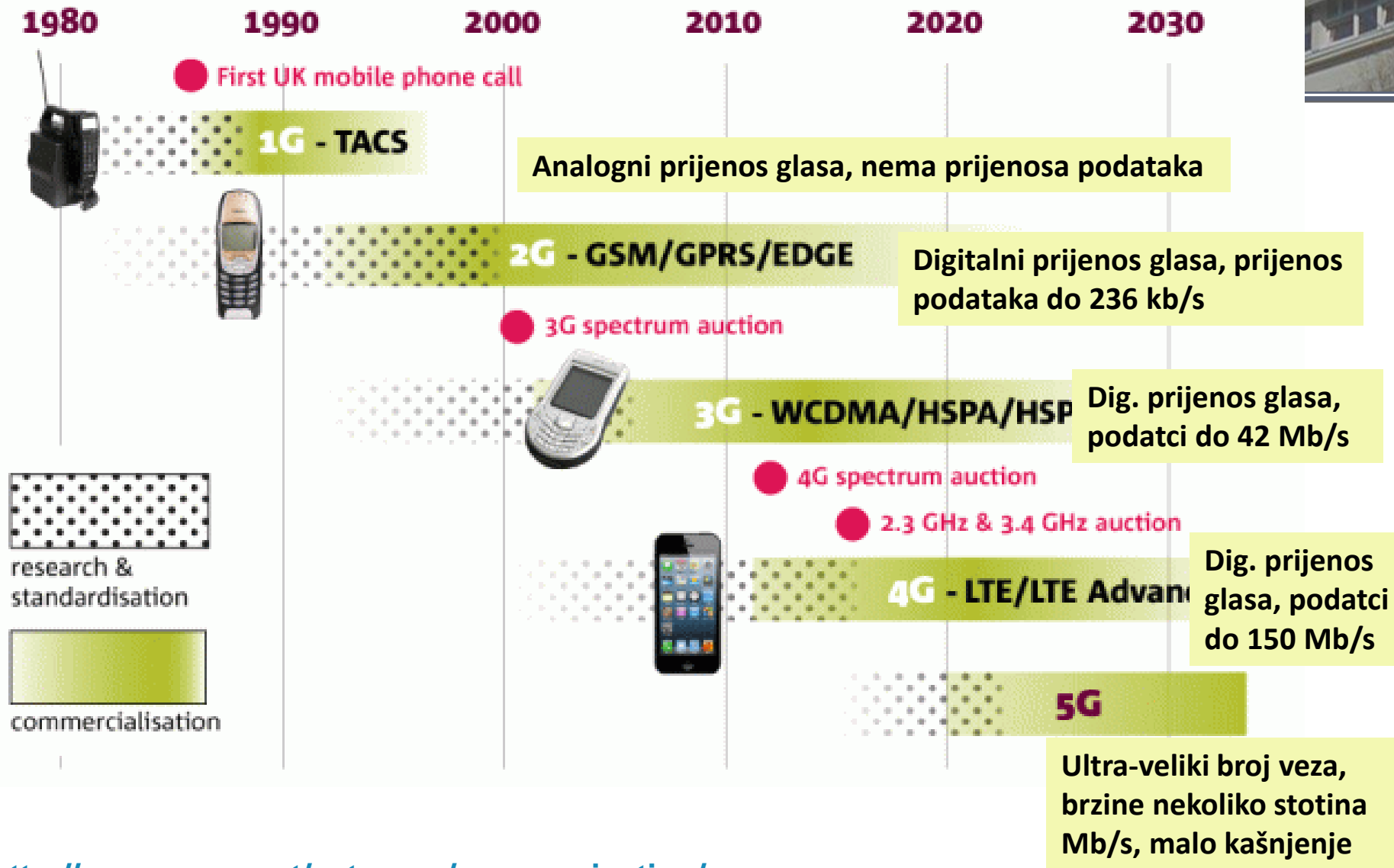


~ 20 000 B.C.

~ 2 000 A.C.



Evolution of mobile phone communications





Predstavljanje kolegija

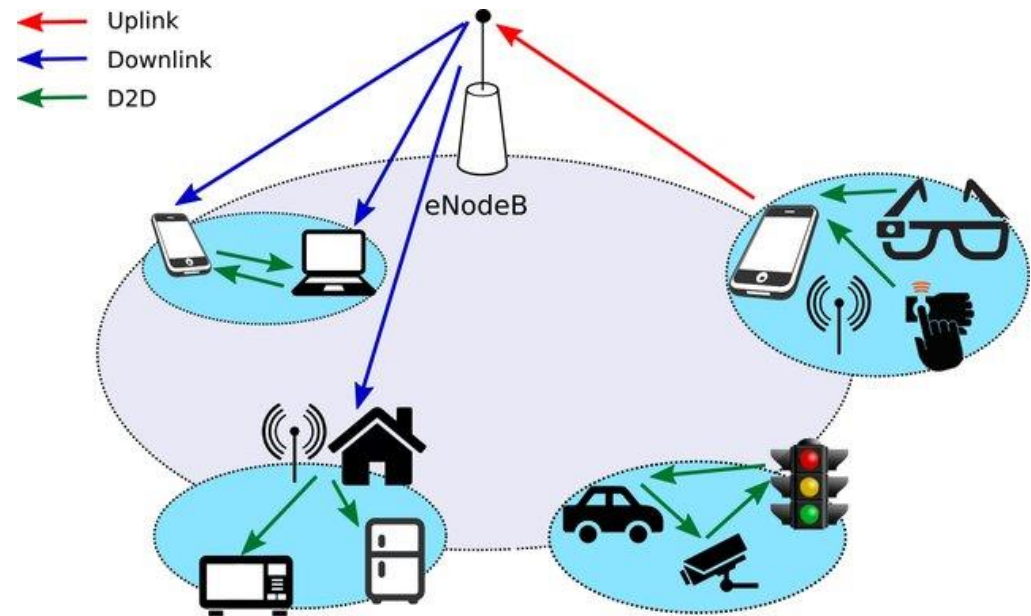


Komunikacijski sustavi



Komunikacijski sustavi

- Preddiplomski studij, 5. semestar
- 45 sati predavanja, 15 sati AV, 15 sati LV
- Kolegij daje teorijska i praktična znanja o fizičkom sloju komunikacijskih sustava:
 - Spektralna analiza signala i mjerenje spektra;
 - Prijenosni vodovi (parice, koaksijalni kabele);
 - Modulacijski postupci;
 - Osnove radiokomunikacijskih sustava (antene, prostiranje radiovala, proračun radioveze);
 - Širokopojasni komunikacijski sustavi.



