



Services Model of Microlet Public Transport Based on Characteristics Movement on Medium City Scale

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Abstract -- Mode of transport in the form of urban transportation has a very urgent role in supporting the growth and the development of a city. Microlet is the only public transportation owned by the city of Palu in performing services for users, this public transportation is increasingly unpopular and users tend to be abandoned because of the easiness to get it is very difficult in a sense; where waiting place is not clear, there is no certainty of a long waiting, the negotiations of travel destination and the time required for travelling can not be predicted. The research objective is to create a model that is suitable to be applied based on the people movement characteristics, with the hope of such urban transportation is still able to survive and operate as stakeholders demands (user, operator / driver and government) and at the end people tend to choose public transportation as an option main mode of transportation in supporting their daily activities. The method of analysis used in modelling the transport trajectory is superimpose method with consideration of; land use patterns, the movement pattern of passengers urban transportation, population density, the service area and the road network characteristics. Based on the analysis of the division of three zones studied region, then the application of fixed route is still can be carried out in zone 2 as a downtown area that includes 4 districts namely; West Palu subdistrict, Tatanga, South Palu and East Palu, while the two other zones, namely zone 1 and zone 3 as connector to the city center, city transportation routes can be applied in accordance with the national road that crosses the area of the zone.

Key words: models, microlet, based on characteristics

I. INTRODUCTION

The role of transport is an essential element in supporting urban activities, especially with the rapid development of the growing urban areas that are not controlled either grow naturally or as a result of migration (urbanization) [1]. This condition influences the structure of the region that is likely to lead to the formation of the spatial region with many centers, especially along the road connecting the centers of activity and across administrative areas [2]. There is also the phenomenon of urban sprawl which is characterized by the development of the region with a low density as well as the symptoms change out of land in suburbs of the city core administrative areas makes great distance and the time taken from the residence to the place of working or other activities places [3].

The high mobility demands in this urban areas, are not equal to the good quality of transport system services with the concept of sustainable transport, causing transport in certain areas experiencing negative externalities such as inefficient, unequal and unsustainable [4]. The phenomenon that appears related to this imbalance include the tendency of the increasing number of ownership and travel by private vehicles which is not matched by the growth of network infrastructure roads lead to congestion, delay, waste of energy and costs, as well as air pollution and noise [5].

Plus, the existence of inadequate public transport and far from being efficient due to having low capacity so resulted in waste costs and excess energy resources. Whereas the existence of mass public transport is a vital to the metropolitan areas scale that having of high population mobility [6].

Good city is a city that can provide mobility to the community in fulfilling their needs. It can only be achieved if the transportation service can provide a sense of security, convenient, economical, and efficient to users of public transport to travel. In general, the people doing the movement with a different purpose and requires a means of supporting the movement in the form of private transport (cars, motorcycles) or public transport (mass transit or paratransit).

Paratransit is an alternative mode that flexible for passengers and not follow fixed routes and schedules. According to [7], paratransit is operated vehicle with no schedules and routes are defined and can be stopped (picking up dropping down passengers) along the route. Based on [8] paratransit is a kind of service of urban transport on public roads with traffic flow are mixed provided by public or private operators to be used by the specific user groups or the general public. Paratransit is defined as all types of urban transport which is located between the transport owned and operated by the private and conventional public transport under a route and a fixed schedule.

The Supplying of public transport services of urban transport in every region has its own method and characteristics in the way of servicing to its users, it is strongly influenced by the degree of flexibility of the respective areas and the road network system provided. The diversity of the system of urban public transport services in Indonesia, is heavily influenced by the limited means of mass transportation, inadequate infrastructure road network, lack of supporting facilities, the desire of the operator / driver and the policy defined by the respective local governments. Observing the paratransit transportation service systems operating in various regions in Indonesia [9], can be categorized in three models namely; 1). Following the route that has been set for the back and forth trip (fixed route), 2). Following the route that has been set for the back and forth trip, but can be deviated along the corridor route, 3). Have a back and forth trip, but have not been followed (full deviation).

Palu city as the capital of Central Sulawesi province, with a variety of activities will attract the movement of people and goods from various regions and its hinterland to meet various needs / activities, so that urban public transportation (angkot) become the primary choice in making the trip especially for captive users who are no choice but to use public transportation.

