HANDOVER MECHANISMS

In the heterogeneous network medium horizontal and vertical handovers are proposed in the earlier literature.

High mobility support will require good scalability of handover framework to be able to handle increased handovers without compromising latency performance [17].

Handover in both IEEE 802.16m and 3GPP LTE-Advanced systems is hard handover and network-controlled; that is, the network decides the target 16m BS (or eNodeB in 3GPP LTE) for the 16m MS (or UE in 3GPP LTE) to hand over to, while some flexibility is allowed for the MS to suggest alternative candidates. Seamless handover and entry before break handover features are advanced handover enhancements that are based on the general handover call flow, whereas legacy supported handover and multicarrier handover features are newly introduced in the IEEE 802.16m air interface protocol. [17]

Seamless internetworking of heterogeneous networks is a challenging task as it requires comprehensive real-time interconnectivity at all layers of the network architecture. In evolutionary mobile communications, one of the most challenging issues is seamless vertical handover (VHO), which is a handover process of an ongoing communication session between different networks. There are three major guidelines in designing VHO solutions between heterogeneous networks. First, the solution should not require significant changes to legacy systems since service providers do not want their existing systems to be modified due to cost and complexity. Second, the signaling process should be optimized, because VHO is a time-consuming process that could result in significant data traffic loss. Third, an IP-based solution is preferred to facilitate internetworking of current network systems and for potential extension to other heterogeneous accesses. [18]

Handover process involves the following phases [16]:

- Handover initiation
- Network and resource discovery
- Network selection
- Network attachment
- Configuration (identifier configuration; registration; authentication and authorization; security association; encryption)
- Media redirection (binding update; media rerouting)

In [14] handover decision criterias are listed in four categories:

- Network-related: coverage, bandwidth, latency, link quality (RSS (Received Signal Strength), CIR (Carrier-to-Interferences Ratio), SIR (Signal-to-Interferences Ratio), BER (Bit Error Rate), etc.), monetary cost, security level, etc.
- Terminal-related: velocity, battery power, location information, etc.

- User-related: user profile and preferences.
- Service-related: service capabilities, QoS, etc.

These criteria can be classified into static and dynamic depending on the frequency and causes of changes. Typically static criteria are user profile and the cost of the different access networks, whereas the MT's velocity and RSS are typically dynamic crit eria.[14]

Table 1 Information parameters pertinent to the VHO process.

Layers	Parameters
Application	User preferences (e.g. cost, provider)
	Context information (e.g. speed)
	QoS parameters (e.g. bw offered, delay, jitter)
	Security alerts (e.g. notifications)
Transport	Network load (e.g. bw available)
Network	Available foreign agents
	Network pre-authentication
	Network configuration
	Network topology
	Routing information
Data-link	Radio access network conditions
	Link parameters
	Link status
Physical	Available access media

In [19], an overview of vertical handover proposals in HWNs are given and compared considering networking technologies. According to their observation, most proposals (72.9%) evaluate the VHO using only two technologies, being that the remaining 27.1% of the proposals have considered three technologies instead. In addition, about 53.6% of the proposals focus on evaluating the VHO viability between Wi-Fi and UMTS. The main drawback of this broad variety of solutions stands in the fact that none proposes a unique homogeneous approach that can be adapted to all the available wireless technologies.

Following the principles of IEEE 802.21, an additional service access point is introduced to implement the control plane for the combined network and transport layer. Also, messages are split into events, being transferred from the network layer to the application layer, and commands, being sent the other way around. The control plane of the combined transport and network layers is named the "Mobile Mediator Control Function - MMCF" and shares functional entities for mobility management, access network selection, network monitoring, and policy engine with the user plane. [12]

