Testiranje performansi sistema - student 3

1. Testiranje opterećenja sistema (*load testing*)

Testiranje opterećenja sistema za česte scenarije korišćenja izvršeno je upotrebom alata Locust za slanje zahteva backendu. Proverene su performanse sistema za 10 različitih scenarija korišćenja i ispitana je njihova promena sa povećanjem količine podataka sa kojim aplikacija rukuje kao i povećanjem broja korisnika koji istovremeno pokušavaju da izvrše neki isti scenario. Sledećih 10 scenarija je ispitano:

1. Registracija termometra kao korisnik

Locust Test Report
During: 2/4/2024, 9:33:22 AM - 2/4/2024, 9:34:05 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
POST	/api/devices/registerThermometer	1351	180	4071	137	12104	49	31.4	4.2
	Aggregated	**1351**	**180**	**4071**	**137**	**12104**	**49**	**31.4**	**4.2**

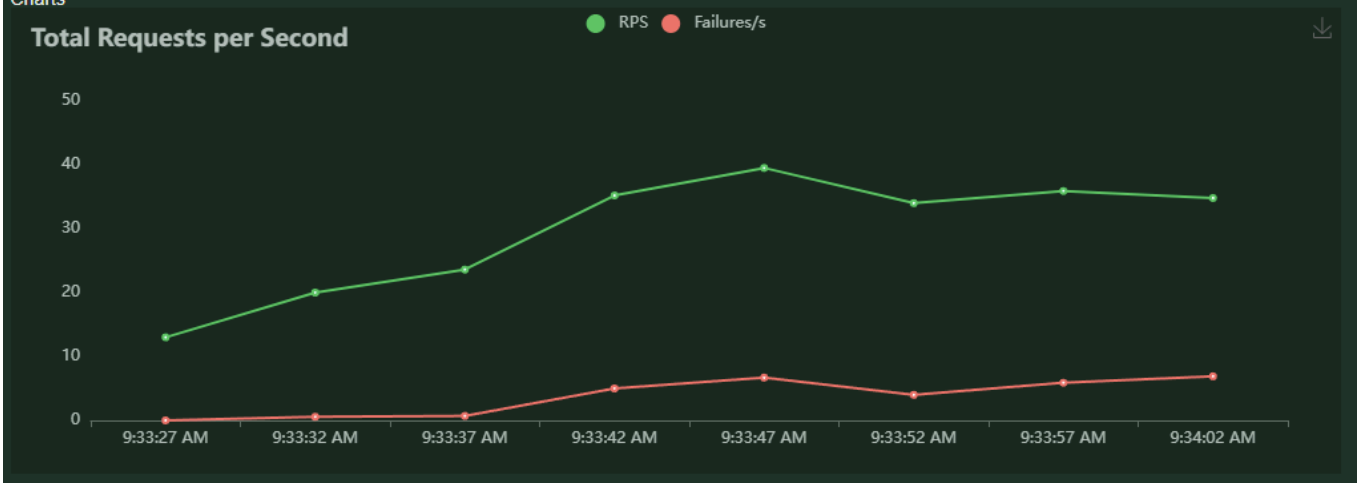
Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
POST	/api/devices/registerThermometer	3900	4800	5700	6400	7200	7900	9600	12000
	Aggregated	**3900**	**4800**	**5700**	**6400**	**7200**	**7900**	**9600**	**12000**

Failures Statistics

Method	Name	Error	Occurrences
POST	/api/devices/registerThermometer	Failed to register thermometer because of status code: 400	2
POST	/api/devices/registerThermometer	Failed to register thermometer because of status code: 500	178

Charts



Final ratio
Ratio per User class
100.0% Test
100.0% register_thermometer
Total ratio
100.0% Test
100.0% register_thermometer

2. Pregled svih nekretnina u sistemu kao administrator

Testiranje je izvršeno sa 10 nekretnina u sistemu.

Locust Test Report
During: 2/4/2024, 8:37:40 AM - 2/4/2024, 8:38:40 AM
Target Host: http://localhost:8080
Script: locustfile.py