The system of urban transportation services in the city of Palu adheres door to door service model is becoming obsolete users (user), this was due to the easiness in getting public transportation more difficult in a sense of; where waiting is not clear, there is no certainty of a waiting duration, it requires negotiations for travel destination, the time needed to travel can not be predicted. In the absence of such certainty, allowing users to switch to public transportation to the motorcycle (ojek) because it is easily obtained, the travel time can be predicted even with a relatively expensive cost.

Congestion problems in the city of Palu also had begun on the certain streets mainly in the area of generating and pulling movements like; residential areas, offices and trade areas, but it also affects the other public service areas such as; schools, markets, malls and surrounded streets because the road segments have been used by the city transport for parking the vehicle in process of passenger waiting to be served.

The level of service that has been felt by the majority of the users is still not satisfactory. Such situation is caused by the inadequate condition of the infrastructure, facilities, and the operating system in supporting the value of a trip such as time, cost, safety, comfort and service. So input from the community on their perceptions of the city transport service system today is required. This is done so that the existence of urban public transportation (angkot) in the city of Palu still exist and can be enjoyed by users. Such input is expected to attract part of private transport users to travel using angkot to meet their needs.

From the description above and the results from previous studies push researchers to conduct a study under title of "Services Model of Microlet Public Transport Based on Characteristics Movement on Scale Medium City" a case study in the city of Palu.

II. LOCATION OF STUDY

City transport service system in the city of Palu has been organized by decision letter of Mayors, where the beginning and end of the trip is set in the terminal or ending at the end of the journey by crossing the routes road that has been set before. But the reality is not capable of running as the expectations of all parties. Due to these routes are not yet implemented causing problems on transportation service performance such as; decreased speed, trip delay, jammed tendency on certain road segments and the impact on the environment in the form of; air pollution, vibration, noise and fuels waste.

Kota Palu is a city in Central Sulawesi, which is part of the State of Indonesia. The population of the Palu city based on the results of registration in 2014 reached to 367 342 people, the average population growth in the period of the last five years is 2.55% per year. The largest population is recorded in the district of East Palu, amounting to 68 674 inhabitants, followed by South Palu districts with a population of 68 385 inhabitants, while the smallest population lies in Tawaeli districts of 19,900 inhabitants [10]. Based on the total population in 2015, Palu City can be categorized as Medium City which is the city having a population between 200,000 s / d 500,000.

Location of study in Palu city with population magnitude and population density within a period of 8 (eight) years is shown in Figure 1.