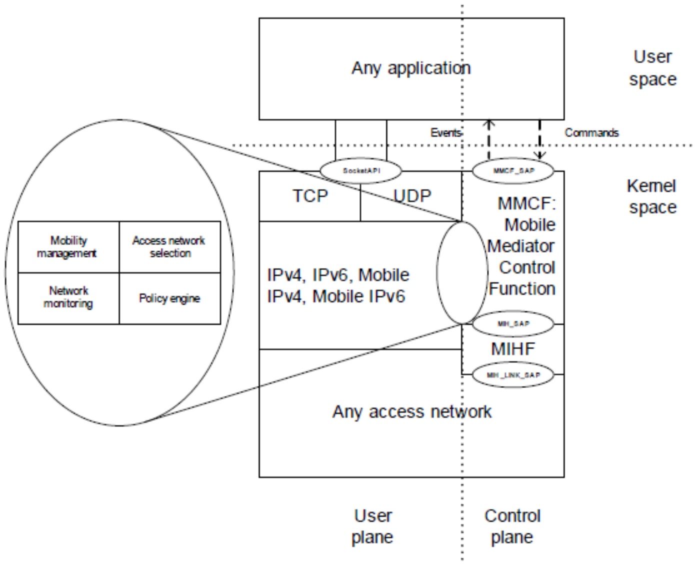

Fig. 3 User Plane and Control Plane of the MMCF Architecture [12]

During the communication, the terminal collects neighboring and serving access network characteristics, available radio interfaces, terminal capabilities, service degradation and terminal's movement speed. This information is used for managing radio interfaces, identifying the need for handover, and selecting the best access network among available ones. Based on this information, the interface management will decide to turn on, off or stand by one or more existing radio interfaces to optimize the power consumption. Interface management becomes thus a constraint for network selection. In the terminal-controlled handover, user preferences should be configured for different contexts which are characterized by current location, velocity and QoS class of running applications. Future mobile terminals will have to provide users facilities (e.g. Graphical User Interface dedicated to user preferences configuration) to specify and alter their preferences in an easy manner. Besides, it is necessary to have an experience repository where experiences of using different access networks are registered. It contains a black list of access network operators with whom the user has had a bad experience. The repository is updated through the feedback from handover execution failures. Users can specify the black list and remove a specific access network from this list.[12]

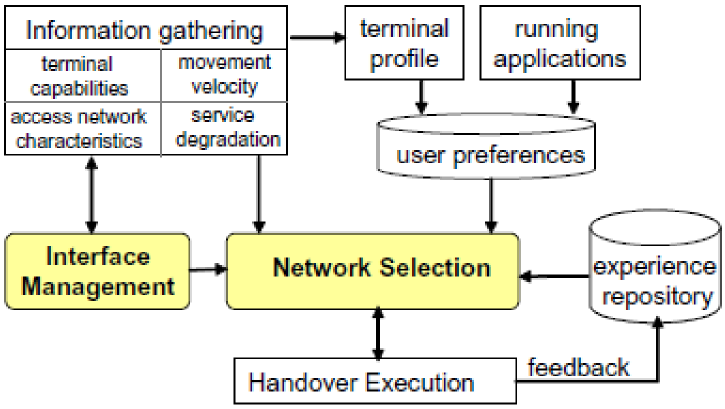

Fig. 4 Terminal handover framework [12]

POWER MANAGEMENT

Since next generation mobile devices are required to have anywhere anytime connection and more computation power for user-centric advanced mobility, handover and QoS mechanisms. In [23] advanced power saving mechanisms such as idle mode and sleep mode for IEEE 802.16m and DRX mechanisms for 3GPP LTE are explained. There are three states are defined for mobile nodes to help power conservation: receive or send traffic, not receive or send traffic while in active sessions and not in an active session. When the mobile node is not sending or receiving any traffic, it can temporarily shut down its transmitter or receiver.

Today's all-in-one portable devices integrated with additional peripheral devices like camera, MP3 player, FM radio have lots of components that drain battery. Mobile devices are equipped with multiple radio interfaces such as 2 G/3G cellular radio transceivers, WiFi, WiMAX, and Bluetooth. Each consumes energy while powered on, an efficient interface management is therefore required to optimize the power consumption. For this purpose studies such as [21, 22] are done which includes many criteria as well as battery life criteria in handover decision making.

CONCLUSION

In the next generation heterogeneous wireless environment which is referred as 5G here, mobility management, handover decisions, network selection and QoS are open research issues and these issues can't be optimized separately. All of them are interconnected to each other. It is not possible to make handover decision without considering QoS parameters, network parameters and mobility parameters. For each issue there are two types of approaches: network-based or client-based, in other words network-centric or user-centric. Regarding the complexity of network-based solutions, user-centric approaches are seem to be more applicable and don't require many deployment changes on the network side. Recent user equipments are developing and have more powerful processing units and more memory compared to previous decade. This means they will be capable to process algorithms for handover, network selection- one or more at the same time and to store QoS history together with other parameters. On the other hand power conservation mechanisms are under development for mobile terminals to ensure capability of high level evaluation of QoS and network parameters.