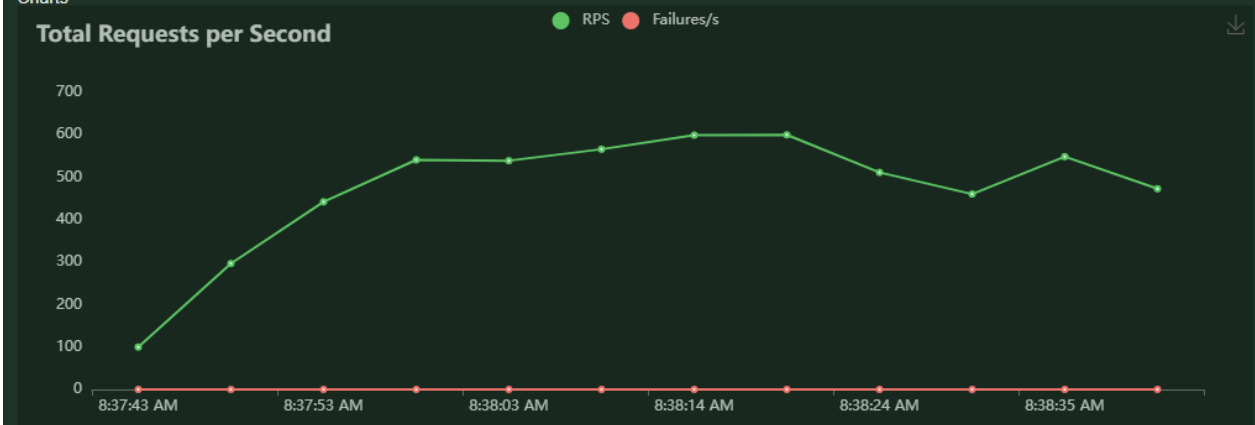
Request Statistics

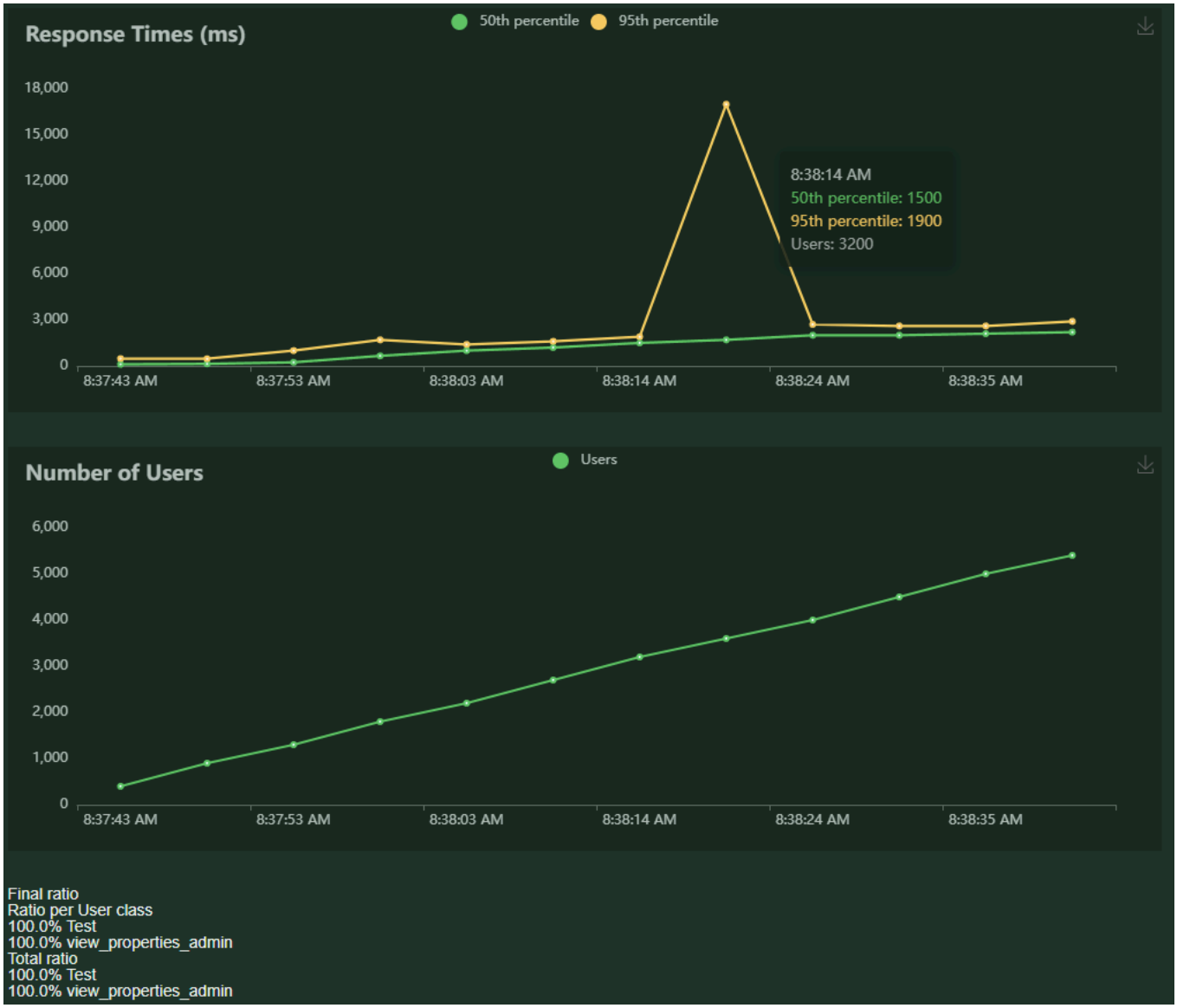
Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View properties	30865	0	1707	29	41313	1695	514.1	0.0
	Aggregated	**30865**	**0**	**1707**	**29**	**41313**	**1695**	**514.1**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View properties	1400	1700	1900	2100	2300	2600	17000	41000
	Aggregated	**1400**	**1700**	**1900**	**2100**	**2300**	**2600**	**17000**	**41000**

Charts





Testiranje sa 1000 nekretnina

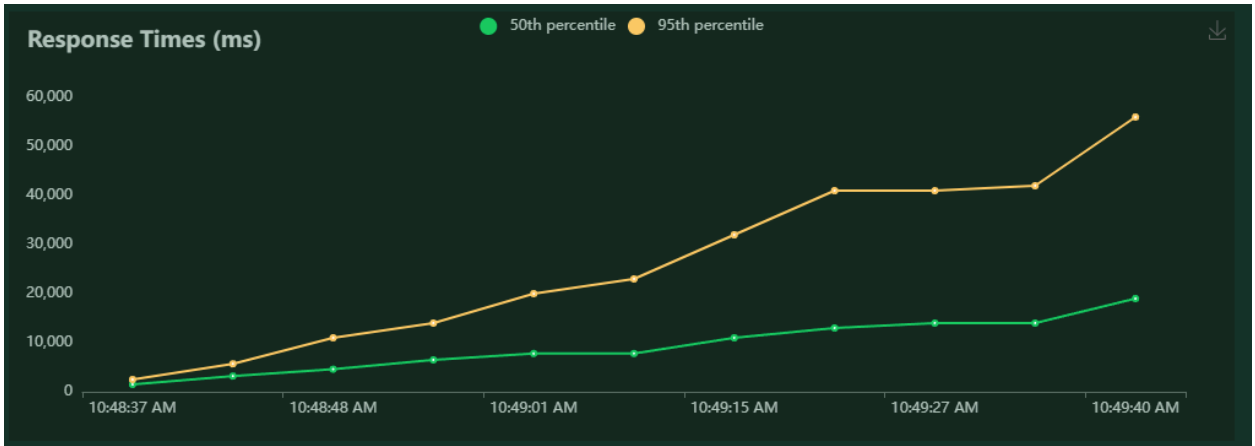
Locust Test Report
During: 2/4/2024, 10:48:35 AM - 2/4/2024, 10:49:46 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