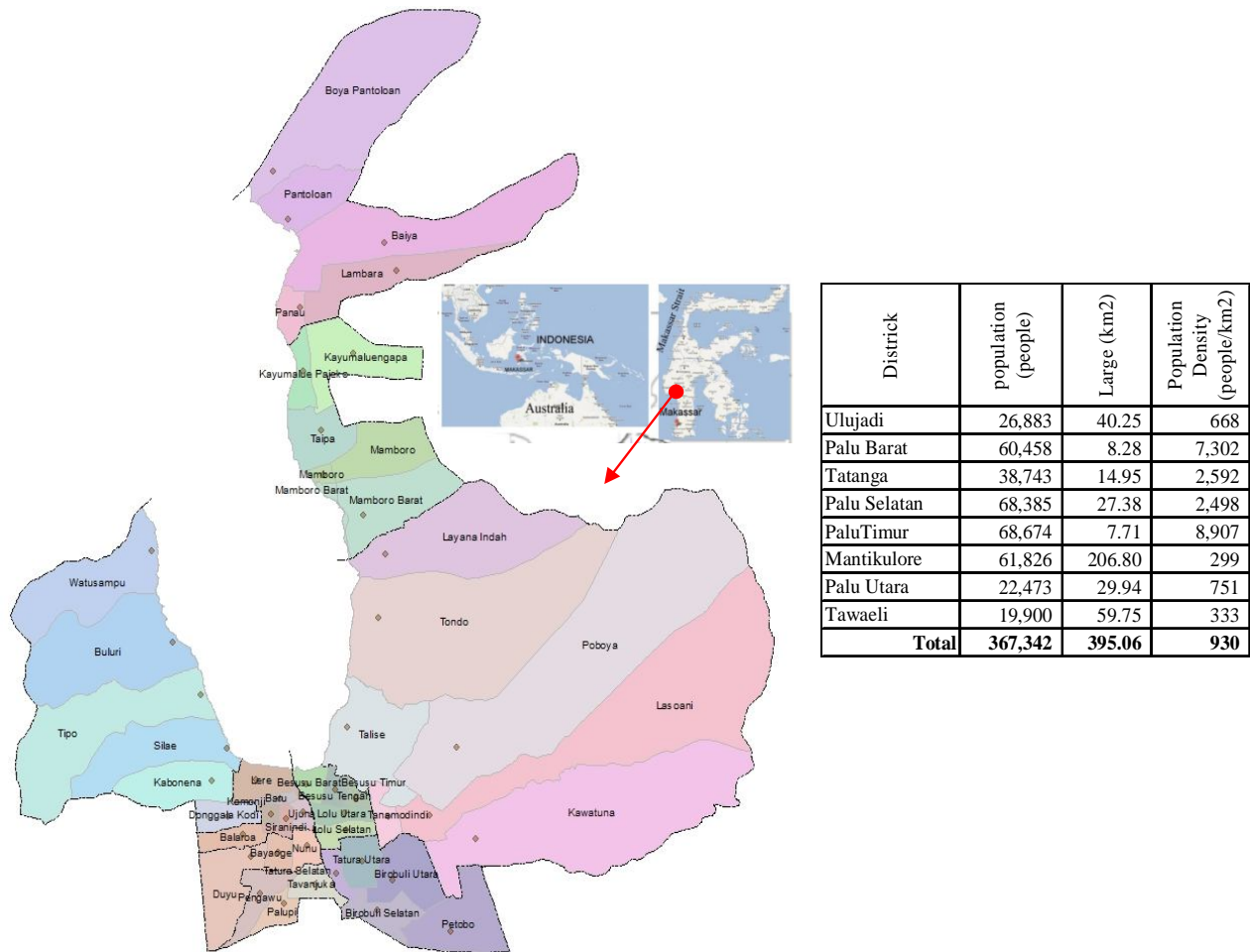


Figure 1 Palu City, Population magnitude and Population Density

III. METHODOLOGY

Model city transport service in the city of Palu was analyzed based on the characteristics of the movement of city transport users. The demand for public transportation can be known by the operation boundaries of the operation required and can not be separated from the structuring of public passenger transport route network [11]. Based on the concept, then the route network as a whole or a set of route will be modeled by considering:

- 1) The pattern of land use, namely public transport services business with good accessibility made to follow a trajectory that land use patterns with potentially high demand;
- 2) The passengers movement pattern of public transport, ie the direction to follow the passenger movemet pattern to more efficient, including modes transfer with public transport can be minimized;
- 3) The population density, namely the trajectory path prioritized in areas of high population density or in the higher potential travel demand.
- 4) The area of services, which are potential areas served and to reach all areas with the concept of equitable distribution of services include the provision of public transport facilities; and
- 5) Characteristics of the road network, namely the configuration, classification, function, the width of the road, and the type of line operation.

Analysis of the urban transport service model done by superimpose technique [12], which compares the system of services that took place today (existing) with movement patterns suited to the users origin purpose,so it can be known or estimated trajectory suitable route is applied to so thatstackholders; manual, driver / operator and the government can be felt the benefits of city public transportation.This analysis was conducted on three zones that are summarized from 8 districts and 45 villages (see Figure 2). Thoseare required zones of city transport user.Superimpose method is based on an overlay of several maps including, origin destination maps, land use maps and maps of population density. Meanwhile in this method is also considering the characteristics of the road network and potential areas to get specialized services for the needs considerable higher demand.