Komunikacije 21. stoljeća



Predstavljanje kolegija

Optoelektroničke komunikacije



Prve optičke komunikacije

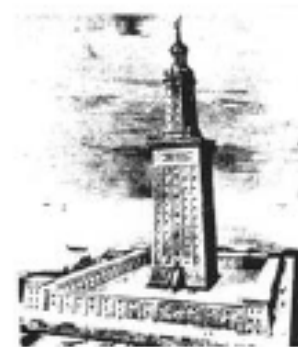
Povijesni pregled

- Prvi optički signali - **dimni signali**



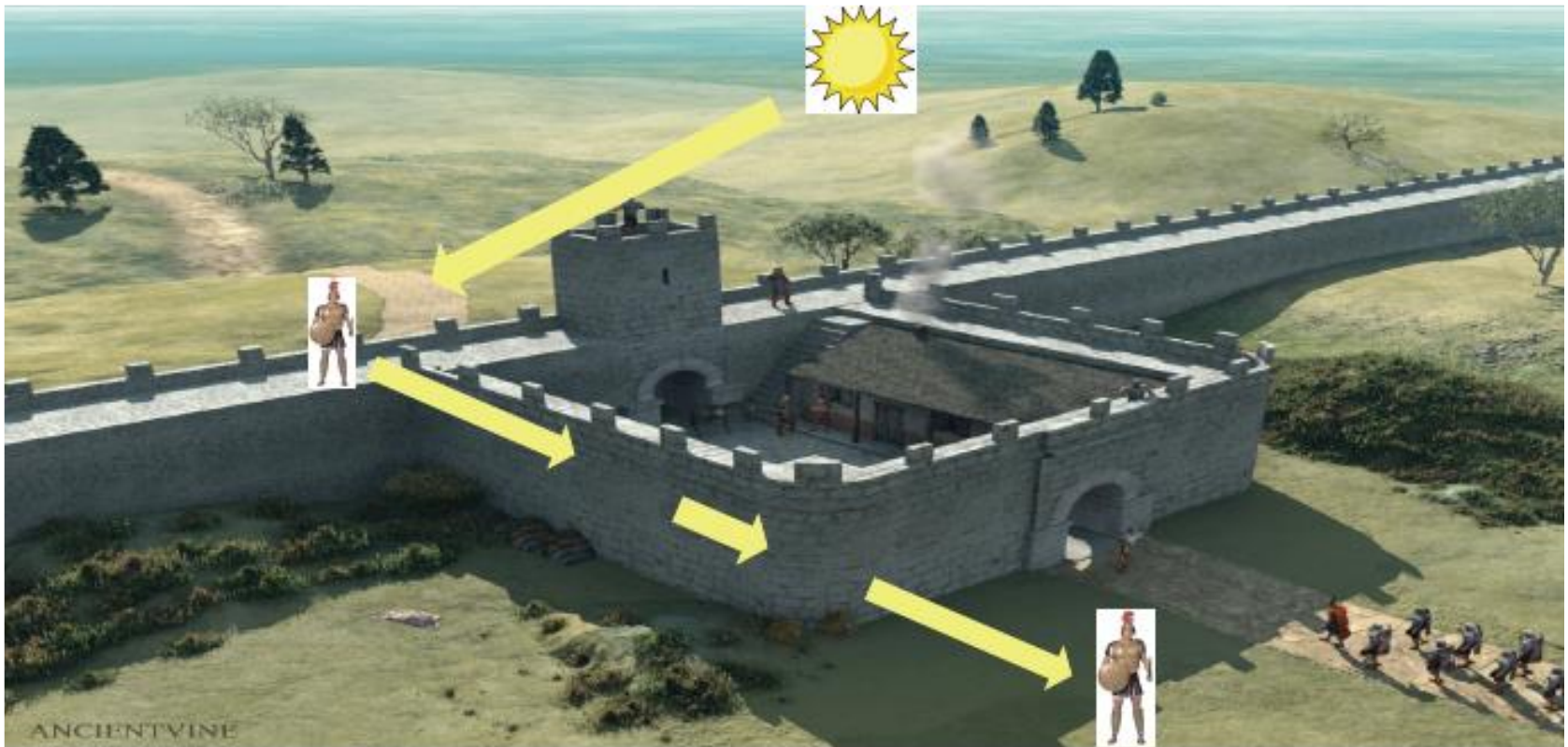
- Kinezi,
Egipćani,
Asirci, Grci

- **Antika**
- Baklje na vrhovima planina
- Svjetionici (Antička Grčka, Otok Pharos)
- Jednostavna zrcala





Prve optičke komunikacije



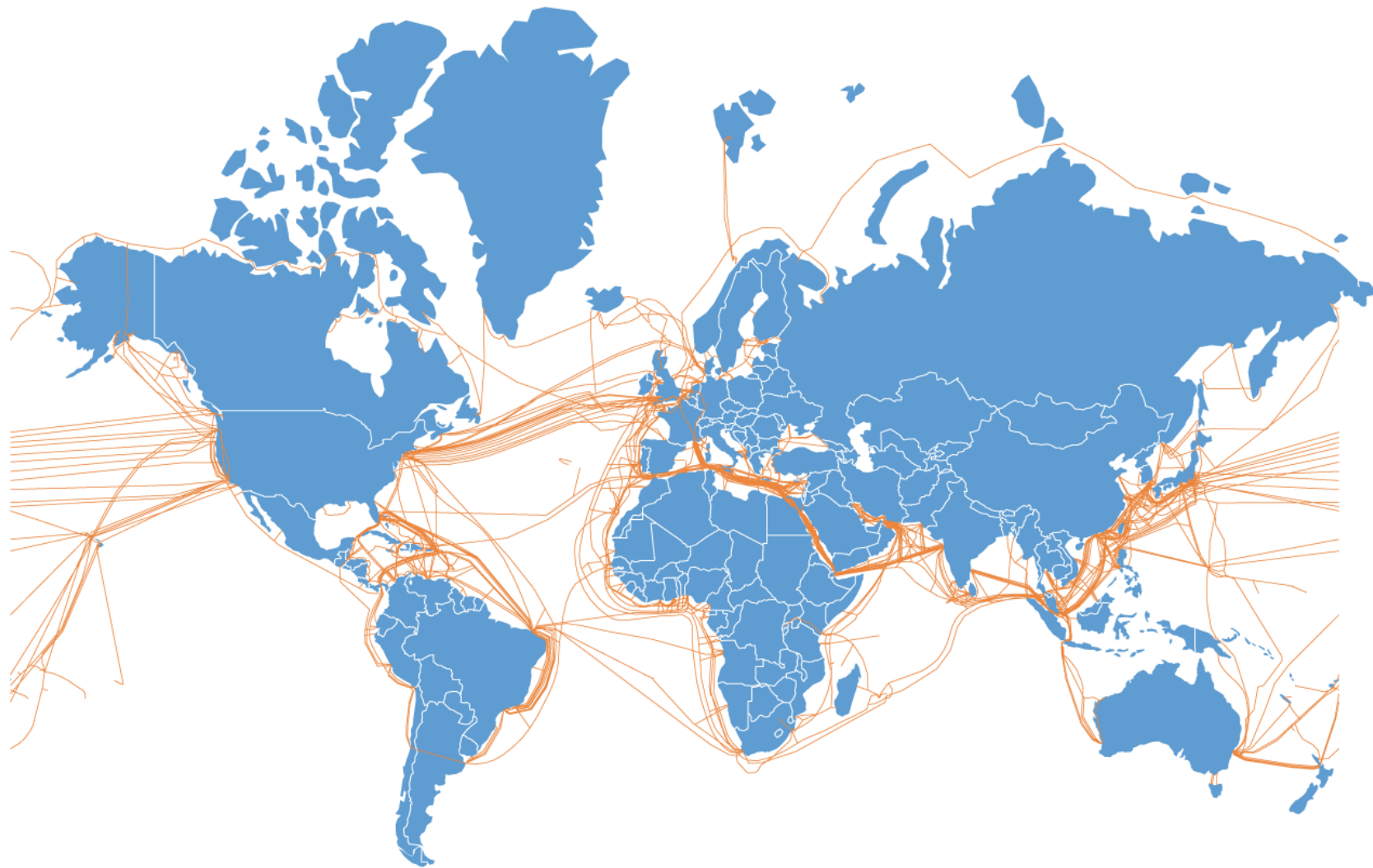
- Carrier 
- Modulator 
- Detector 

- Channel = Air
- Speed of Light
300,000,000m/s

- Distance = 1 km
- $V=d/t \Rightarrow t= 3.3 \mu s$



Današnja podmorska mreža optičkih kabela





Optoelektronički komunikacijski sustavi

Why Fiber Optic Network is High Speed Internet Connection



Fastest Speed



More Reliability



Temperature Fluctuation

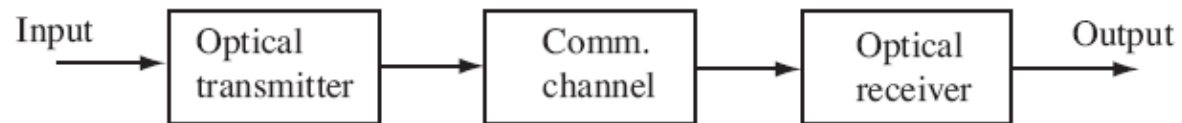


Cost

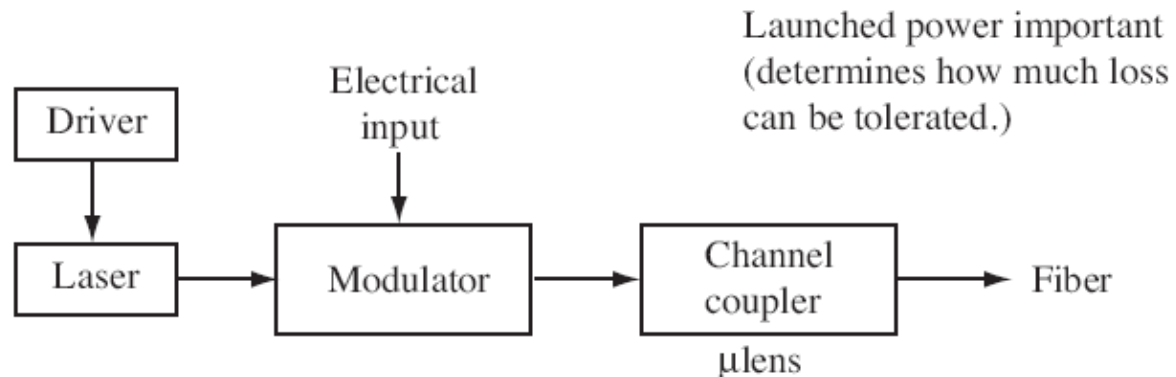




Optoelektronički komunikacijski sustavi



- Transmitter



$$\text{Power (dBm)} = 10 \log_{10} \left(\frac{\text{power}}{1 \text{ mW}} \right)$$