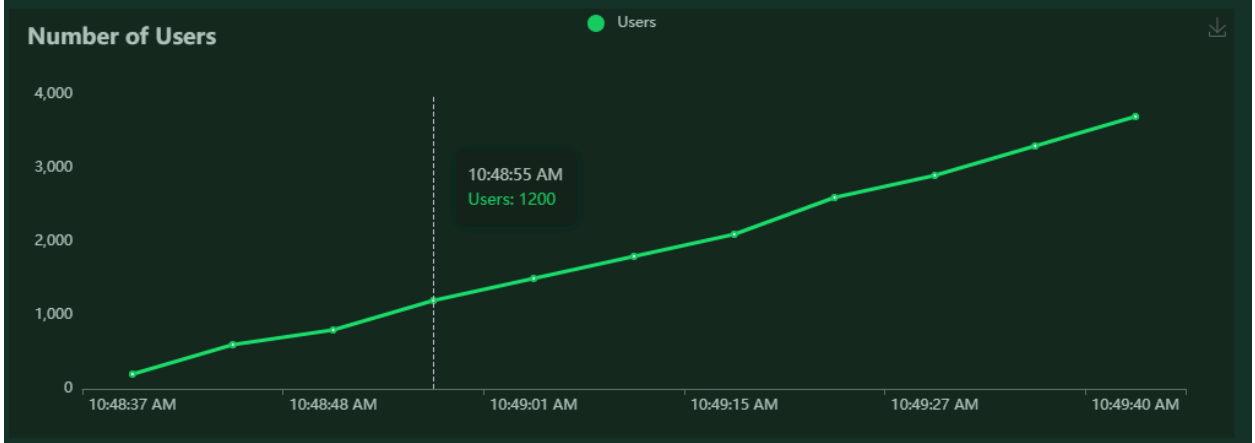
Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View properties	1529	0	14962	1087	61324	174051	21.4	0.0
	Aggregated	**1529**	**0**	**14962**	**1087**	**61324**	**174051**	**21.4**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View properties	13000	14000	16000	19000	32000	41000	58000	61000
	Aggregated	**13000**	**14000**	**16000**	**19000**	**32000**	**41000**	**58000**	**61000**

Charts





Final ratio
Ratio per User class
100.0% Test
100.0% view_properties_admin
Total ratio
100.0% Test
100.0% view_properties_admin

3. Pregled potrošnje i proizvodnje struje unutar jedne nekretnine kao administrator

Testiranje je izvršeno sa oko nedelju dana podataka u sistemu.

Locust Test Report
During: 2/4/2024, 8:47:32 AM - 2/4/2024, 8:48:37 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View property power consumption	2337	8	2284	98	6746	398611	35.5	0.1
GET	View property power production	2342	5	3160	96	17883	394498	35.6	0.1
	Aggregated	**4679**	**13**	**2723**	**96**	**17883**	**396552**	**71.1**	**0.2**

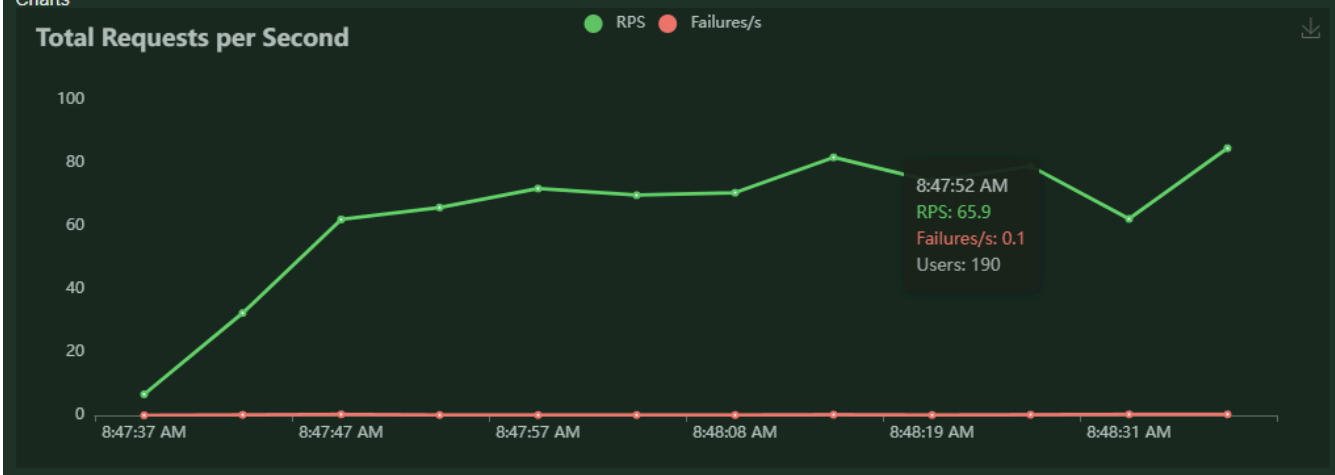
Response Time Statistics

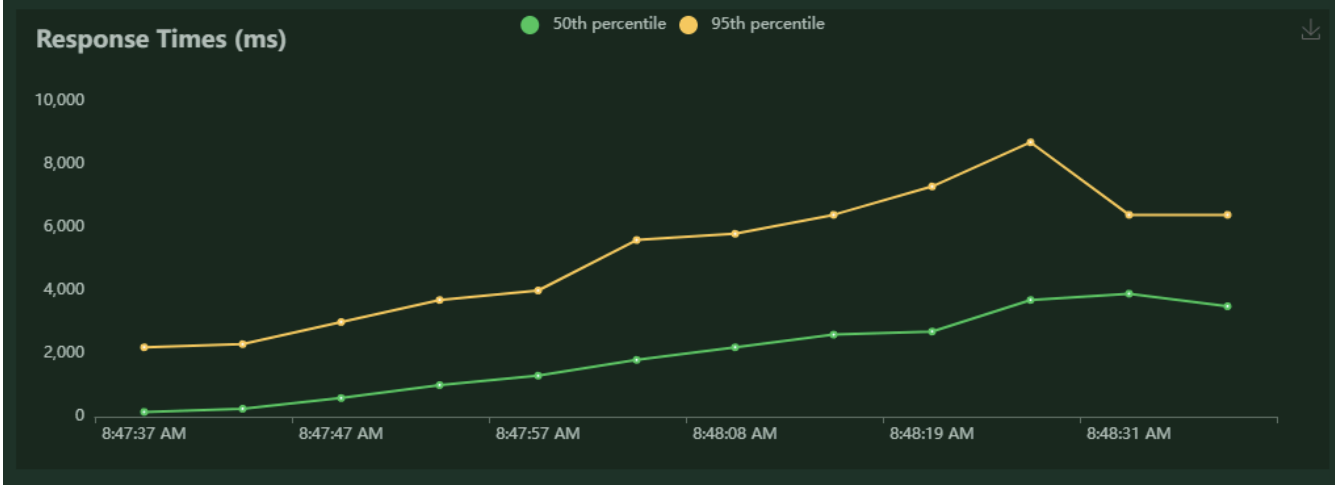
Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View property power consumption	2100	2400	2900	3300	4100	5000	6000	6700
GET	View property power production	2600	3300	3900	4500	5800	7200	15000	18000
	Aggregated	**2300**	**2800**	**3300**	**4000**	**5100**	**6000**	**10000**	**18000**