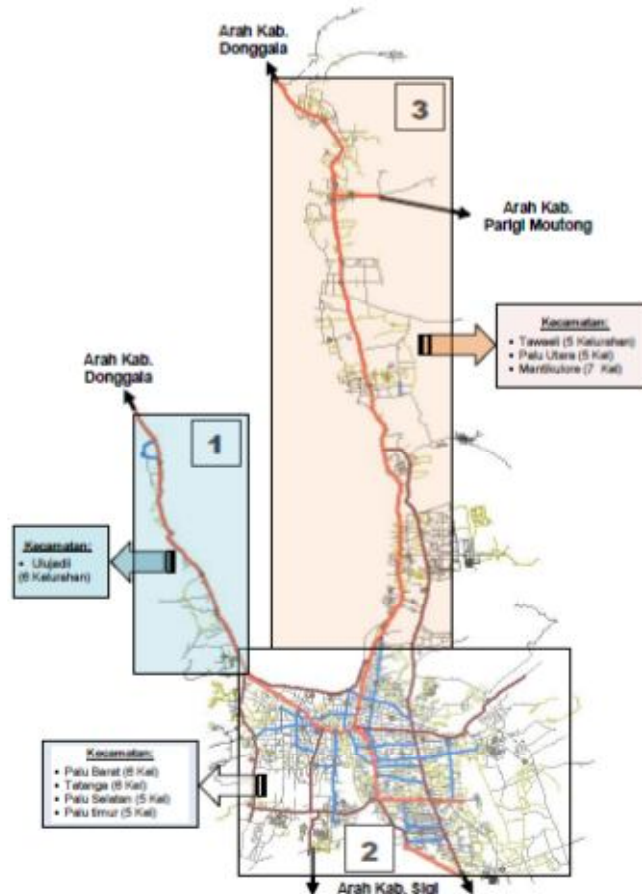


Figure 2 Regional Distribution Study Zone City Transport Services

IV. RESULTS AND DISCUSSION

1) PATTERN OF LAND USE

Based on land use patterns in the division of 3 zones studied region can be identified that the constructed region with the function of settlements, industry, and services in general is still dominant use, where these locations are areas with high attractive movement. From the image is also known that the land use in those three zones identified that the average dominated for industry, trade / services, fields, embankment, and open space / road, while the settlements as a generator of movement is still dominated by the zone 2 in all districts and have also begun evolved into suburban areas such as in zone 1 ie districts Ulujadi (Tipo and DonggalaKodi), and zone 3 which Mantikulore districts (Tondo, Talise and Kawatuna). Moreover, the existence of Tadulako University and Madani Hospital in the district of Mantikulore in zone 2 areas identified to be dominant as a destination for fulfilling the requirements of education and health.

2) THE PASSENGER MOVEMENT PATTERN OF TRANSPORT CITY

The good quality route of public transport passengers is the direction that follows the particular pattern of passenger movements and the population in general, so that the more efficient movement can be created by minimizing the passenger journey from origin to destination in the event of transfer modes. Based on the principles mentioned above, the patterns of passenger movement in three study zones can be identified as shown in Table I.

TABLE I
 POPULATION PATTERN TRAVEL IN RESEARCH LOCATIONS

zone	districts	population (people)	Passenger travel patterns			information
			Purpose Travel	origin Travel	Destinations	
1	Ulujadi	26,454	Social, work, and shopping	6 village	internal and zone 2	dominant to zone 2
	amount	26,454		6 village		
2	01. West	59,492	Social, work,	6 village	internal, zone	dominant

zone	districts	population (people)	Passenger travel patterns			information
			Purpose Travel	origin Travel	Destinations	
	Palu		and shopping		1 and 3	to zone 2
	02. Tatanga	38,127	Social, work, and shopping	6 village	internal, zone 1 and 3	dominant to zone 2
	03. South Palu	67,122	Social, work, and shopping	5 village	internal, zone 1 and 3	dominant to zone 2
	04. East Palu	68,534	Social, work, and shopping	5 village	internal, zone 1 and 3	dominant to zone 2
amount		233,275		22 village		
3	01. Mantikulore	60,626	Social, work, and shopping	7 village	internal and zone 2	dominant to zone 2
	02. North Palu	22,110	Social, work, and shopping	5 village	internal and zone 2	dominant to zone 2
	03. Tawaeli	19,737	Social, work, and shopping	5 village	internal and zone 2	dominant to zone 2
amount		102,473		17 village		
total number of		362,202		45 village		

Source: Results of Data Analysis (2016)

Based on the data analysis, it can be identified that the purpose of travel among the largest area of the three zones in general and 45 villages in particular is a social activity (education, recreation, and others) and the working and shopping activities.

Original passenger travel from those 3 zones studied region, which is predominantly located in zone 2 of the district East Palu, South Palu, West Palu and Tatanga), and zone 3, namely districts Mantikulore, while the purpose of the trip dominantly visited is the region of zone 2 as an urban center with a range of facilities available that attracted movement. The passenger movement patterns in general is a journey of Origin - Destination (home-work, home-shopping, home-social, office-shopping, office-social and social-shopping) with variations in the average travel distance between 7-15 km.