Also collaboration between layers in other words cross-layering is necessary to achieve higher QoS and more informed access network selection. Rather than selection of best network between different RATs, to enable more than one access network selection simultaneously could be a more feasible option. To achieve this, different interfaces on the mobile terminal should be coordinated. This approach may prevent unnecessary handovers. For future work mobility management, network selection and handover mechanisms in next generation wireless heterogeneous networks will probably be evaluated in the frame of "accessing multiple networks simultaneously".

REFERENCES

1. Willie W. Lu, "An Open Baseband Processing Architecture for Future Mobile Terminals Design", IEEE Wireless Communications, April 2008.
2. Toni Janevski, "5G Mobile Phone Concept" – CCNC conference in Las Vegas, 2009.
3. Irfan Ali, Alessio Casati, Kuntal Chowdhury, Katsutoshi Nishida, Eric Parsons, Stefan Schmid, Rahul Vaidya, "Network-Based Mobility Management in the Evolved 3GPP Core Network", IEEE Communications Magazine , February 2009.
4. John Fitzpatrick, Séan Murphy, Mohammed Atiquzzaman, John Murphy, "Using cross-layer metrics to improve the performance of end-to-end handover mechanisms", Computer Communications, Elsevier, 32 (2009) 1600–1612, doi:10.1016/j.comcom.2009.06.005.
5. C.E. Perkins, Mobile IP, Communications Magazine IEEE 35 (5) (1997) 84–99.
6. D. Johnson, C. Perkins, J. Arkko, Mobility Support in IPv6, RFC 3775 (Proposed Standard), June 2004.
7. Shaojian Fu, Liran Ma, Mohammed Atiquzzaman, Yong-Jin Lee, "Architecture and Performance of SIGMA: A Seamless Mobility Architecture for Data Networks", IEEE International Conference on Communications – ICC, 2005.
8. D Crocker, "Multiple address service for transport (MAST): An extended proposal", draft-crocker-mast-protocol-01. txt, 2003, Available at: http://www.bbiw.net/specifications/draft-crocker-mast-proposal-01.doc,
9. R. Moskowitz, P. Nikander, P. Jokela, T. Henderson, Host Identity Protocol, draft-ietf-hip-base-06.txt, Internet-Draft, work in progress, IETF, June 2006.
10. W.M. Eddy, "At what layer does mobility belong?", IEEE Communications Magazine, Oct. 2004, pp. 155-159.
11. Kenichi Taniuchi, Yoshihiro Ohba, Victor Fajardo, Subir Das, Miriam Tauil, Yuu-Heng Cheng, Ashutosh Dutta, Donald Baker, Maya Yajnik, and David Famolari," IEEE 802.21: Media Independent Handover: Features, Applicability, and Realization", IEEE Communications Magazine, January 2009.
12. Karl Andersson, Christer Ahlund, Mobile Mediator Control Function: An IEEE 802.21-based Mobility Management and Access Network Selection Model", ICT-