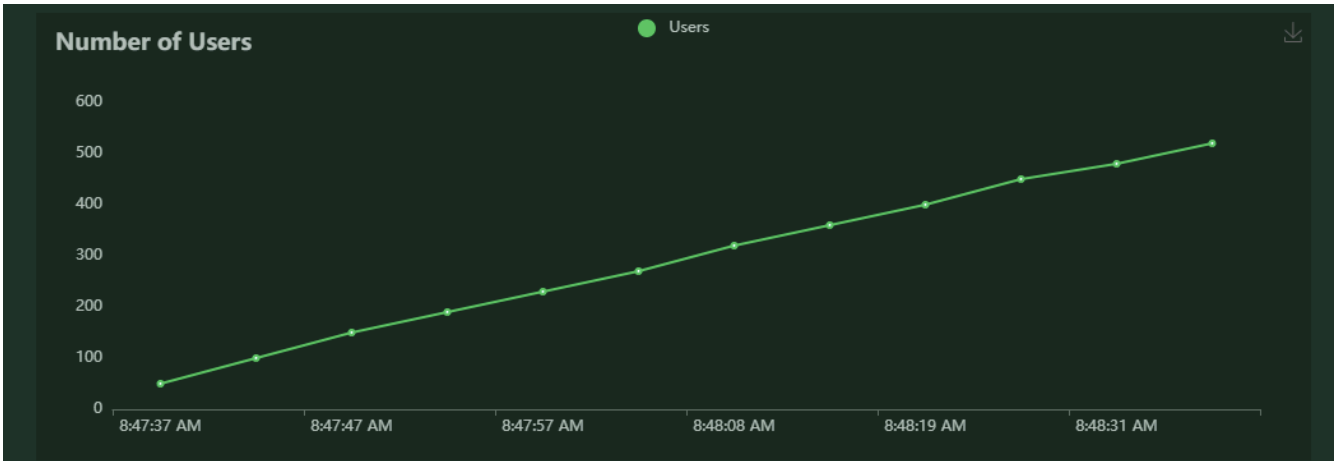
Failures Statistics

Method	Name	Error	Occurrences
GET	View property power consumption	Failed to view property power consumption	8
GET	View property power production	Failed to view property power production	5

Charts







Final ratio
Ratio per User class
100.0% Test
100.0% view_property_power_admin
Total ratio
100.0% Test
100.0% view_property_power_admin

4. Pregled potrošnje i proizvodnje struje unutar jednog grada kao administrator

Testiranje je izvršeno sa oko nedelju dana podataka u sistemu.

Locust Test Report
During: 2/4/2024, 8:50:30 AM - 2/4/2024, 8:51:22 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View city power consumption	702	1	5348	213	17061	312553	13.7	0.0
GET	View city power production	703	1	5139	137	14435	311271	13.7	0.0
	Aggregated	**1405**	**2**	**5244**	**137**	**17061**	**311912**	**27.4**	**0.0**

