SCADA SYSTEMS

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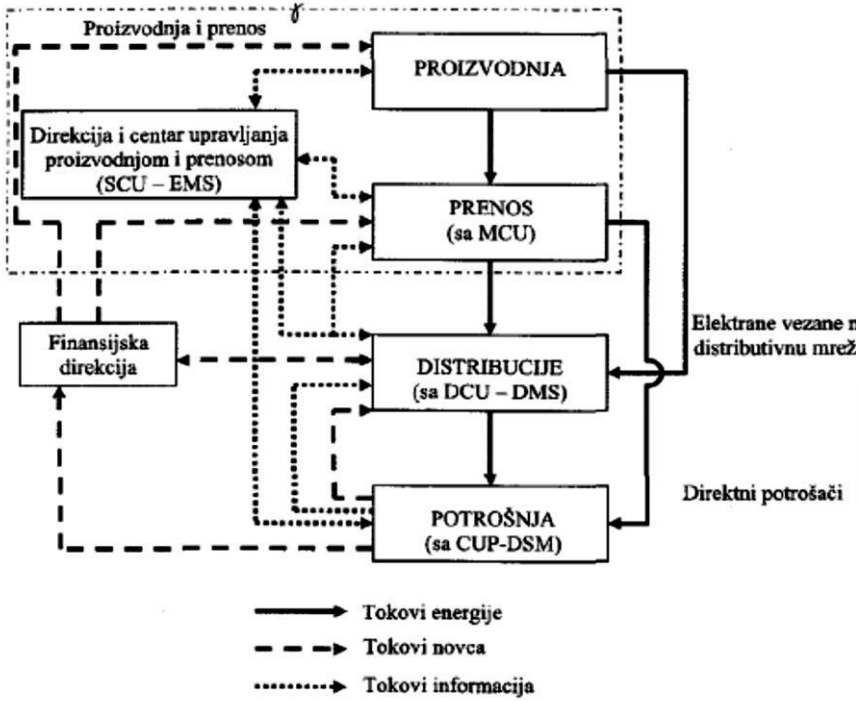
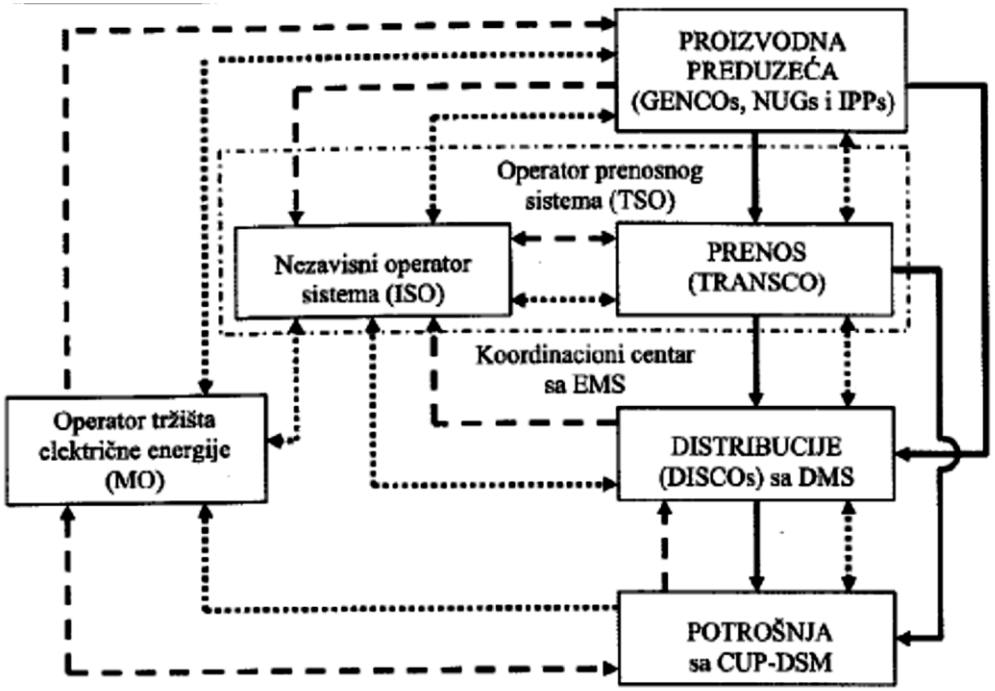


Legenda:

SCU – Sistemski centar upravljanja
MCU – Mrežni centar upravljanja
DCU – Distributivni centar upravljanja
CUP – Centar upravljanja potrošnjom
EMS (Energy Management System) – Sistem upravljanja električnom energijom na n proizvodnje i prenosa
DMS – (Distribution Management System) – Sistem upravljanja distribucijom
DSM – (Demand Side Management) – Upravljanje potrošnjom u cilju racionalnog korišćenja električne energije

Tipična struktura vertikalno-integrisanog elektroprivrednog preduzeća



Tipična struktura deregulisanog elektroenergetskog sistema

SCADA SYSTEMS

SCADA is an acronym for Supervisory Control and Data Acquisition and is the part of EMS that consists of systems for monitoring and controlling power systems. The first SCADA systems appeared in the 60s of the twentieth century and their purpose was to monitor the state of technical processes.

With the advancement of technology, i.e. the emergence of faster and more efficient computer and microcontroller devices, these systems have been extended to control functions.

SCADA is a broad set of equipment, systems and solutions that enable the collection of data on a process-remote system, its processing, monitoring and, in some cases, responding appropriately.

SCADA SYSTEMS

The main objectives of a SCADA system are:

› Monitoring and management of systems,

› Effective management of the system's resources,

› Collecting and storing data,

› Reducing the need for physical presence in certain parts of the system,

› reduce the operating costs of the technological process and increase work safety,

› Enables the upgrade of many additional functions, further development and improvement.

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SCADA systems comprise several functionally connected units:
Hardware subsystem - includes all hardware that is installed for monitoring and control purposes (computer equipment, programmable controllers, communication hardware, cables,...),

Software subsystem – includes all software, including utilities that control the operation of full-coupon hardware,

Communication subsystem – includes software and hardware for connecting elements of a SCADA system, Technological process – represents a system in which you want to monitor, manage and acquire data by installing a SCADA system.

SCADA SYSTEMS

The SCADA system consists of several units:

A central processing unit (MTU) is a computer on which data is collected, monitored and managed by various remote processes.

› Remote Terminal Units (RTUs) and PLCs - devices intended exclusively for use in outdoor areas and industrial environments.

› Communication network - establishes a connection between the MTU and the RTU and transmits data between them (via radio communications, telecom connections, lines, etc.). › Instrumentation – measuring devices, various instruments, process controllers...

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Architecture of the SCADA system:

SCADA systems consist of four basic components:

› Servers - Central Unit or Master Terminal Unit (MTU),

› Clients - provide services for the needs of human-system interaction (Eng. Human Machine Interface (HMI). Clients enable the display of the current state in the system, display the history of system behavior and system management.

› Remote monitoring devices – RTUs (data collection),

› Communication equipment.

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Servers have the role of collecting data from remote measurement control devices located in the wider area of the power system. The relationship between the operator and the measuring and control devices can be described as a master-slave relationship.

The server or central computer of the SCADA system (MTU) is usually located in the control center and enables two-way communication and control of remote monitoring devices.

The role of the server is to:
› initiates communication with remote devices,
› collects data and stores it,
Transmitting information to other systems.
› Allows the user to interact with the process.

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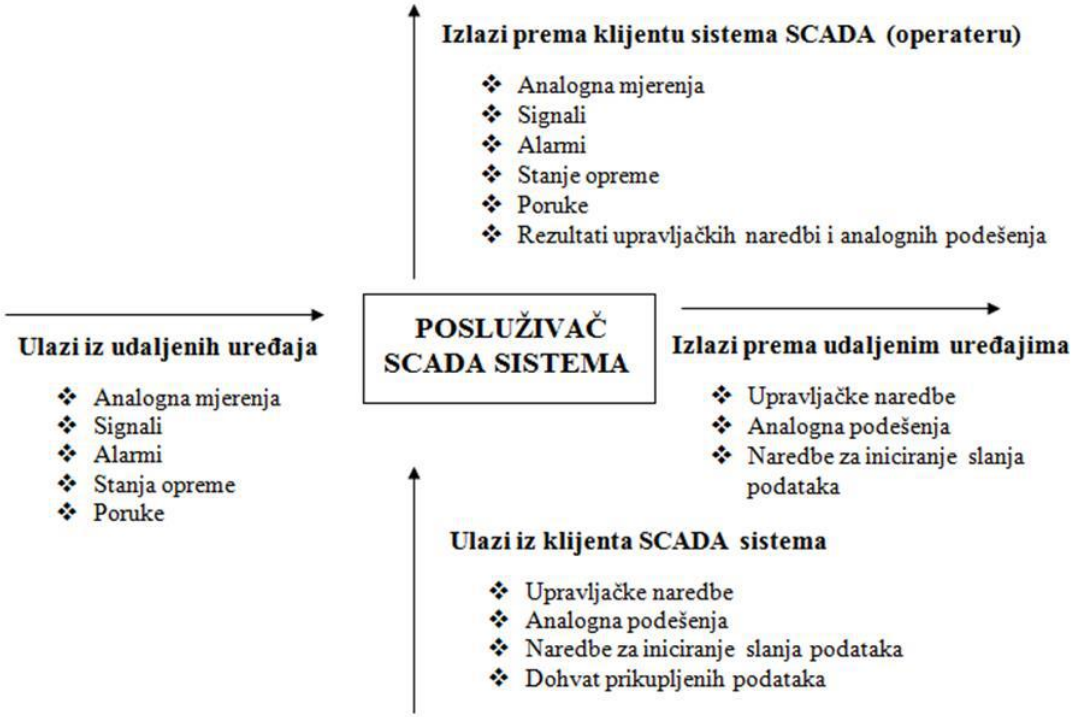
Messages that the SCADA system server exchanges with other components of the system