MobileSummit 2009 Conference Proceedings, IIMC International Information Management Corporation, 2009, ISBN: 978-1-905824-12-0.
13. Hannes Ekström, “QoS Control in the 3GPP Evolved Packet System”, IEEE Communications Magazine, February 2009.
14. Meriem Kassar, Brigitte Kervella, Guy Pujolle, “An overview of vertical handover decision strategies in heterogeneous wireless networks”, Computer Communications 31 (2008) 2607–2620, Elsevier, doi:10.1016/j.comcom.2008.01.044.
15. Aleksandar Tudzarov, Toni Janevski, “M-RATS: Mobile-based Radio Access Technology Selector for Heterogeneous Wireless Environment”, 18th Telecommunications forum TELFOR 2010, Serbia, Belgrade, November 23-25, 2010.
16. William J. Song, Jong-Moon Chung, and Daeyoung Lee, Chaegwon Lim, Sungho Choi, and Taesun Yeoum, “Improvements to Seamless Vertical Handover between Mobile WiMAX and 3GPP UTRAN through the Evolved Packet Core”, IEEE Communications Magazine, April 2009.
17. Ronny Yongho Kim, Inuk Jung, Xiangying Yang, Chao-Chin Chou, “Advanced Handover Schemes in IMT-Advanced Systems”, IEEE Communications Magazine, August 2010.
18. Adrian Popescu, David Erman, Dragos Ilie, Markus Fiedler, Alexandru Popescu, and Karel de Vogeleer, edited by Demetres D. Kouvatsos, “Seamless Roaming: Developments and Challenges”, In Lecture Notes In Computer Science 5233, Springer, 2011, Pages: 795-807, ISBN: 978-3-642-02741-3.
19. Johann Marquez-Barja, Carlos T. Calafate, Juan-Carlos Cano, Pietro Manzoni, “An overview of vertical handover techniques: Algorithms, protocols and tools”, Computer Communications 34 (2011) 985–997, Elsevier, doi:10.1016/j.comcom.2010.11.010.
20. Ronny Yongho Kim, Shantidev Mohanty, “Advanced Power Management Techniques in Next-Generation Wireless Networks”, IEEE Communications Magazine, May 2010.
21. M. Mansouri and C. Leghris, "A battery level aware MADM combination for the vertical handover decision making," *2017 13th International Wireless Communications and Mobile Computing Conference (IWCMC)*, Valencia, 2017, pp. 1448-1452.doi: 10.1109/IWCMC.2017.7986497
22. S. Kunarak and R. Sulessathira, “Vertical Handover Decision Management On The Basis Of Several Criteria For Lvqnn With Ubiquitous Wireless Networks”, International Journal of GEOMATE, June, 2017, Vol.12 Issue 34, pp. 123-129 Geotec., Const. Mat. & Env., ISSN:2186-2990, Japan, DOI: http://dx.doi.org/10.21660/2017.34..2730

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Determination of heat demand and optimal production capacity for yeast production by use of MS Solver

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ABSTRACT

The main cost of production is directly related to the heat demand, the quantity of used raw material and the prices of raw materials and utilities. This value could be optimized. So, the main task of this work would be the minimization of heat energy demand and maximization of production capacity. For these purposes, it was created a simulation model as mathematical function of all inputs and outputs of the analyzed system. That model is based on mass and heat balances for all streams which connect processing units in different modes of work as batch, continuous, semi-continuous and feed-batch. This mathematical model was made in MS Excel. All variables like temperatures and flows are inserted in that worksheet and calculated from set of equations for mass and heat balances. Change of values for input variables (quantity of raw materials), cause changes of all processing parameters and parameters that characterize final products. The optimization is done with MS Solver. That tool use only one parameter as objective for optimization. Because of that, three different objectives were chosen for three different optimization goals for the production processes. Optimization was done as minimization of total heat demand, maximization of final product's capacity and minimization of the common parameter that relate to heating demand and production capacity. The use of the common parameters for heat demand and production capacity gives the best result, because it minimized heat energy and maximizes production capacity. This optimization also created optimal process scheduling as its result.

Keywords: ***optimization; heat demand; heat recovery; Baker`s yeast***

ABREVIATIONS

μ - specific growth of microorganism
E – energy [kJ]
e – energy flow (streams) [kW]
FBD – fluid bed dryer
FT – feeding tank
g – gravity [9.81 m/s^2]
h – enthalpy [kW]
HE – heat exchanger
in – inlet
j – processing unit (machine)
M – mass [kg]
m – mass flow [kg/s]
MILP – Mixed Integer Linear Programing
MX – mixer
out – exit
p – product, exit streams
PSP – phase separator
Q – heat energy [kJ]
r – entering streams
S – system
SP – centrifuge (separator)
SS – subsystem
V – velocity [m/s]
VF – vacuum filter
W – work [kJ]
z – high [m]
τ – time [s]

1. INTRODUCTION

Batch production is widely used. It is flexible to control the quantity and quality in fabrication of products. Batch processes are favorable for manufacture of high-valuable products, but that way of production makes additional problems to scheduling of equipment involvement and process`s order and length. Furthermore, batch processes are mode of production that has higher demand of energy and other kind of utilities, compared to continuous processes. So, scheduling and utility demand is very important for batch processes. Scheduling of processes is depending by many factors. The first and most important factor for scheduling is the production process itself. Production processes make the order of events and predict its duration. The other factors that have an impact to the scheduling are quantity of products that need to be produced, heat demand, cooling utility demand, electricity demand, raw material`s demand, efficiency of processes as well as loss of energy and mass from processes. According to that, the basic technological schedule needs to be optimized. Optimization means minimizing of make span, minimizing production cost and maximizing of profit. The objective for optimization could be time, quantity of products, energy, raw material, prices, costs and other factors. The main task of this work is determination of process`s length and schedule in case of minimized energy use.