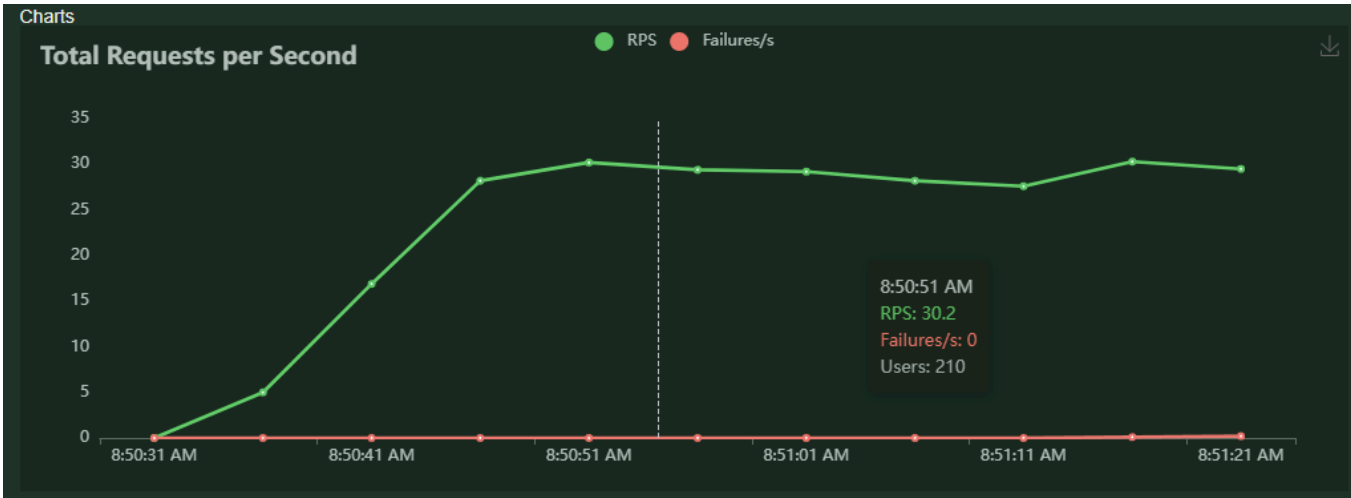
Response Time Statistics

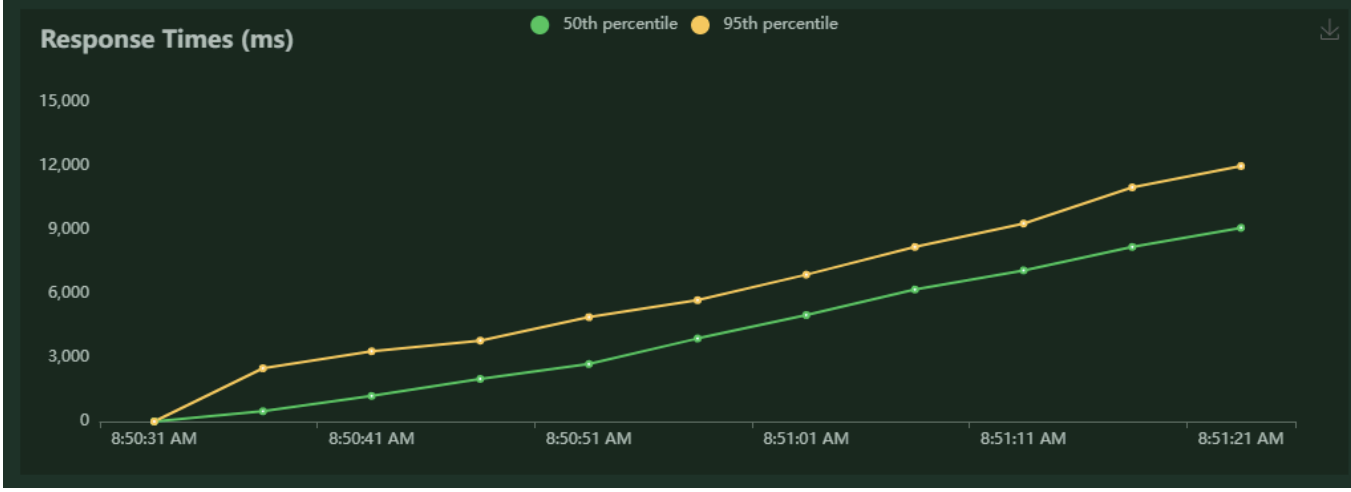
Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View city power consumption	5200	6500	7400	8700	9500	10000	13000	17000
GET	View city power production	4900	5700	6700	7600	9300	10000	12000	14000
	Aggregated	**5000**	**6000**	**7000**	**8200**	**9400**	**10000**	**12000**	**17000**

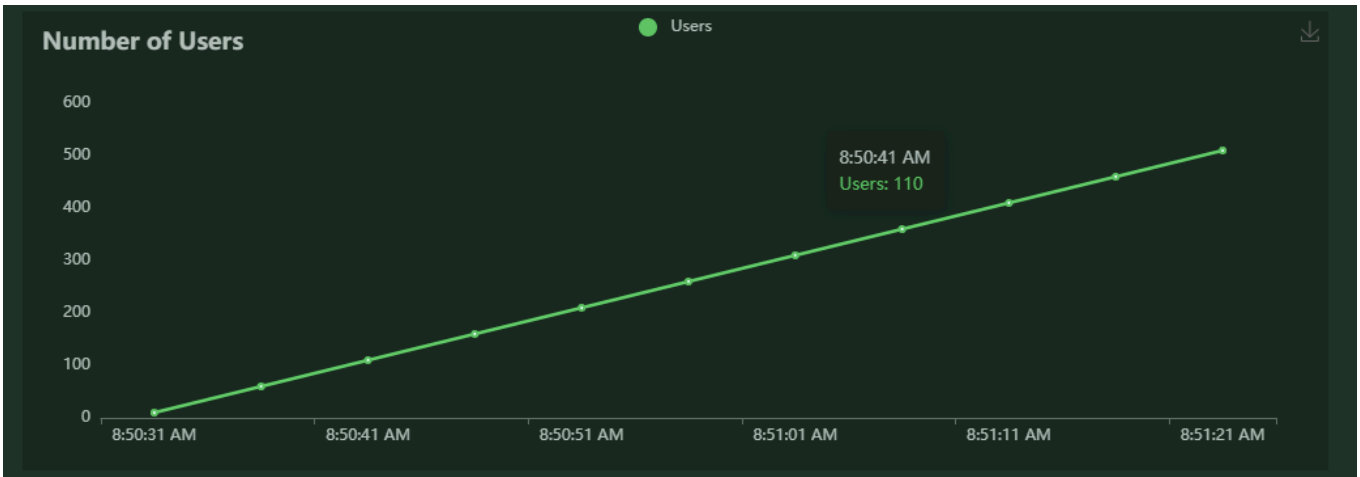
Failures Statistics

Method	Name	Error	Occurrences
GET	View city power production	Failed to view city power production	1
GET	View city power consumption	Failed to view city power consumption	1

Charts







Final ratio
Ratio per User class
100.0% Test
100.0% view_city_power_admin
Total ratio
100.0% Test
100.0% view_city_power_admin

5. Paljenje i gašenje sistema solarnih panela kao korisnik

Ekstreman slučaj gde veliki broj korisnika konkurentno pokušava da pali i gasi 2 solarna panela, pa postoji veliki broj neuspeha (jedan korisnik ugasi solarni panel pa želi da ga ponovo upali, ali ga je neko upalio u međuvremenu i slični slučajevi)

Locust Test Report
During: 2/4/2024, 9:15:39 AM - 2/4/2024, 9:17:01 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
PUT	Turn off solar panel	1574	842	10	3	42	26	19.0	10.2
PUT	Turn on solar panel	732	154	8	3	34	28	8.8	1.9
	Aggregated	**2306**	**996**	**10**	**3**	**42**	**26**	**27.8**	**12.0**