1 mW → 0 dBm

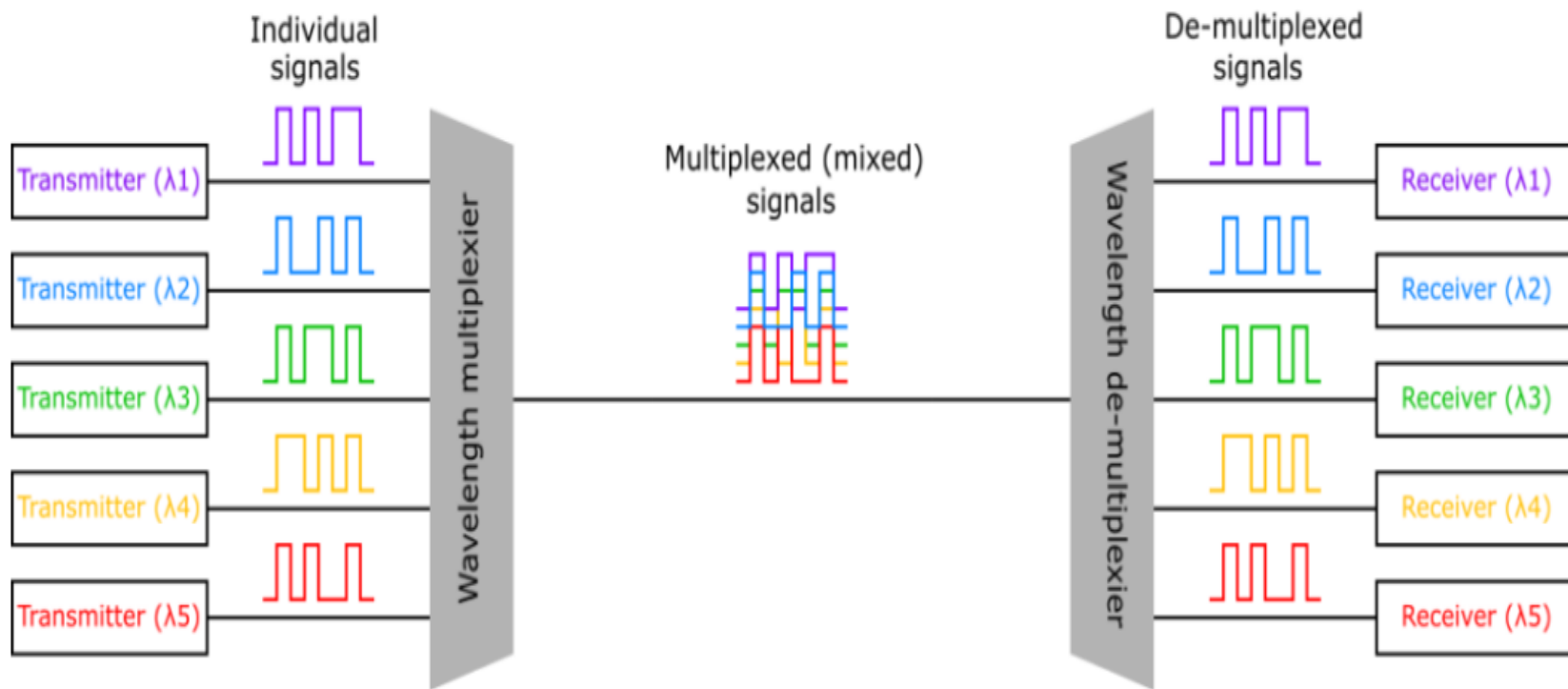
1 μW → -30 dBm

LED ~ -10 dBm

Laser diode ~ 10 dBm

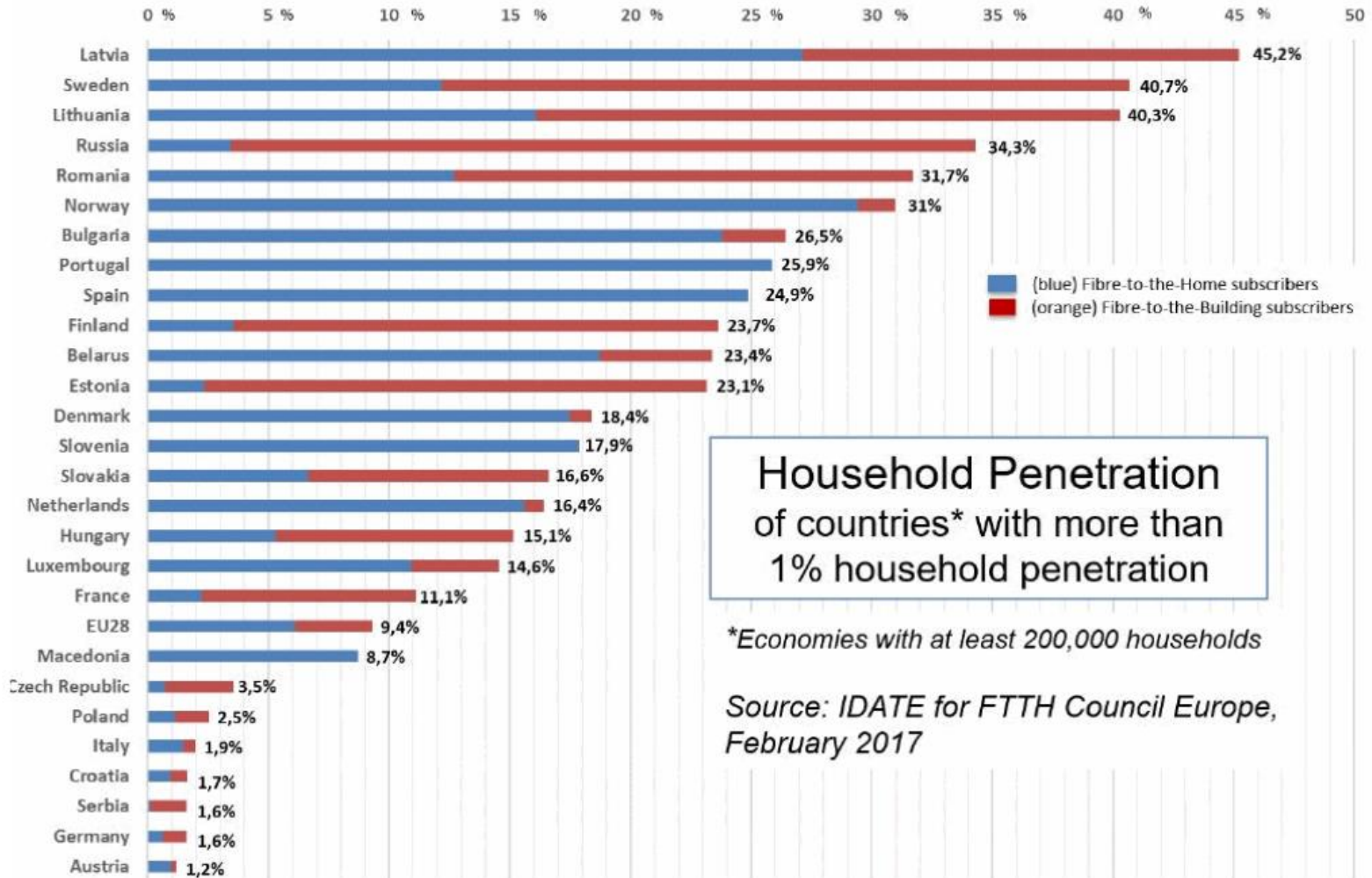


Višekanalni optoelektronički komunikacijski sustavi





Razvoj optoelektroničkih komunikacijskih sustava



Household Penetration
of countries* with more than
1% household penetration

*Economies with at least 200,000 households

Source: IDATE for FTTH Council Europe,
February 2017



Predstavljanje kolegija

Kodovi i kodiranje



Kodovi i kodiranje

- Satnica 3+1+1
- Predavanja:
prof.dr.sc. Drago Žagar
izv.prof.dr.sc. Krešimir Grgić
- Auditorne vježbe:
doc.dr.sc. Višnja Križanović
- Laboratorijske vježbe:
Jelena Vlaović, mag. ing. el.



Kodovi i kodiranje

- Informacija i komunikacije.
- Kodiranje informacije na izvoristu.
- Optimalno kodiranje.
- Zaštitno kodiranje.
- Primjena algebre u zaštiti informacije.
- Blok kodovi.
- Kodovi s kontrolom pariteta: paritet s jednim bitom, kodovi s križnim prioritetom, binarni kodovi s ponavljanjem, binarni kodovi s ponavljanjem i paritetom.
- Hammingovi kodovi.



Kodovi i kodiranje

- Binarni linearni kodovi.
- Ciklički kodovi.
- Primjena pomačnih registara za kodiranje i dekodiranje kodova.
- BCH - Bose-Chaudhury- Hocquenghem kod.
- Peterson-Gorenstein-Zierler dekodeer.
- Konvolucijski kodovi.
- Viterbijev dekodeer.
- Primjena kodova u računarstvu i komunikacijama.
- Kodovi za zaštitu integriteta podataka



Kodovi i kodiranje



- Osnovni zadatak svakog komunikacijskog sustava je *efikasan* prijenos raznih vijesti od jednog objekta ili sudionika do drugog
- Efikasnost prijenosa se očituje u prijenosu *što više istinitih podataka u zadanom vremenu*



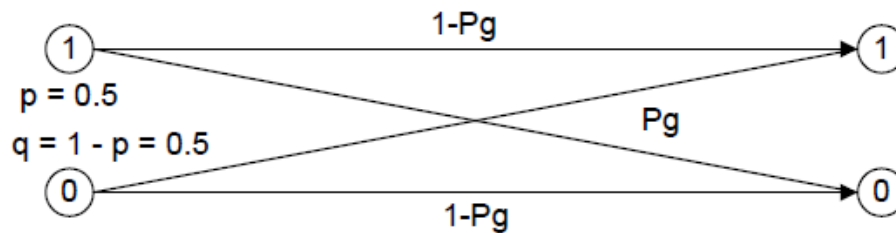
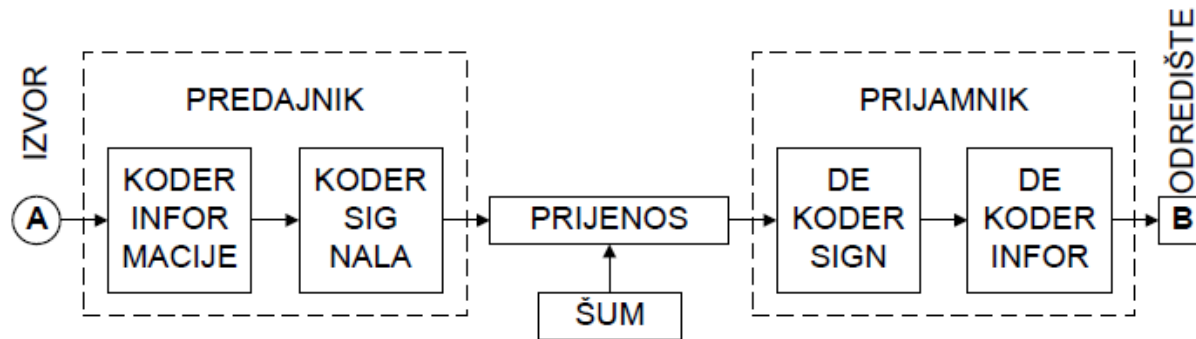
Kodovi i kodiranje