There are many researches related to methodology and directions of cost minimization. Janak and Floudas report for existing of different scheduling methodologies [1]. In general, mixed integer linear programming is used for those purposes. Kondili et al. [2] make discrete the entire time period into the number of equal duration intervals and associate different task events to the boundaries of the intervals. They explore two methodologies that could be used for scheduling and heat integration together. Simultaneous and sequential approaches are those optimization methodologies. Simultaneous approach takes scheduling and heat integration into account simultaneously and can lead to be global optimum. There are some disadvantages of simultaneous approach methodology. Those disadvantages are linear model of utility demand, limiting temperature constraint for heat transfer is not considered, as well as heat exchange superstructure network needs to be specified a priori. The second methodology, sequential approach take scheduling and heat integration as separate problems and does not require simplifying assumption such as one-to-one heat exchange and reinstalled heat exchanger unit. Disadvantages of sequential approach are possibilities to lead to the global optima, but not always. Lee and Reklaitis choose maximum energy recovery as objective for optimizing problem for batch processes scheduling [3]. Papageorgiou et al. [4] describe a procedure for determining optimal policies for thermally coupled batch operations by using dynamic optimization techniques. There are different combinations of tactics used in sequence approaches. Pinch technology and heat cascade analysis as its part are used to minimize heat energy on already prepared schedule of batch processes. Some of them use pseudo-continuous behavior of batch operations. Kemp, McDonald and Deakin divide process as a set of temperature and time intervals [5, 6]. There, heat is taken as cascades. Work of Vaselenak et al. [7] explore the possibility of heat optimization over a predefined production schedule. Optimal solution is find by using a combined heuristic and MILP optimization methodologies. Vaklieva-Bancheva et al [8]. use minimum cost as objective for optimization of preinstalled heat exchange units. Other scientists as Halim and Srinisvan [9] use sequential methodology for scheduling of heat integrated batch plant. Corominas et al. and Font et al. report solution for problem of energy integration in batch plants for a given production schedule [10]. Some of the suggested approaches and methodologies by different researchers have many disadvantages. Sequencing approach gives more accurate results. This work illustrates case study based on yeast and alcohol production plant. There could find a batch, semi-continuous, feed-batch and continuous processes. Batch, semi-continuous and feed batch processes are the reason for time scheduling of production processes. Simulation of production is the first step. That simulation based on mass and energy balances is the starting point for further optimization. Nonlinear General Reduced Gradient (GRG) method is used for optimization of production plant. That method is part of MS Solver tool. All simulation equations are taken as a set of equations, which are base for optimization (Figure 3). There are limits on chosen parameters given as inequalities, range of changing their values. The objective for this optimization is sum of heating and cooling utilities need. That objective needs to be minimized. The main task is a minimization of energy utilities. In case of minimal energy utilities, production cost decrease. That minimum energy consumption determine time length of production processes at different stages. When determined processing time is connected in an order of those processes in production plant, schedule of production could be designed. That schedule is the case of production with minimal energy consumption and minimal production cost. Scheduling of processes length is also made with optimization of production capacity as well as optimization of heat energy demand per unit of end product. This procedure can be used for optimization of any production plant that involves batch processes.

2. PRODUCTION SYSTEM

The referent production plant as base of this work is yeast and alcohol production factory. Production system is divided to sections or subsystems for better process analysis and reorder of a different process`s time periods [11]. Every subsystem is a combination of processes that finish one step of production of yeast and ethanol, separately. For better understand of this work is good to represent the system. This production system is divided into the following subsystems (Figure 1): A – preparing of raw materials, B – aerobic fermentation (yeast production), C – vacuum filtration for fresh yeast, D – vacuum filtration for dry yeast, E – continuous drying of yeast and packaging, F – anaerobic fermentation (ethanol production), G – distillation system and alcohol storage, U – utility preparing and distribution.