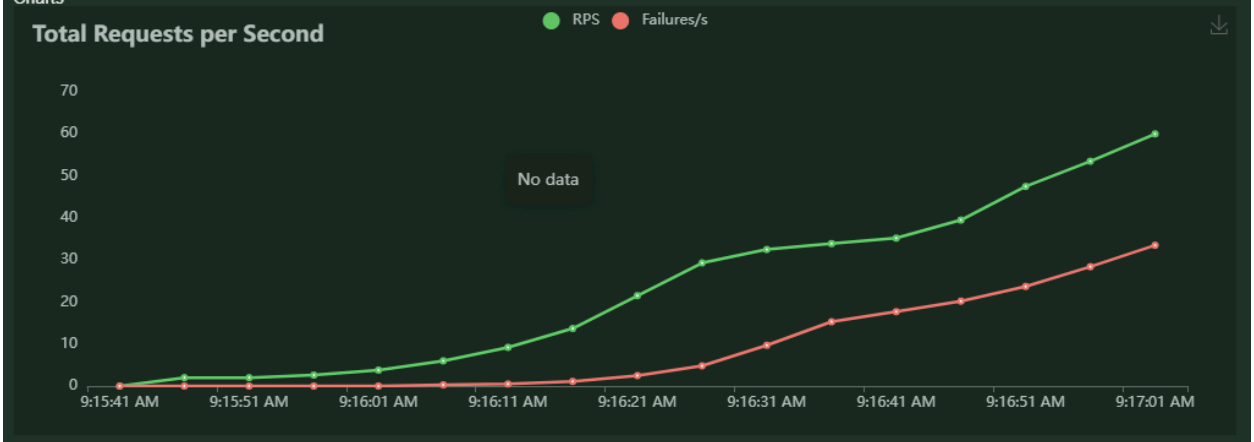
Response Time Statistics

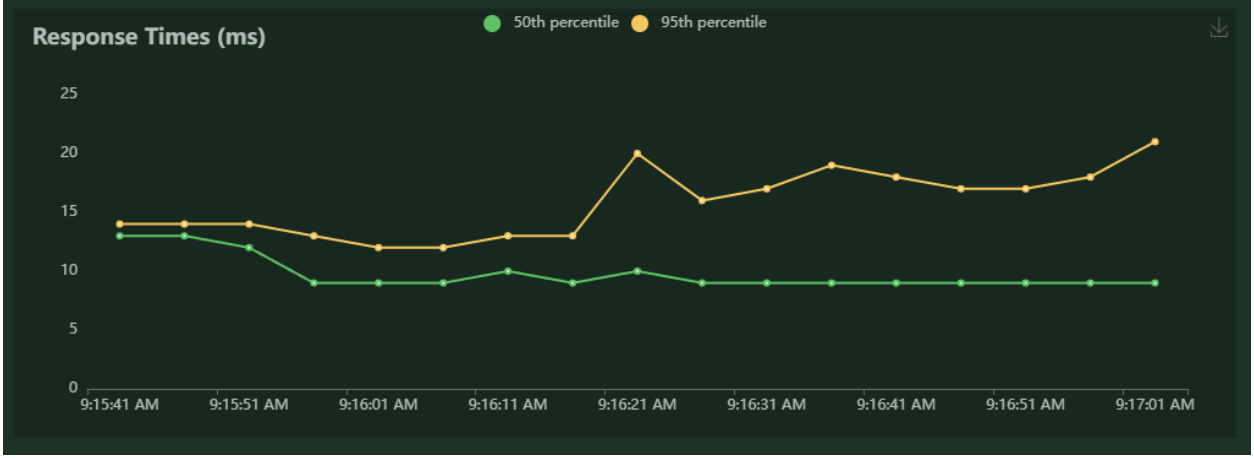
Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
PUT	Turn off solar panel	10	11	12	14	17	20	25	42
PUT	Turn on solar panel	9	9	9	10	12	13	20	35
	Aggregated	**9**	**10**	**11**	**13**	**16**	**19**	**24**	**42**

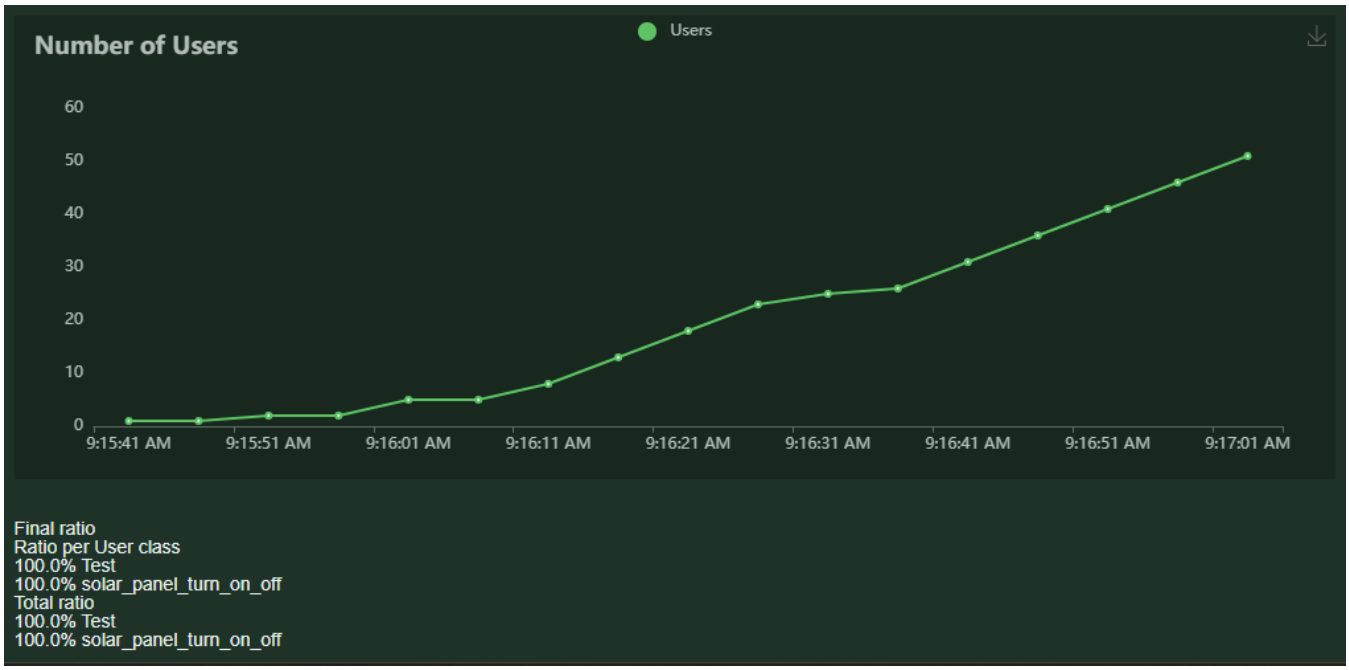
Failures Statistics

Method	Name	Error	Occurrences
PUT	Turn off solar panel	Failed to turn off solar panel	842
PUT	Turn on solar panel	Failed to turn on solar panel	154

Charts







6. Pregled akcija izvršenih nad sistemom solarnih panela kao korisnik

Testiranje je izvršeno sa preko 100 unesenih komandi.