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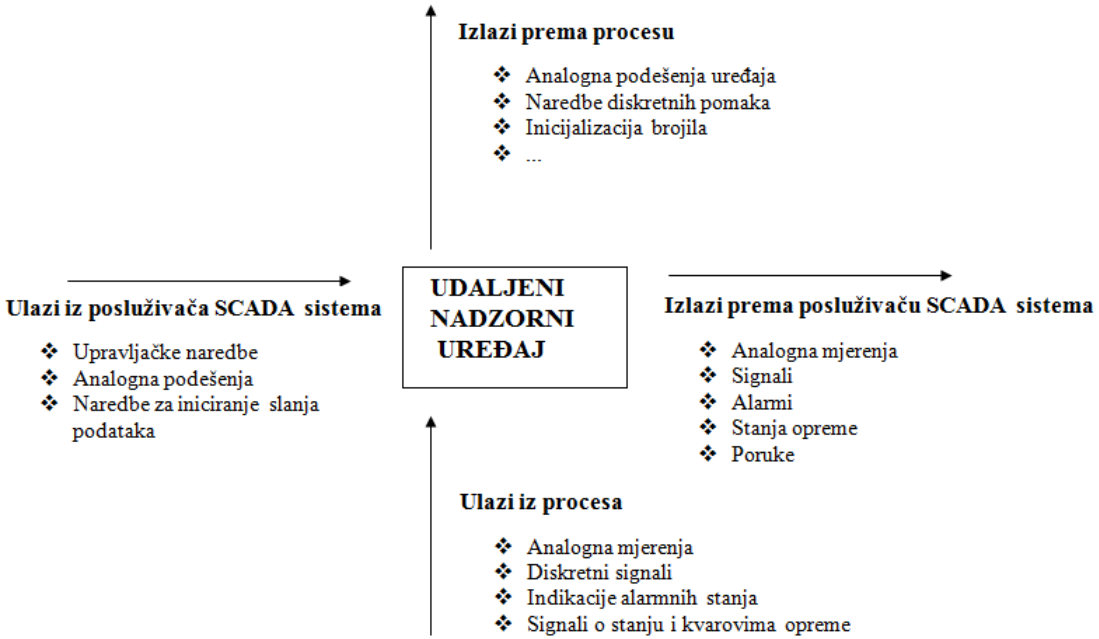
Remote monitoring devices (RTUs) collect the following data from various objects in the EES: analog measurements (e.g., current voltages and currents), discrete states (e.g., circuit breaker state: on/off), meter data, etc.



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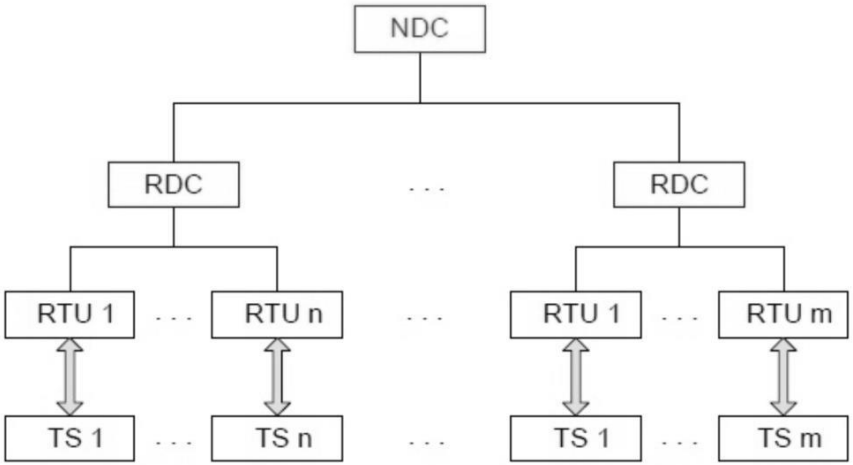
For the safe and reliable operation of the power system, it is very important to carry out the quality of the monitoring and control functions (system management).
The concept of production management, transmission and distribution network is mainly based on the hierarchical principle.