2.1 Subsystems

All subsystems are connected between them. There are two paths of production that start from subsystem A (Figure 1). Subsystem A is the place for preparing molasses and feed salts for both types of fermentation. Hot water and raw molasses are mixed, and its pH value is adjusted. That mixture contains solid particles that must be separated. Sediment and other solid impurities are taken out with centrifuges SP1 (Figure 1). Molasses's solution is going to sterilization with indirect heating HE1 (Figure 1). Already sterile molasses is cooling within vacuum expander - phase separator PSP (Figure 1). In that stage, volatile components are allocated from solution. Finally prepared molasses's solution is ready for fermentation processes.

The two paths of production are branching in two directions. The first one is directed to production of yeast, and the other one is going to production of ethanol.

Subsystem B (Figure 1) is the first step of yeast production. It is related with aerobic (aerated) fermentation of yeast. In this stage has production of yeast biomass. Laboratory starter culture through few pre-fermentations is growing up to mother seed yeast. Mother yeast seed is the base for producing of final yeast generation, which need to be prepared for selling as a food product. At the end of aerobic fermentations, fermentation mash is going to the centrifugal separation system for yeast cells and washing SP 2 – 4 (Figure 1). Washed and separated yeast cells represent yeast cream that is stored to cooled storage tanks ST (Figure 1). That is the final stage of this subsystem. If yeast cream is produced from mother cell fermentation, that is the seed for following fermentations, else yeast cream is going to next step of production to separate yeast as solid material.

Subsystem C (Figure 1) represents all processes connected with vacuum filtration. The main maintenances are rotary vacuum filters VF. They are used to take out extra water and separate yeast cells as sediment. Separated yeast has 32 % dry matters and is suitable for packaging as fresh yeast. If some quantity of yeast is planned to be produced as dry yeast, than fresh yeast is separated and dried in subsystem for that.

Subsystem D (Figure 1) contains also rotary vacuum filter VF. This filtration is used to separate yeast cells for production of dry yeast.

Subsystem E (Figure 1) covers all processes for drying and packaging of dry yeast. Separated yeast from rotary vacuum filters (subsystem D) enter in the continuous dryer (FBD – Fluid Bed Dryer). Produced dry yeast contain 95 % dry matters. Dry yeast is transported to silo ST2 (Figure 1) and is going to packaging.

Another branch from subsystem A is directed to production of ethanol. That path is starting with subsystem F (Figure 1). That subsystem cover anaerobic fermentation of yeast. Mixture of molasses and feed salts as well as yeast cells form fermentation mash. That is fermented without presence of air (oxygen). As a result of anaerobic fermentation, the most of the quantities of present fermentable sugars are transformed into ethanol (ethyl alcohol) and some small quantity of new yeast biomass. Yeast biomass is slightly increasing, but almost all sugar quantities are transformed into ethanol. Fermented mash at the end of fermentation is going to the separation unit SP5 (Figure 1). Separated yeast is the seed for next anaerobic fermentations. Liquid part of fermentation mash is not containing yeast cells and represent alcoholic mash. Yeast is separated as yeast cream and stored in cooled tanks. Alcoholic mash is stored into feeding tanks FT (Figure 1) for supply of distillery subsystem. Subsystem G (Figure 1) consists of distil columns DC 1 – 3 connected in series.

There, ethanol and other impurities are separated. Final products of this subsystem are refined alcohol (97 %Vol ethyl alcohol) and technical alcohol (mixture of higher alcohols with high content of ethyl alcohol).

Subsystem U (Figure 1) is containing all equipment for production and distribution of steam, cold and hot process water, technical water and heating of administrative and production departments. This is so-called utility subsystem.

Whole this system is the base for determination of equation set for its simulation.