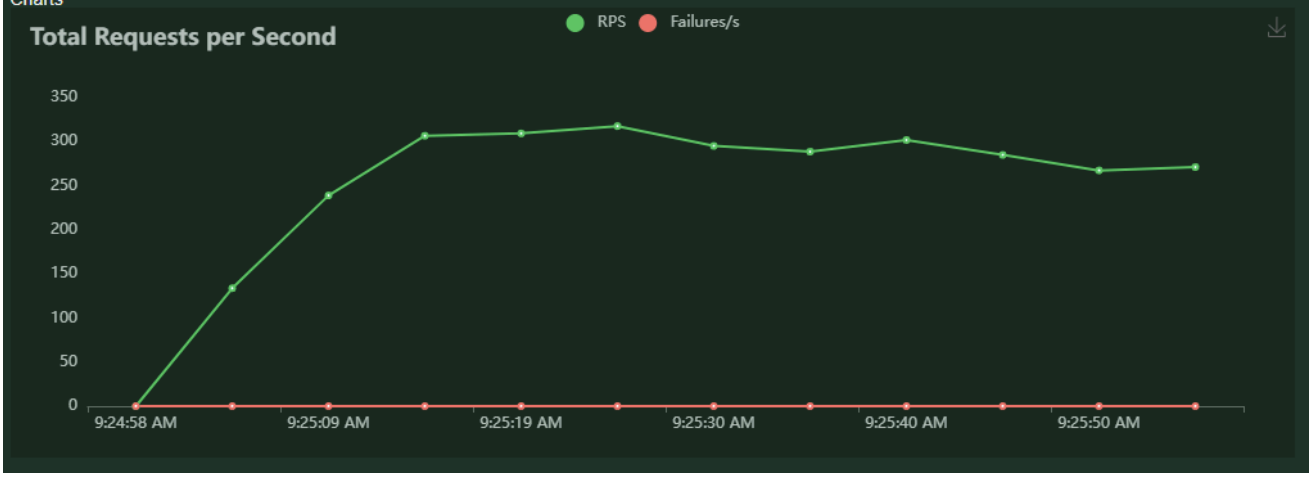
Locust Test Report
During: 2/4/2024, 9:24:58 AM - 2/4/2024, 9:25:59 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View solar panel commands	17563	0	2969	60	48690	9652	289.1	0.0
	Aggregated	**17563**	**0**	**2969**	**60**	**48690**	**9652**	**289.1**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View solar panel commands	2500	2900	3200	3500	4100	5200	24000	49000
	Aggregated	**2500**	**2900**	**3200**	**3500**	**4100**	**5200**	**24000**	**49000**

Charts



7. Pregled istorijske potrošnje struje unutar jedne nekretnine kao korisnik

Testiranje je izvršeno sa oko nedelju dana podataka u sistemu.

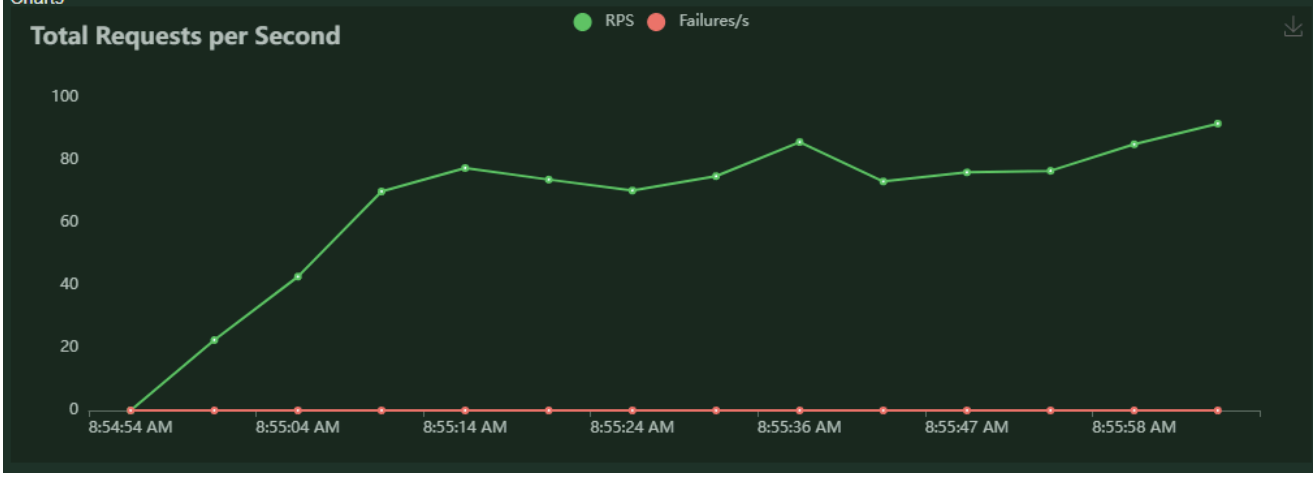
Locust Test Report
During: 2/4/2024, 8:54:53 AM - 2/4/2024, 8:56:06 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