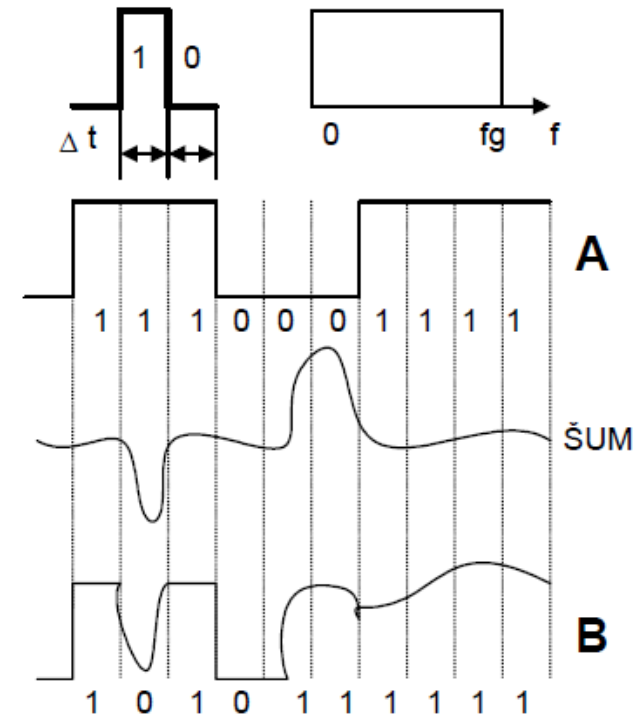
Kodovi i kodiranje

Primjer: Binarni simetrični izvor, binarni simetrični kanal



BRZINA PRIJENOSA KANALA: $1 \text{ bit}/\Delta t$

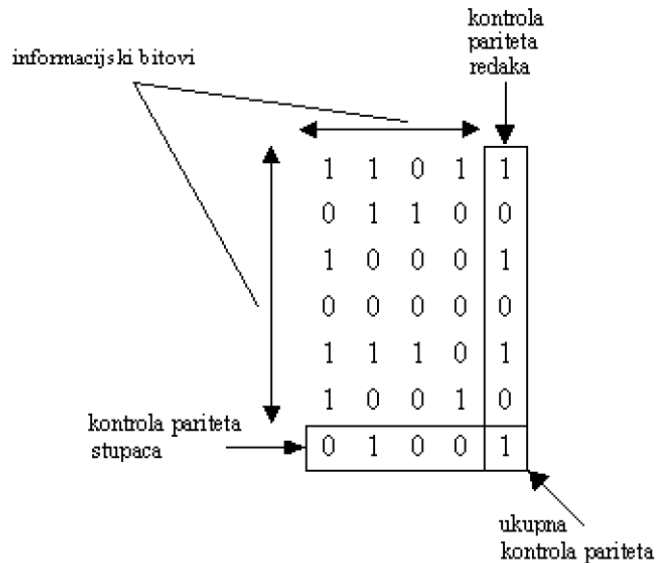
BRZINA GENERIRANJA NA IZVORU: $F \text{ bit}/\Delta t$



Npr. $f_g = 4 \text{ kHz}$ $\Delta t = \frac{1}{2f_g} = \frac{1}{2 \cdot 4 \cdot 10^3} = 125 \mu\text{s}$



Kodovi i kodiranje



1	0	0	0	1
0	0	0	1	1
0	1	1	1	1
0	1	0	0	0
1	0	1	1	1
0	1	1	0	0
0	0	1	1	0

Jednostruka pogreška

0	1	1	0	0
0	0	0	1	0
1	1	0	1	1
1	0	1	0	1
1	1	0	1	1
1	0	1	1	1
0	1	1	0	0

Dvostruka pogreška

0	1	0	0	1
1	1	1	1	1
0	1	0	0	1
0	1	0	1	0
1	0	1	0	1
0	1	0	1	0
0	0	0	0	0

1	0	1	1	1
0	1	0	0	0
1	0	1	1	1
0	0	0	1	1
1	1	1	1	0
1	1	0	1	1
0	1	1	0	0

Trostruka pogreška

0	1	0	1	0
1	0	1	1	1
0	1	0	1	0
1	0	1	0	0
1	1	0	1	1
0	1	1	1	1
1	0	1	1	1

Četverostruka pogreška

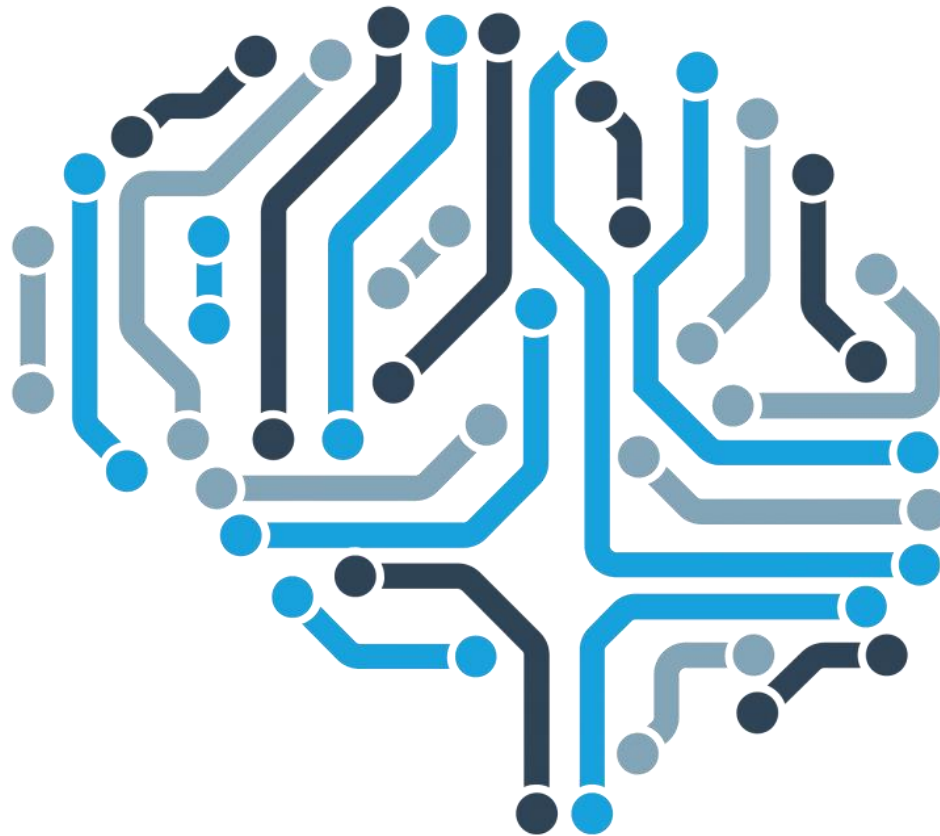


Predstavljanje kolegija

Sigurnost računalnih sustava i mreža



Kako ljudski mozak percipira problematiku sigurnosti?