2.2 Scheduling

All those processes mentioned in subsystem description need to be scheduled. This system is working in batch mode, except some parts. Scheme given on Figure 1 show technological order of all processes in production. There is an opportunity to change processes' time periods (sequences). The main problem is to make the schedule of all those processes to have minimum energy consumption and to get maximal production of yeast and alcohol. Fermentation scheduling is also connected with other processes, but it could be ordered and reordered independently as the main process. Aerobic fermentation system is containing few different pre-fermentation units and three yeast production fermenters. Pre-fermentation stages produce seed for mother yeast cells. Those mother yeast cells are seed for final production of Baker`s yeast. Capacities of yeast production fermenters are with different sizes. Fermentation stage is a combination of final fermentations that are doing in the same time in different fermentation units. Time scheduling of fermenter`s occupation is shown on Figure 2. The batch for mother yeast is the seed for five new fermentations Mother yeast cream is divided into seven parts. The number of 7th parts as seed is determined with fermenter size. Smaller fermenters use 1/7 part of mother seed. The quantity of seeding yeast for double size fermenter is duplicated (3+4/7 and 6+7/7 parts of mother yeast). So, there are two small size fermenters and double-size fermenter for final yeast production. Every fermentation finish with separation of yeast cream. After that, units are cleaned (CIP), sterilized (SIP) and prepared for next fermentation.