Based on Figure 3 pattern of population movement are identified the movement purpose is a social activity, work and shopping are drawn to the city center in the zone 2 spread over 4 districts (East Palu, South Palu, Tatanga and West Palu), while zone 3, especially in districts Mantikulore be an area with large enough attracted movement of the various villages in the Palucity with the availability of educational facilities, in addition to the presence of university has become an idol and pride of the people in Central Sulawesi. Lowest movement is noticed in zone 1 Ulujadi district.

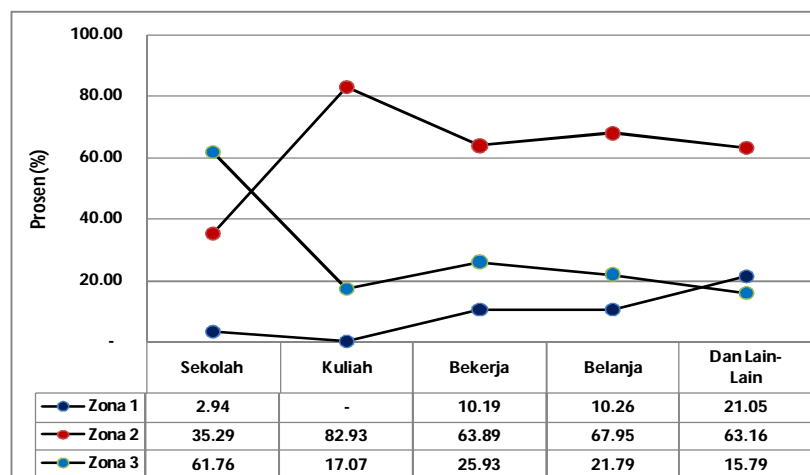


Figure 3 Passenger Movement Patterns Based Destinations

Figure 3 shows the attractive and fulfilled movement of city transport users are still dominated by the second zone as the city center with various service facilities are available, following of a zone 3 area and the smallest number of the attractive and fulfilled movement users are situated in area of zone 1.

3) POPULATION DENSITY

Priority city transport services that taking into account of population density, as identical with the high potential for demand movement (attractive movement), so the urban transportation route can be directed as closely as possible to reach the region. Based on this principle, the population density in the three zones can be known as shown in Table II and Figure 4.

TABLE II
 THE DISTRICT POPULATION DENSITY IN RESEARCH LOCATION

Zone	Districk	population (people)	area (Km2)	Density(People/km2)	Attractive Opportunity *)
1	Ulujadi	26,454	40.25	657.24	Rare
	amount	26,454	40.25	657.24	Rare
2	01. West Palu	59,492	8.28	7,185.02	moderate
	02. Tatanga	38,127	14.95	2,550.30	Rare
	03. SouthPalu	67,122	27.38	2,451.50	Rare
	04. East Palu	68,534	7.71	8,888.98	moderate
	amount	233,275	58.32	5,268.95	moderate
3	01. Mantikulore	60,626	206.8	293.16	Rare
	02. North Palu	22,110	29.94	738.48	Rare
	03. Tawaeli	19,737	59.75	330.33	Rare
	amount	102,473	296.49	453.99	Rare
	TotalPalu city	362,202	395.06	507.60	rare

Source: BPS Kota Makassar (2015)

*) Assuming levels: solid (15001-25000), moderate (5001-15000) and rare (1-5000)

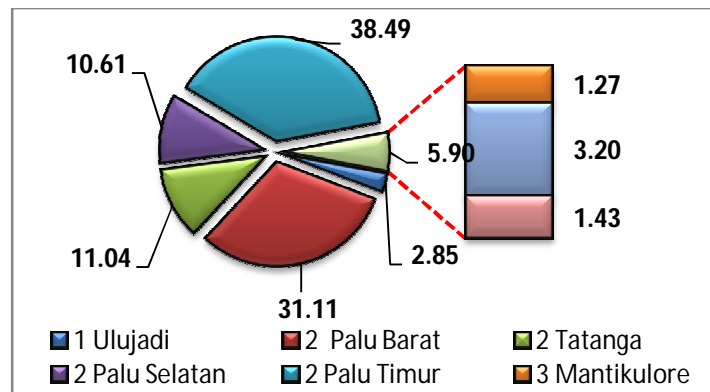


Figure 4 Population Density in Study Location

According to the table and the image based on the standard density the population density is identified, area of the zone 2 is dense enough, following with the zone 3 and the lowest density is area of the zone 1.