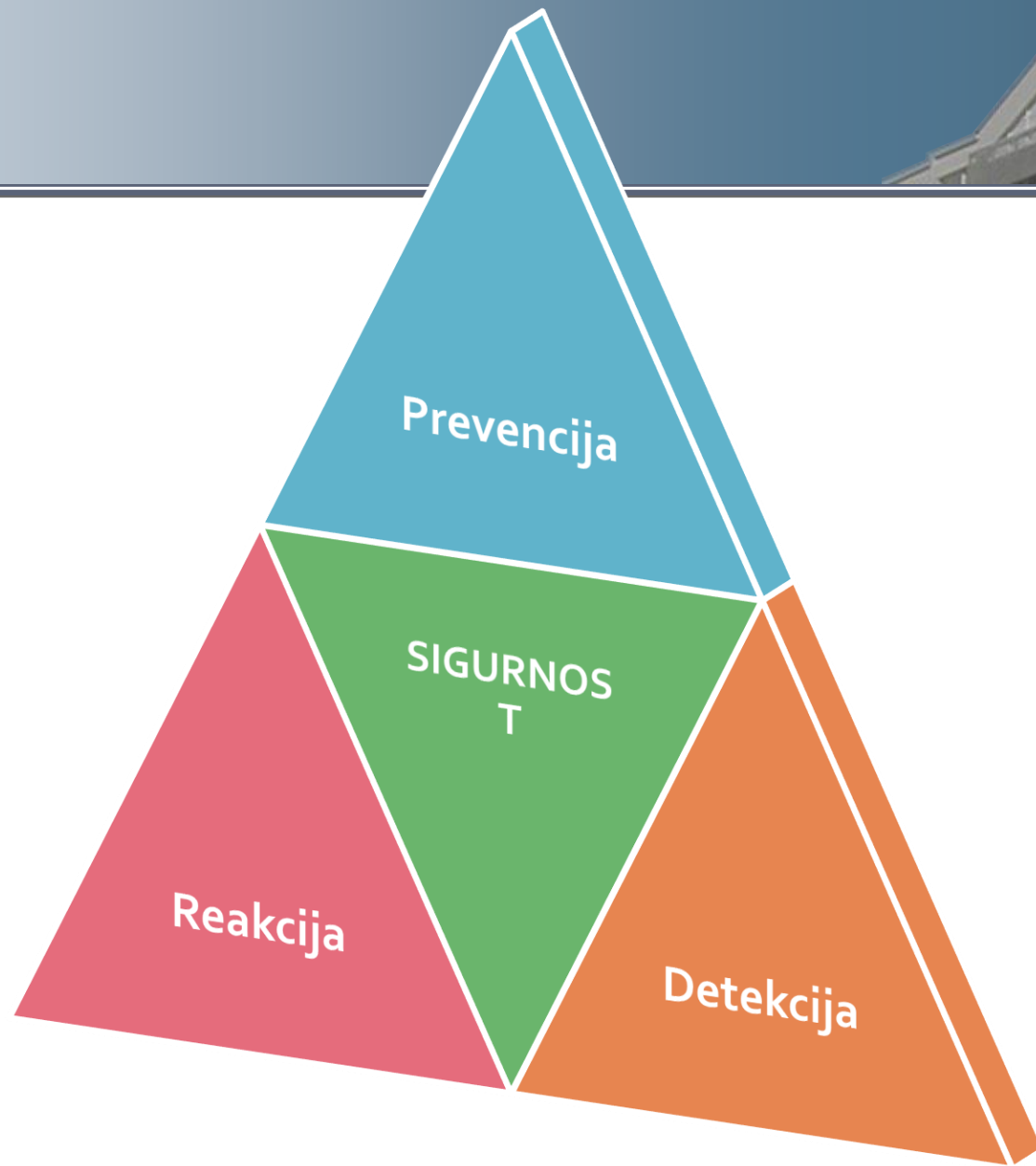




- 1) Koju biste opciju mogućeg dobitka radije izabrali:
- a) siguran dobitak od 5000 kuna
 - b) mogući dobitak od 10000 kuna ili ništa (odlučuje se bacanjem novčića)



- 2) Koju biste opciju mogućeg gubitka radije izabrali:
- a) siguran gubitak od 5000 kuna
 - b) mogući gubitak od 10000 kuna ili ništa (odlučuje se bacanjem novčića)





Povjerljivost

Integritet

**Sigurnost
informacije**

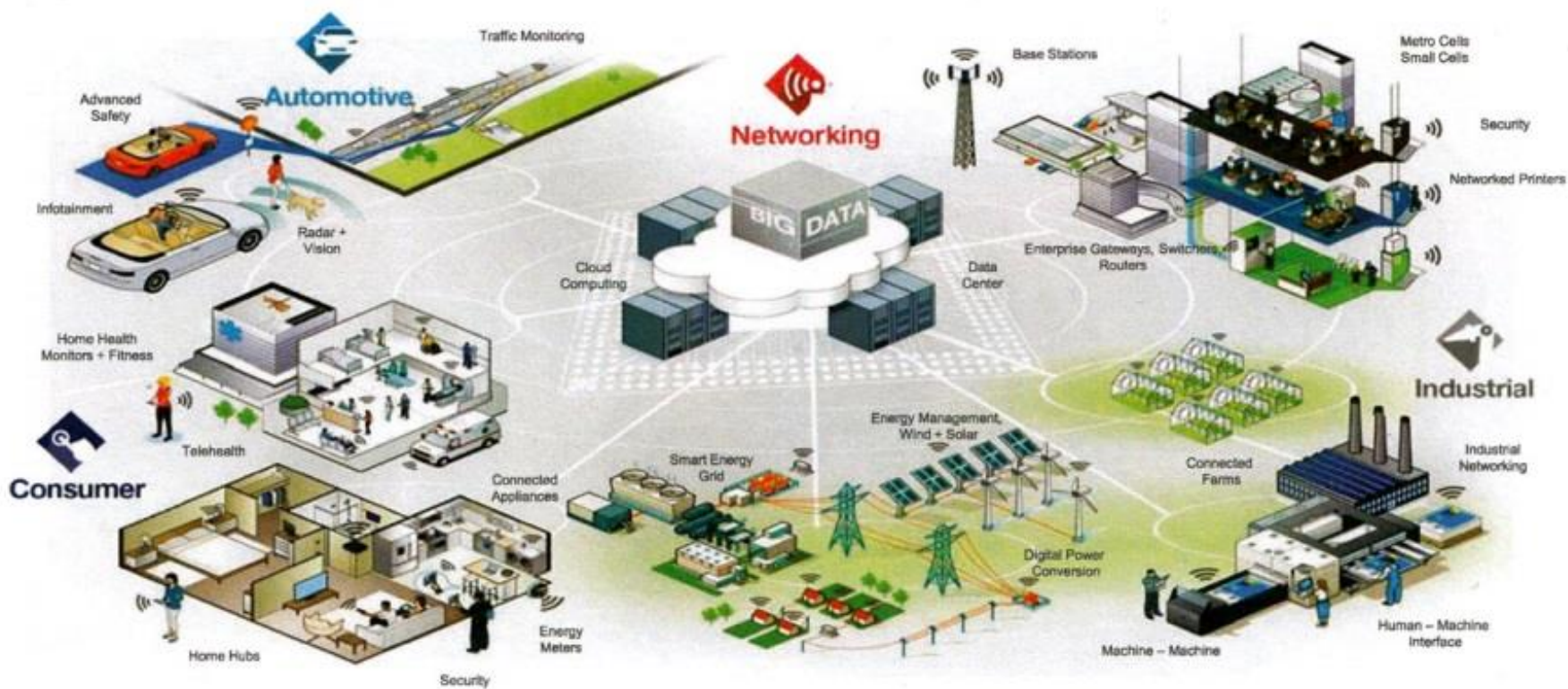
Raspoloživost

Autentičnost

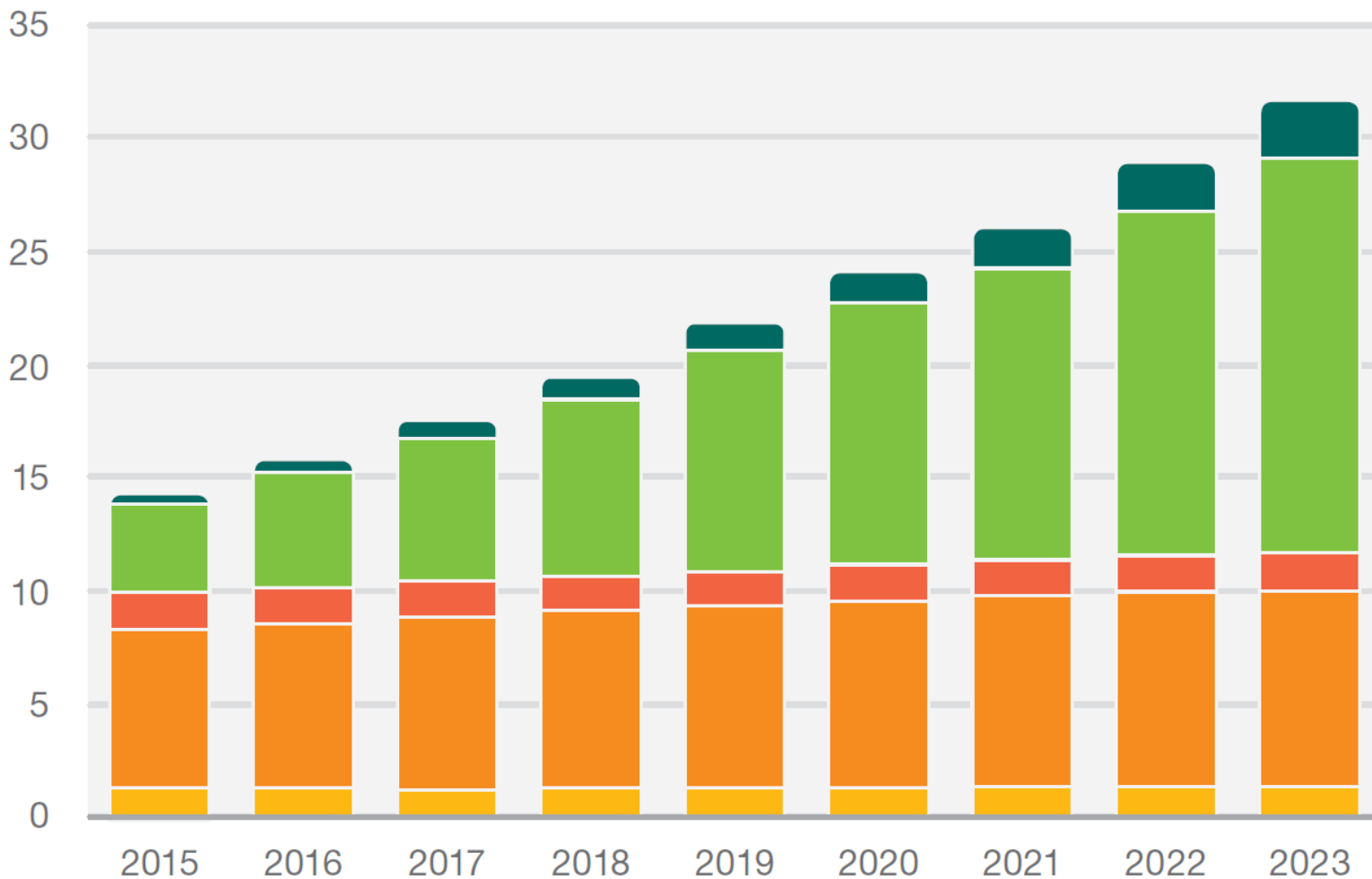


Internet of Things (IoT)

The Internet of Things








Broj umreženih uređaja (u milijardama)



(Ericsson Mobility Report, 2017)



Broj umreženih uređaja (u milijardama)

	2017	2023	CAGR
 Wide-area IoT	0.6	2.4	26%
 Short-range IoT	6.4	17.4	18%
 PC/laptop/tablet	1.6	1.7	0%
 Mobile phones	7.5	8.8	3%
 Fixed phones	1.4	1.3	0%
	17.5 billion	31.6 billion	CAGR – Compound Annual Growth Rate

(Ericsson Mobility Report, 2017)

„Pametni svijet“

Air Pollution

Control of CO₂ emissions of factories, pollution emitted by cars and toxic gases generated in farms.