National Dispatching Center – NDC
Regional Dispatching Center – RDC

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Some of the problems:
In most existing centers, the time it takes for a piece of information to get from a metering point to the NDC is from a few seconds (even longer).

Such long delays and especially their non-simultaneity are one of the important reasons that affect the quality and speed of response of the functions of the monitoring and control system.

In modern dispatch centers, instead of a centralized structure, a distributed, networked structure of the management system is used, which is significantly more flexible and faster compared to conventional systems.

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Transmission Network Management SystemThe foundation of every transmission network management system is the SCADA system, which collects and processes the data necessary for operational management.

Based on the collected data, various calculations and analyses are conducted, leading to decisions that are critical for safe and efficient management.

Real-time operations involve automatic functions of the SCADA system and the EMS system (online calculations) - these processes are carried out independently of dispatcher requests.

Offline calculations are performed on archived (study) files and are utilized in analyzing performance and planning operations of the EES.

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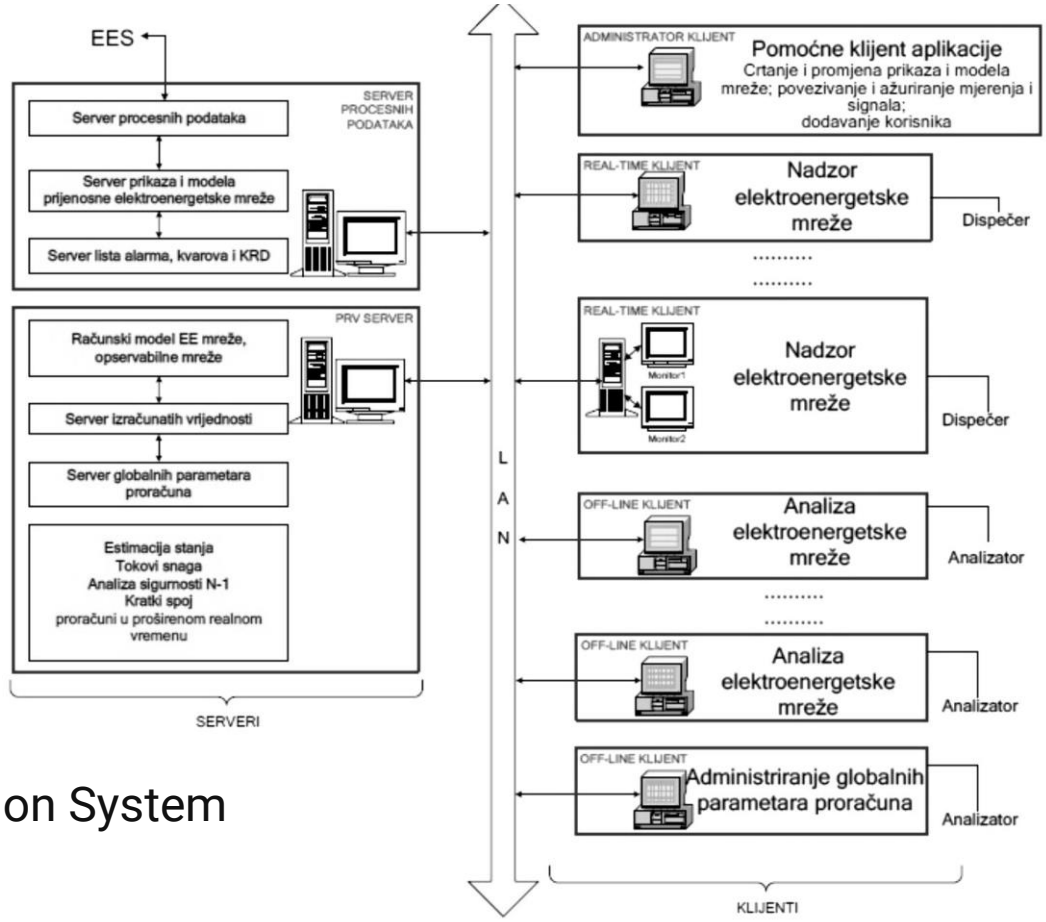