4) SERVICES AREA

Determination of the farthest points demand for public passenger transport services in urban areas can be predicted by knowing the range of services on village located around the boundary of the built region at three areas of study zone. Service area is also included the farthest point and broad data that unreached villages by urban transportation.

The results of the map analysis shows that the area of the zone 1 has outer zones that consist of 3 villages amounted to 4.496% (DonggalaKodi, Kabonena and Watusampu) which is impossible to reach by public transportation because road infrastructure is inadequate and also the distribution of settlements which are still very rare and the attractive movement facilities as the destination trip is still very low, the urban transport route can only be done by following or by crossing the national road infrastructure.

Territory zone 2 as a downtown area consisting of 4 districts (Palu Barat, Tatanga, South Palu and Palu East) did not have the outermost regions because it has the road infrastructure is very adequate to the functions and status as national, provincial and city roads, it allows to make some routes that can be connected both between districts within the city as well as liaison with the region are heading out of town.

The area of zone 3 has outer zones of 6 villages dispread on two districts, ie: District of Mantikuloreconsists of 4 villages (Lasoani, Poboya, Tondo and Layana Indah) and district of Tawaeliconsists of two villages namely Baiya and PantoloanBoya. All of 5 outer villages have a total area of 52 455%,Actually these regions are still crossed by main national roads but most of their territory protruded inside with the terrain is hilly to mountainous. Settlements in this area is still relatively small with distance from house to house is distantly spaced and are also not equipped with other common facilities except health and education facilities.To support the movement of people by using public transportation, the only served route that can be used is national road that connects to the downtown area.

5) THE ROAD NETWORK CHARACTERISTICS

Service pattern of public transportation trajectoryis also determined by the existing condition of road network, namely: the classification of road functions, the side barriers, pavement width, and the type of track operations, available capacity, peak hour volume and degree of saturation [13].Based on these provisions, the condition of the road network in the Palu city that possible to connect to the three zones regions used 24 street locations as the study samples.

From the analysis of the road network based on their characteristics, it can be classified type and function of the road observed, which is reviewed in the form of primary roads, secondary roads and local urban roads. Those road types are crossing areas of the city transportation in doing daily movement to all three areas zones studies in picking up / taking down passengers.A description of the traffic flow at peak hours is shown in Figure 5, while the degree of saturation of each of the paths presented in Figure 6.

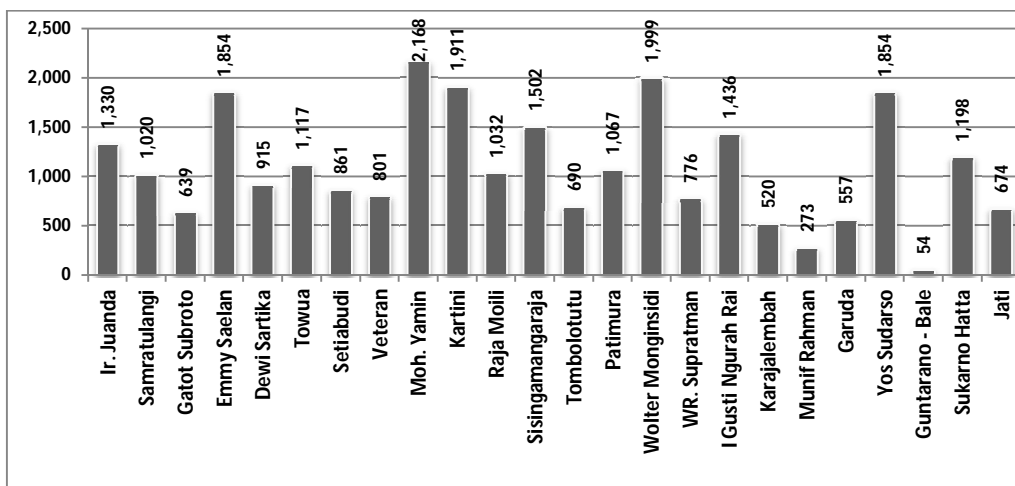


Figure 5 Volume of Peak Flow Traffic Jam in 24 Road Areas that is being investigated.