Forest Fire Detection

Monitoring of combustion gases and preemptive fire conditions to define alert zones.

Wine Quality Enhancing

Monitoring soil moisture and trunk diameter in vineyards to control the amount of sugar in grapes and grapevine health.

Offspring Care

Control of growing conditions of the offspring in animal farms to ensure its survival and health.

Sportsmen Care

Vital signs monitoring in high performance centers and fields.

Structural Health

Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

Quality of Shipment Conditions

Monitoring of vibrations, strokes, container openings or cold chain maintenance for insurance purposes.

Smartphones Detection

Detect iPhone and Android devices and in general any device which works with Wifi or Bluetooth interfaces.

Perimeter Access Control

Access control to restricted areas and detection of people in non-authorized areas.

Radiation Levels

Distributed measurement of radiation levels in nuclear power stations surroundings to generate leakage alerts.

Electromagnetic Levels

Measurement of the energy radiated by cell stations and WiFi routers.

Traffic Congestion

Monitoring of vehicles and pedestrian affluence to optimize driving and walking routes.

Smart Roads

Warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Lighting

Intelligent and weather adaptive lighting in street lights.

Intelligent Shopping

Getting advices in the point of sale according to customer habits, preferences, presence of allergic components for them or expiring dates.

Noise Urban Maps

Sound monitoring in bar areas and centric zones in real time.

Water Leakages

Detection of liquid presence outside tanks and pressure variations along pipes.

Vehicle Auto-diagnosis

Information collection from CanBus to send real time alarms to emergencies or provide advice to drivers.

Item Location

Search of individual items in big surfaces like warehouses or harbours.

Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.

Smart Parking

Monitoring of parking spaces availability in the city.

Golf Courses

Selective irrigation in dry zones to reduce the water resources required in the green.

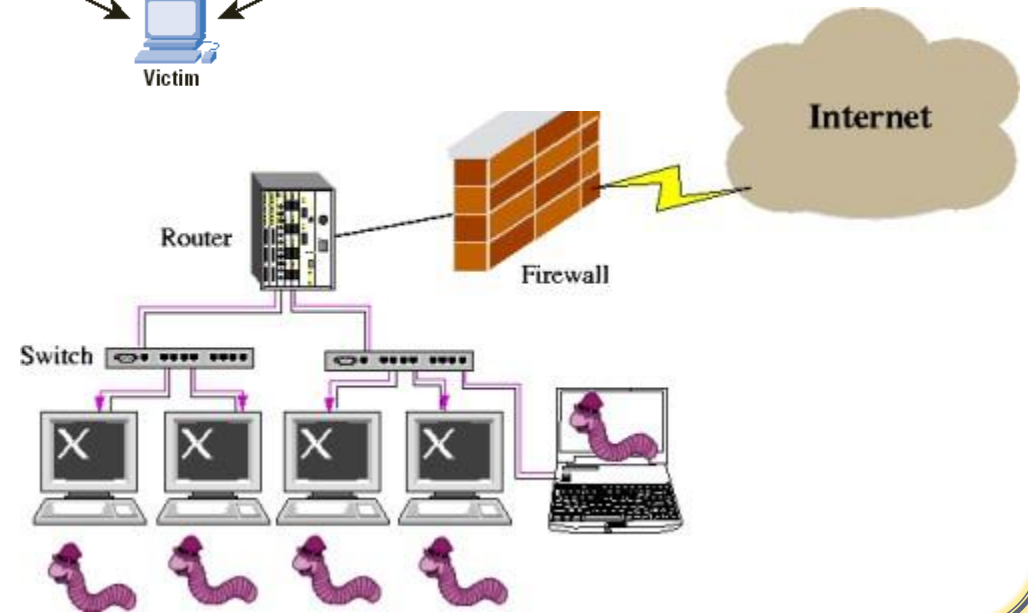
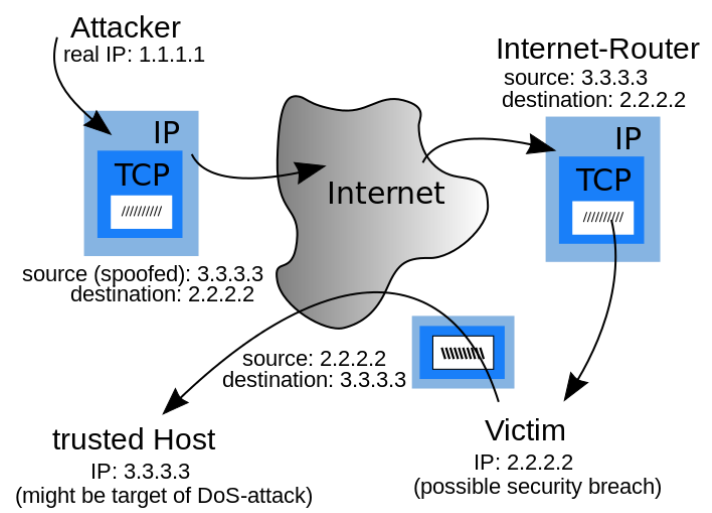
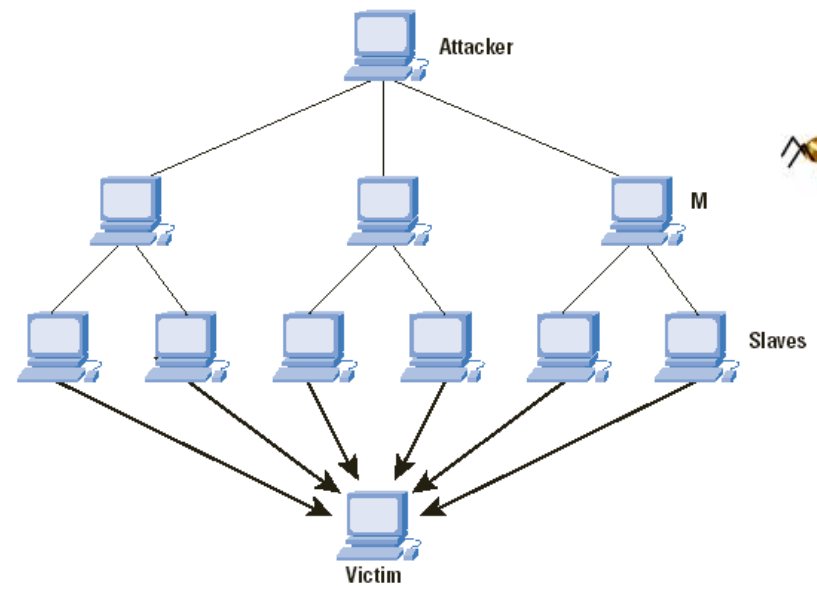
Water Quality

Study of water suitability in rivers and the sea for fauna and eligibility for drinkable use.