General Structure for Transmission System Management

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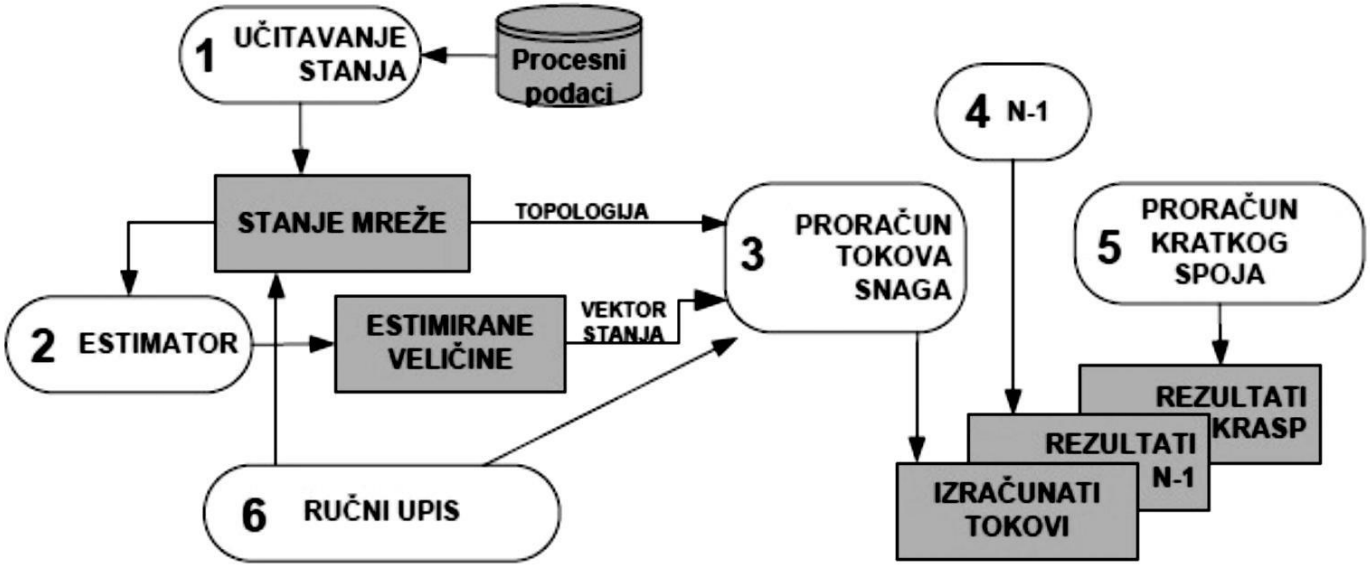

Structure and sequence of EMS calculation execution in the management of transmission networks.

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Distribution Management System (DMS) is a system that performs the functions of monitoring and managing the distribution of electricity at the MV level.

There are some similarities between transmission and distribution network management systems, but also differences.

Similarities (data collection, processing and display to the operator, calculations, archiving, etc.)

Differences (method of control of the drive (radial, radial, transmission networks – trapped, looped), a higher number of failures, switchgear along radial lines...)

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Example of process quantities: Transmission line (cable) inlet and outlet bays, 35 and 10(20) kV

Commands - Switch Command
Measurements – three currents, active and reactive power, active and reactive energy Signaling – signaling of the position of the switch, signaling of the position of the bus disconnector-system I, signaling of the position of the bus disconnector-system II, signaling of the position of the line disconnector, signaling of the position of the ground coupler, signaling of the position of the retractable (moving) part of the cell.
Alarms - overload protection I>, short circuit protection I>>, ground fault protection, automatic restart-operation, automatic restart-interlock, present voltage at the drain – 3 phases, operation of the automatic auxiliary control voltage fuse, operation of the automatic auxiliary voltage protection fuse, operation of the automatic auxiliary voltage fuse – electric motor drive, operation of the automatic auxiliary voltage fuse of signaling....

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Basic Analytical Functions of EMS

Network functions: Topology check, State estimation, Detection and identification of bad measurements, Short-term load forecast, Power flows, OPF, n-1,...

Generator functions: Generator selection in operation, Reserve monitoring and analysis, Frequency regulation, Economic dispatching, Hydro-thermal coordination, Stability.

Market functions: Forecasting of market prices of energy and ancillary services, Calculation of transaction costs, Contract management, Processing of transactions with other EESs....

THANK YOU FOR YOUR ATENTTION!