Figure 5 shows the volume of peak hour traffic flow (smp / hour) at 3 zones locations observed. From the results of the data analysis shows that the volume of peak hours is varied for each of road segment, the highest volume is in the Moh. Yamin street of 2.168 smp / hour. This street is a provincial road where a number of government offices are located. Meanwhile this road is also access road to airport of Sis Aljufrie Mutiara Palu and to the border regency of Sigi, while other streets with the amount of traffic flow is high enough is the national road, provincial and city roads. These locations are trade and services areas that in general located in urban city centers of zone 2 area. Yos Sudarso street has traffic flow at peak hours by 1854 smp / hour is a national road which crosses the territory of zone 3 towards the border of Donggala and Parigi Moutong regencies.

Based on Figure 6 above, it was identified that the degree of saturation of each road is varied to national, provincial and city roads. A number of street that have a high degree of saturation level include two national roads ie; Emmy Saelan road, and Yos Sudarso road. Also consist of I Gusti Ngurah Rai provincial road. On the other hand, the city street with a fairly high degree of saturation is Kartini and Pattimura road. The high degree of saturation at peak hours in certain streets one of them caused by the large number of public transportation passing when looking for passengers. This situation is occurred because the land uses are big enough attracted and fulfilled movement due to its function as residential areas, offices, trade and services. While other streets with small to medium of degree saturation occurred due to its street function is mixed land use that quite distantly spaced.

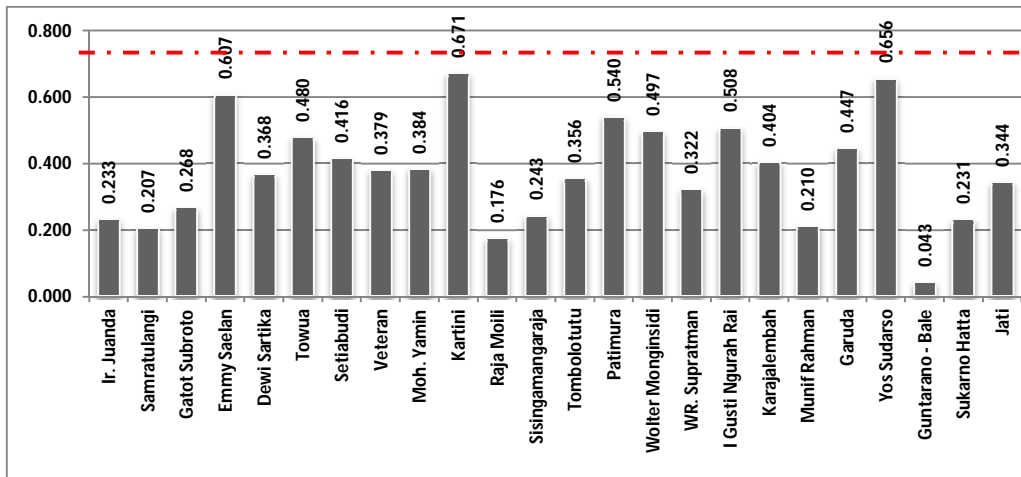


Figure 6 Degree of Saturation On Peak Hours

The service demand activity is a derived demand where the nature of the services depend on the goods demand or other services needed including the city transport. Therefore, demand for transportation services in the city needs to be arranged in term of its trajectory so that the accessibility and the mobility of users can easily interact with the region based on economic, social, physical, environmental, and institutional. The results of the modeling of the transport network in the city of Palu, shown on Figure 7, while the city transport network scenarios based division of zones of the study sites is presented in Table III.