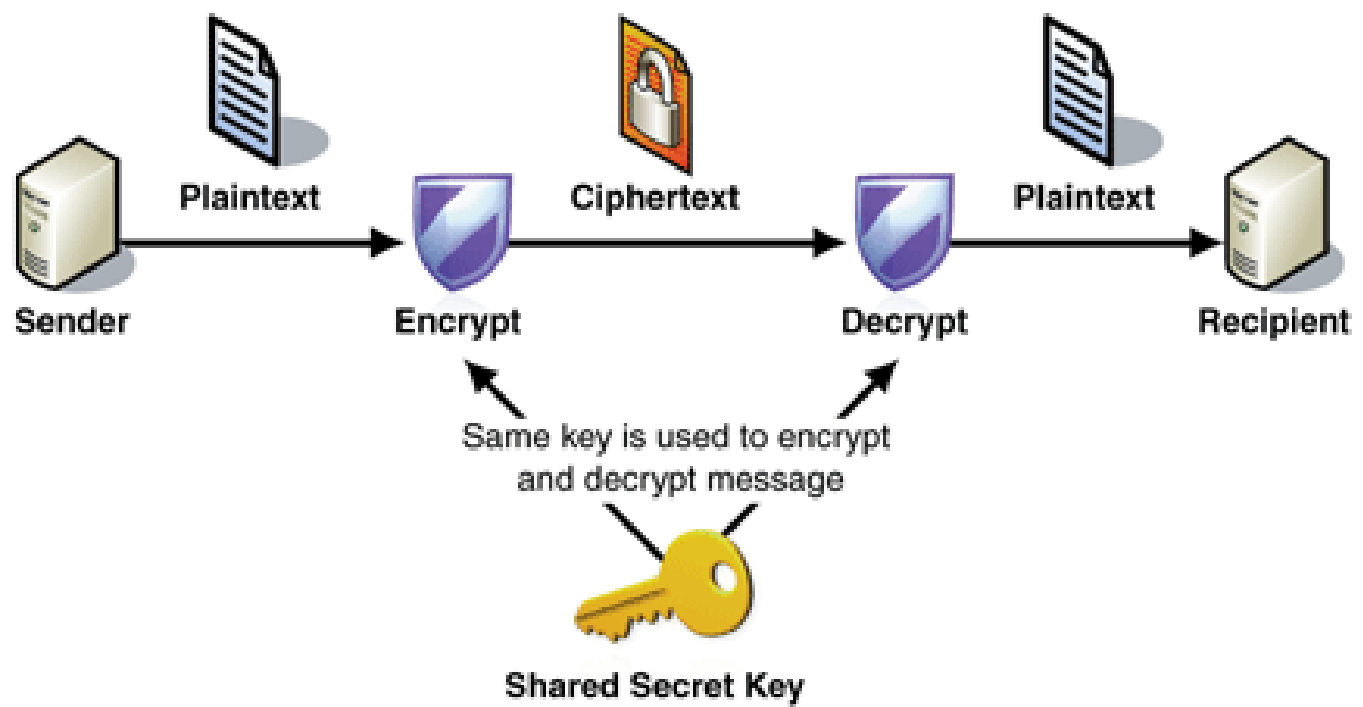


Primjeri prijetnji u računalnim mrežama

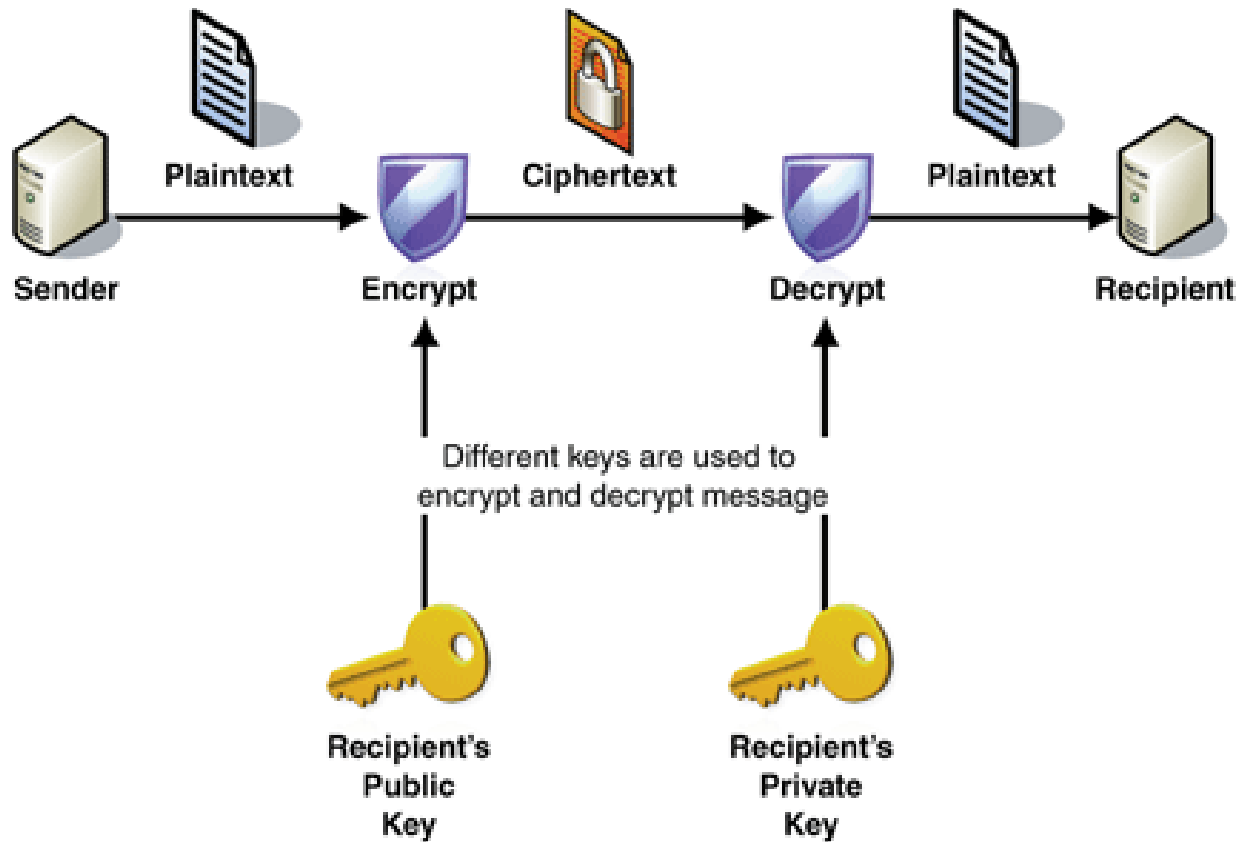




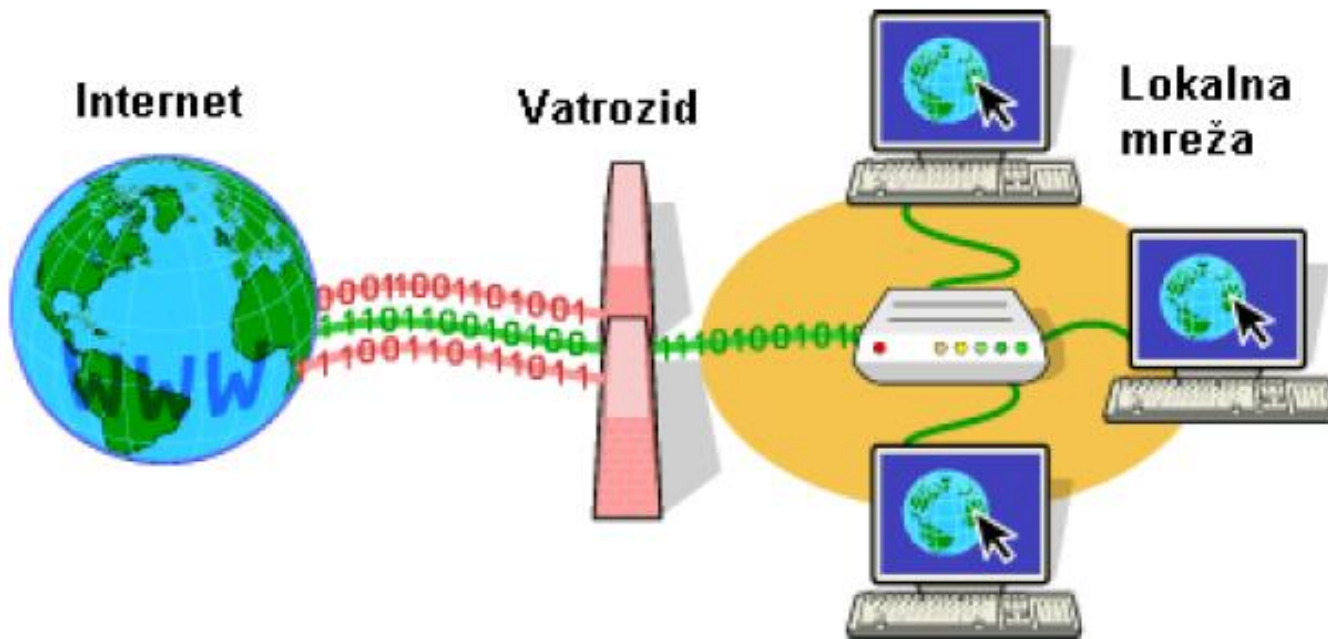
Simetrične šifre



Asimetrične šifre

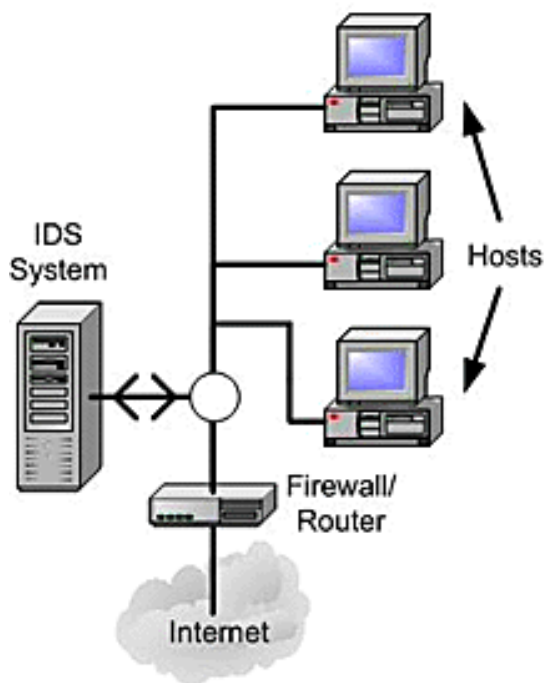


Vatrozid (Firewall)