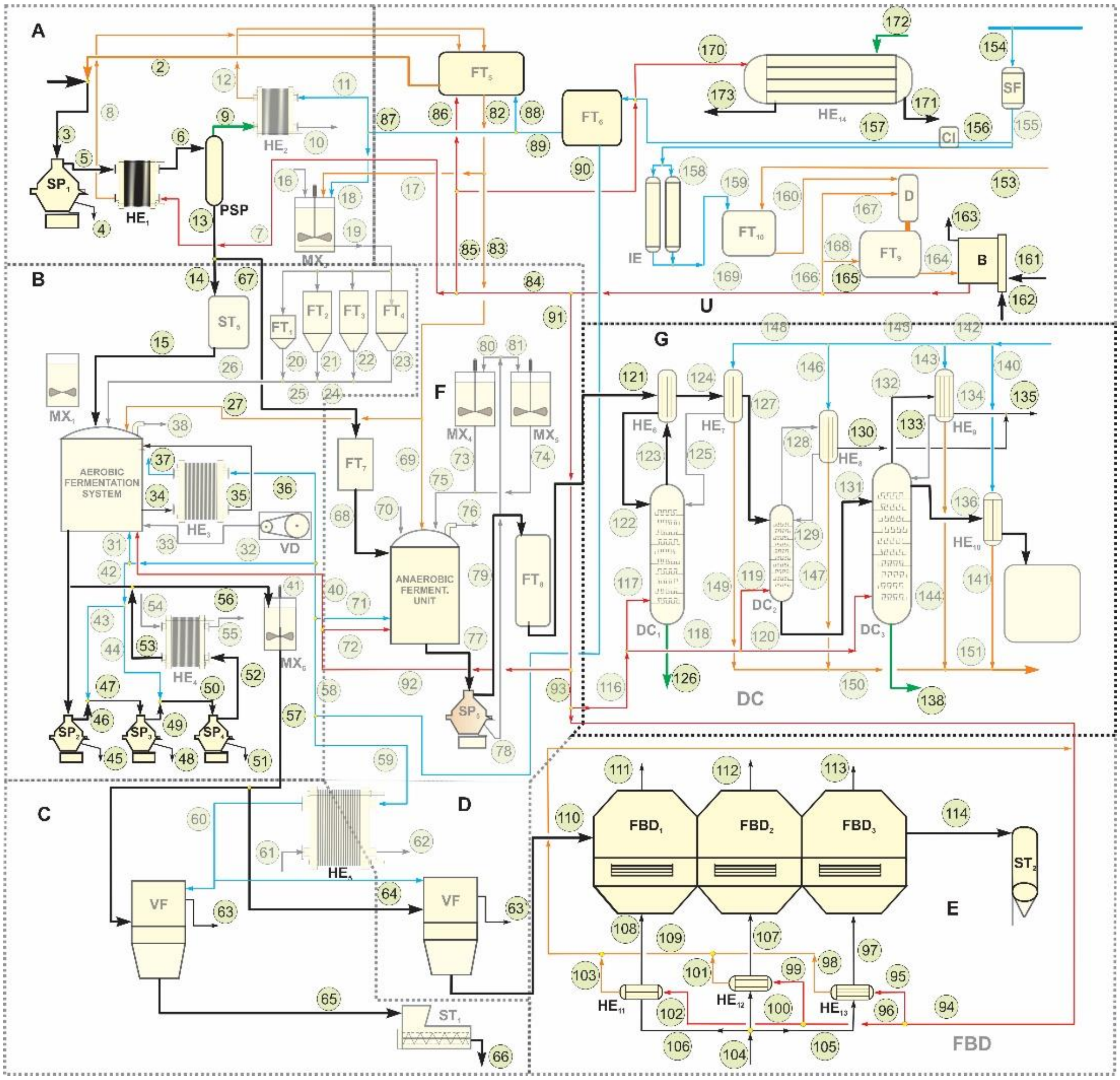

Fig. 1. Processing scheme for production of yeast and ethyl alcohol with its subsystems. All steam`s descriptions and processing units shortcuts are given on stream list and symbols (Apendix A); (dotted lines are subsystem boundaries, and bold arrows are two main routes of production)

. Schedule shown on Figure 2 is taken to have constant overall production time for each fermentation. The processing time of fermentation is the same and is designed by the characteristics of fermenter and feeding molasses. Fermentation time depends on molasses feeding as a feed-batch process. Its processing time could be changed with changing of quantity and quality of molasses. In case when quantity of feeding molasses is changed because of changing of fermentation recipe or changed content of sugar, fermentation time for all fermenters will be changed for the same value. It not depends on size of fermenters.

Other processes inside the system are ordered with its beginning from subsystem A, to B, C, D and final E for yeast production and beginning from A to F and G for ethanol production. All processes' length depends on quantity and quality of molasses. So, system optimization depends from molasses quantities, its quality and process temperatures.

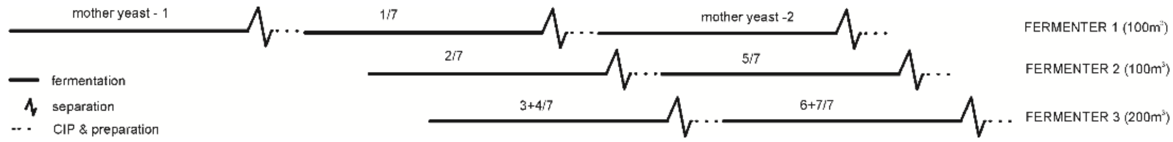

Fig. 2. The Schedule of Fermentation Batches

3. MODEL DESIGN AND OPTIMIZATION

In this study is used mathematical modelling principles for optimization of production plant. Mathematical model of facilities is determined, and based on mass and heat energy balances. All those balances form set of equations for certain part of the production process. The strategy of connection between models of different parts is using of variables that depend on values of other parameters from previous production steps. At the end of creating this set of equations, values of finally produced products is directly depending on values of parameters determined for input raw materials. That is actually the simulation of production as function: Products = f(raw materials). That means all different products are depending in some way with quantity and quality of raw materials. Fresh yeast is depending on quality and quantity of raw materials similarly as dry yeast depends on it. This model in practice is prepared in MS Excel worksheet. All parameter`s cells in MS Excel worksheet are connected between themselves with equations of mass and heat energy equations. If some input value of raw materials change, result will change quantity and quality of final products. Heat energy that is used for preparing of raw materials, different processes of sterilization, heating or cooling are directly connected with input values of raw materials. As e.g. could be taken the value of sucrose concentration in molasses. That is a very important parameter for bioprocesses. Sucrose is sugar that is transformed into yeast biomass or into ethanol (biochemical transformation). The quantity of used molasses is depending on this value. Smaller concentration will use larger quantities of molasses and smaller quantities of hot water to be prepared molasses solution with standard concentration of sugar. That will have an impact with heat energy that needs to be used for sterilization of molasses solution. That is the way of functioning this simulation model. All heat energy consumption is relating with every process of heating and cooling in production plant. Those values as parameters could be chosen for heat energy minimization. In this study are made few cases according to heat energy consumption. Those are cases with an objective for optimization such as the sum of heat for all heating processes, sum of heat for all cooling processes and total sum of all heating and cooling energy. MS Excel has Solver as an excellent optimization tool. MS Solver use objective as value that need to be minimized, maximized or to set as 0. There also need to choose parameters which values will be changed over the process of optimization. Furthermore, optimization methods need limits of parameter`s values. Those limits must be filled as set of inequalities. MS solver makes