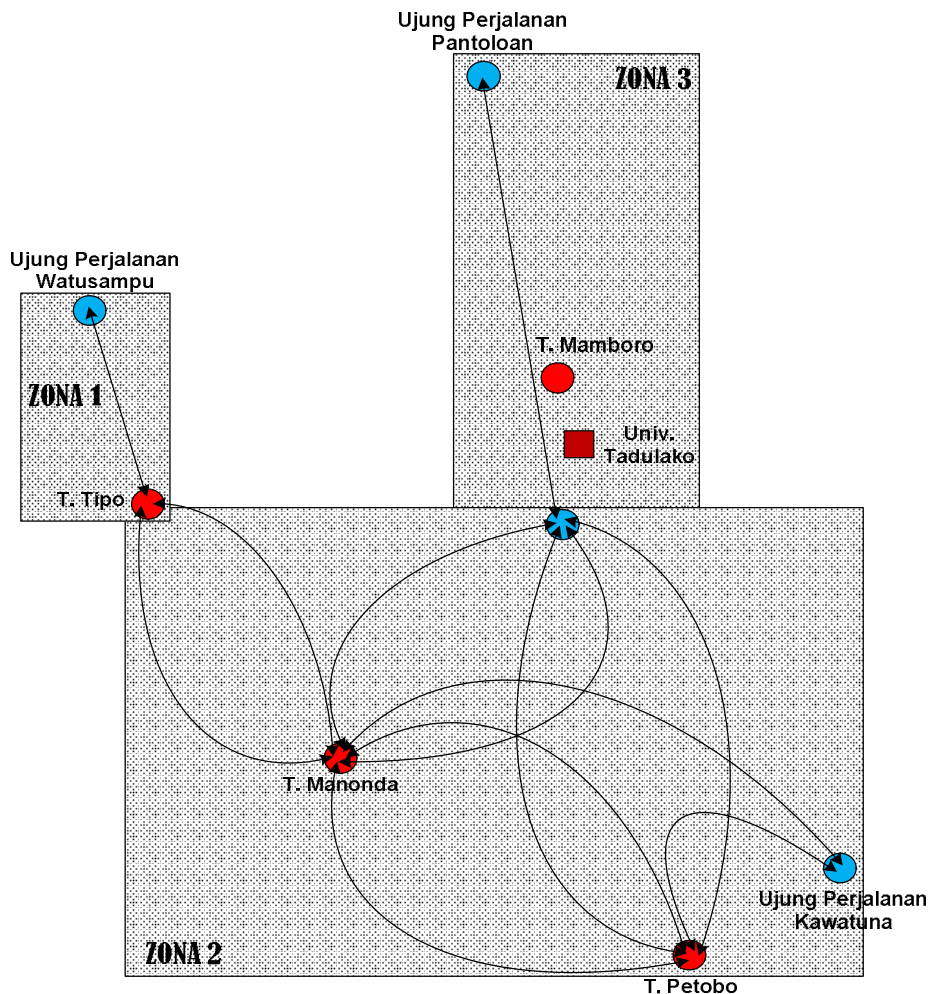


Figure 7 City Transport Route Network Model Based on Distribution Zone

Superimpose the results of the analysis are presented in Figure 7 and Table III, shows the service model of urban public transportation network using public transportation minibus for the area zone 1 and zone 3 using a model of the taxi while the second zone using these models remain. Model of urban public transport is generated in the city of Palu, can be a model for the cities of medium-sized comprehensive city development patterns and elongated.

TABLE III - CITY TRANSPORT NETWORK SCENARIO ROUTE
 LOCATION BASED ON ZONES DISTRIBUTION IN RESEARCH AREA

Terminal	Total and Code Route	Mamboro	Petobo	Manonda	Tipo	Pantoloan*	Kawatuna*	Watusampu*	number Route
Mamboro	the amount of stretch		2	2	-	1	-	-	5
	microbus		A2,A3	A4,A5	-	A1	-	-	
Petobo	the amount of stretch	2		2	-	-	1	-	5
	microbus	B4,B5		B2,B3	-	-	B1	-	
Manonda	the amount of stretch	1	2		2	-	1	-	6
	microbus	C6	C3,C4		C1,C2	-	C5	-	
Tipo	the amount of stretch	-	-	1		-	-	1	2
	microbus	-	-	D2		-	-	D1	
Total These									18

Source: Data Analysis, (2016)

Note: *) travel tip

V. CONCLUSION

By arranging the public transport of microlet service model based on the movement characteristics of the Palu city, It is expected that the city transport services will be more regular and will eventually be interested by users because of; the place of waiting is already clear, measurable long waiting, do not need negotiations for travel destinations and travel time can be predicted. With well-organized of urban transportation route, it is expected that the captive users can be enthusiastic again for taking advantage of city transport in fulfilling their daily demands. Moreover, under such condition may also expect to attract the choice users to use public transportation as an alternative mode of travelling. Another positive impact of applying the fixed route is that possible to reduce the level of congestion, air pollution, noise pollution and vibration due to urban transports activities in servicing users to its appropriate route that has been set.

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