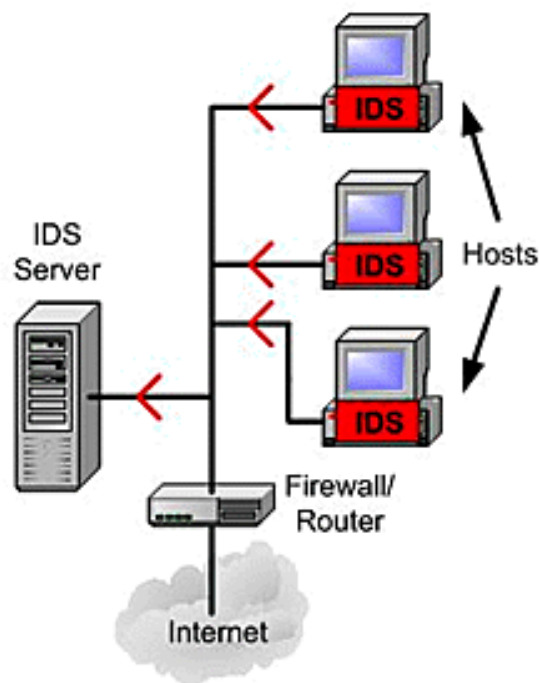


Sustavi za otkrivanje upada

Network Based IDS



Host Based IDS



Ekosustav i infrastruktura vozila sljedeće generacije



I



Satellite Communications



Mobile Communications

Security Systems



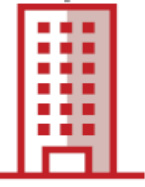
Schedule and Location



Travel and Passenger Information



Mobile Communications



Vehicle-to-Vehicle

Traffic and Construction



WiFi



Security Systems



Smart Intersection



Fleet Management



City Traffic Management

Toll System





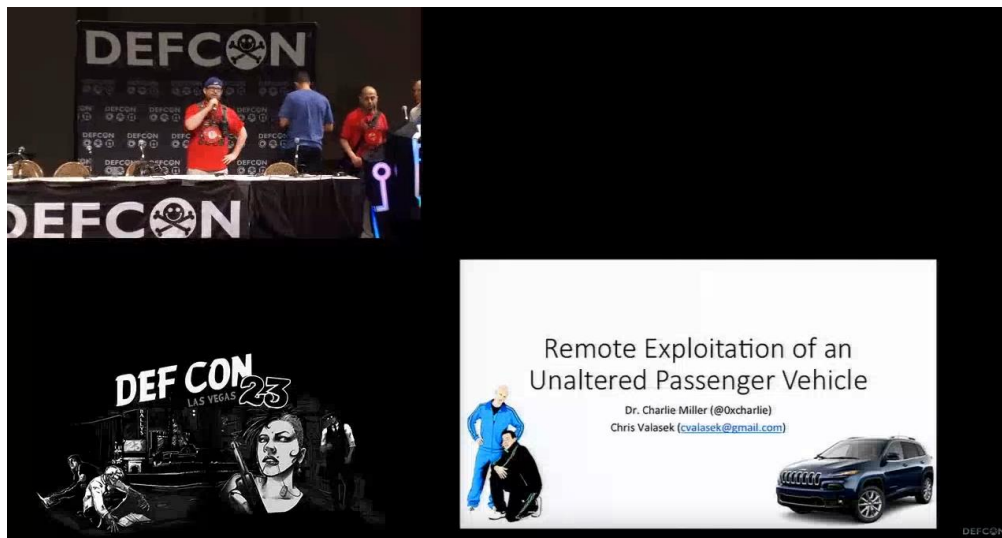
Remote Exploitation of an Unaltered Passenger Vehicle

Chris Valasek, Director of Vehicle Security Research for IOActive
chris.valasek@ioactive.com

Charlie Miller, Security Researcher for Twitter
cmiller@openrce.org



https://ioactive.com/pdfs/IOActive_Remote_Car_Hacking.pdf



<https://www.youtube.com/watch?v=OobLb1Mcxnl>

Software Sabotage

How Stuxnet disrupted Iran's uranium enrichment program

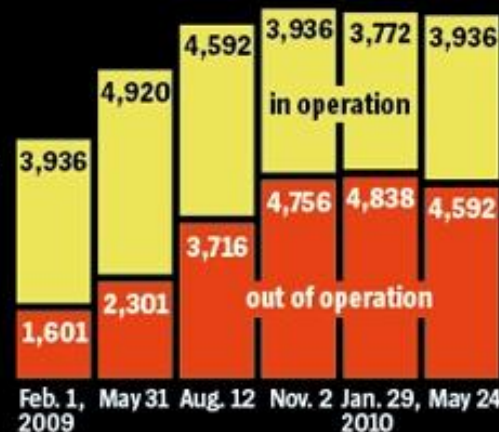
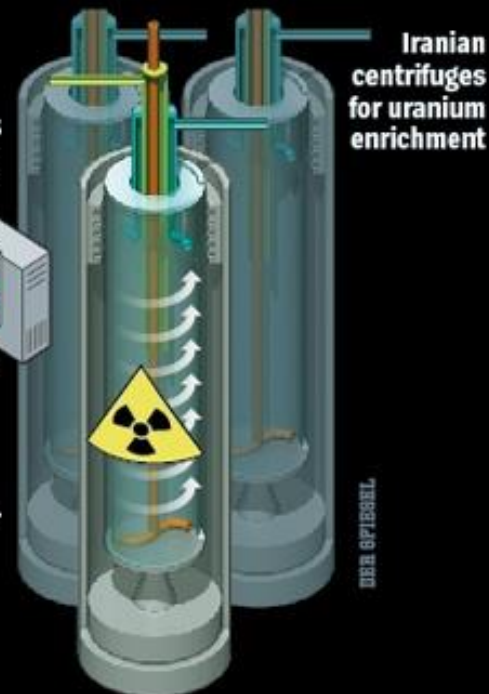
1 The malicious computer worm probably entered the computer system - which is normally cut off from the outside world - at the uranium enrichment facility in Natanz via a removable USB memory stick.

2 The virus is controlled from servers in Denmark and Malaysia with the help of two Internet addresses, both registered to false names. The virus infects some 100,000 computers around the world.

3 Stuxnet spreads through the system until it finds computers running the Siemens control software Step 7, which is responsible for regulating the rotational speed of the centrifuges.

4 The computer worm varies the rotational speed of the centrifuges. This can destroy the centrifuges and impair uranium enrichment.

5 The Stuxnet attacks start in June 2009. From this point on, the number of inoperative centrifuges increases sharply.



Source: IAEA, ISIS, FAS, World Nuclear Association, FT research

5

WAYS TO KEEP YOUR DATA SECURE



MAKE SURE YOUR EMPLOYEES KNOW WHAT THEY CAN AND CAN'T DO WITH COMPANY DATA. **UNINTENDED USE** CAN BE AN UNEXPECTED WAY TO HAVE A DATA BREACH.



KEEP AN ANTIVIRUS SOFTWARE ON ALL OF YOUR MACHINES. THE MOST EXPENSIVE VIRUS WORLDWIDE COST MORE THAN **\$35 BILLION TO REMOVE.**



BE AWARE OF HOW YOUR COMPANY USES SOCIAL MEDIA. MORE THAN 600,000 **SOCIAL MEDIA ACCOUNTS** ARE HIJACKED EVERY DAY.



KEEP YOUR PLUGINS UPDATED. JAVA OR ADOBE READER MAKE UP TO **99% OF COMPUTERS VULNERABLE** THROUGH SOFTWARE WEAKNESSES.



KNOW YOUR OWN PEOPLE. 59% OF EMPLOYEES TAKE **PROPRIETARY COMPANY INFORMATION** WITH THEM WHEN THEY LEAVE THEIR JOBS.

10 CYBERSECURITY TACTICS

YOU SHOULD BE DOING **NOW**



ONE PAY ATTENTION TO THE WARNINGS YOUR BROWSER IS FLASHING IN YOUR FACE

TWO HAVE A DIFFERENT, **UNIQUE** PASSWORD FOR EVERY ACCOUNT



THREE KEEP PASSWORDS TOUGH ENOUGH TO GUESS THAT EVEN YOUR SPOUSE COULDN'T FIGURE THEM OUT

FOUR **DO NOT CLICK** ON ANY LINKS THAT ARRIVE IN AN UNSOLICITED EMAIL, NO MATTER WHAT



FIVE KEEP YOUR **BUSINESS** ACCOUNTS SEPARATE FROM YOUR **PERSONAL** ACCOUNTS

SIX CHANGE YOUR PASSWORDS OFTEN



SEVEN DO NOT TAPE ALL OF YOUR PASSWORDS ONTO YOUR MONITOR... SERIOUSLY

EIGHT IF YOU'RE STRUGGLING TO REMEMBER YOUR PASSWORDS, GIVE **LASTPASS** OR **1PASSWORD** A TRY



NINE KEEP ALL PERTINENT SECURITY SOFTWARE UP TO DATE

TEN BACK UP YOUR COMPUTER AND SETTINGS OFTEN





Za razmišljanje...



Kad me netko pita kako najbolje mogu opisati svoja iskustva od gotovo četrdeset godina na moru, jednostavno kažem neuobičajeno. Nikad nisam doživio nesreću bilo koje vrste o kojoj vrijedi razgovarati ... Nikad nisam vidio olupinu i nikada se nisam potopio, niti sam ikada bio u nevolji koja je prijetila da će završiti katastrofom bilo koje vrste.

Edward John Smith

(kapetan broda RMS Titanic)

Rođen: 1850, Hanley, Staffordshire,

Zavod za komunikacije



FERITOS



Hvala na pažnji!