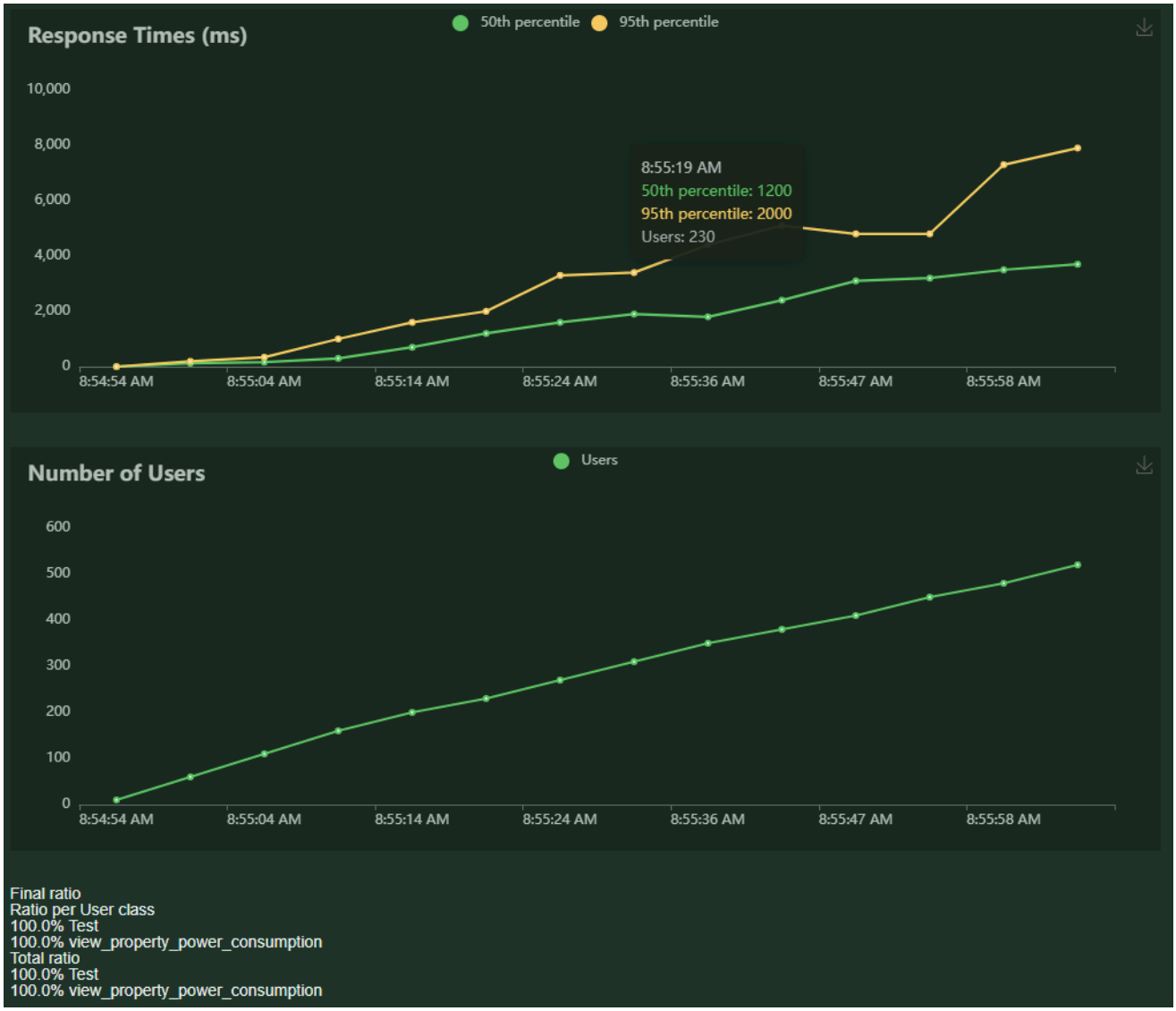
Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View property power consumption	5472	0	2223	66	12372	400766	75.4	0.0
	Aggregated	**5472**	**0**	**2223**	**66**	**12372**	**400766**	**75.4**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View property power consumption	1900	2500	2900	3500	4200	4700	8000	12000
	Aggregated	**1900**	**2500**	**2900**	**3500**	**4200**	**4700**	**8000**	**12000**

Charts





8. Pregled akcija izvršenih nad punjačem za električna vozila kao korisnik

Testiranje je izvršeno sa oko nedelju dana podataka u sistemu.

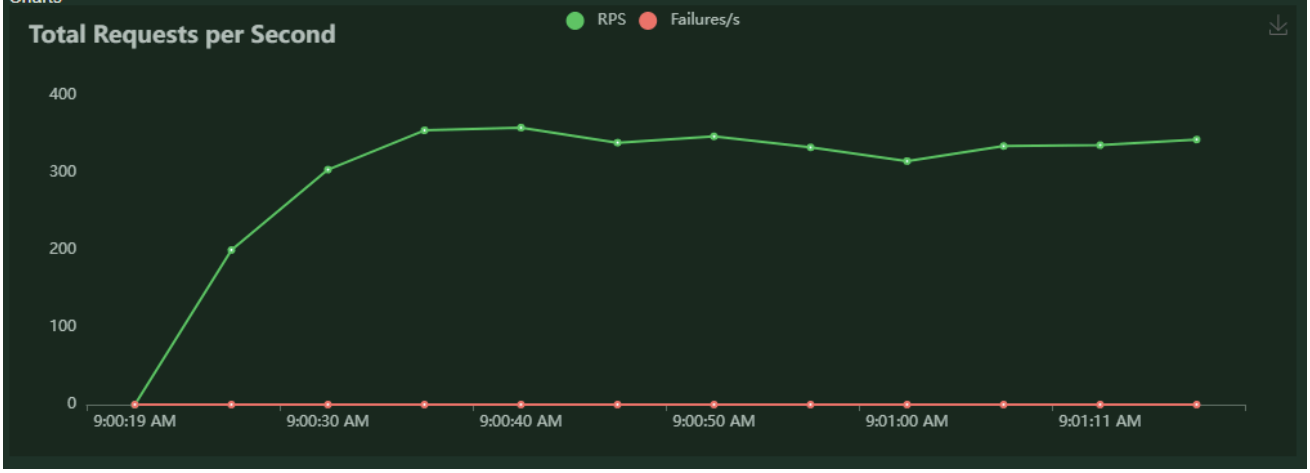
Locust Test Report
During: 2/4/2024, 9:00:17 AM - 2/4/2024, 9:01:16 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

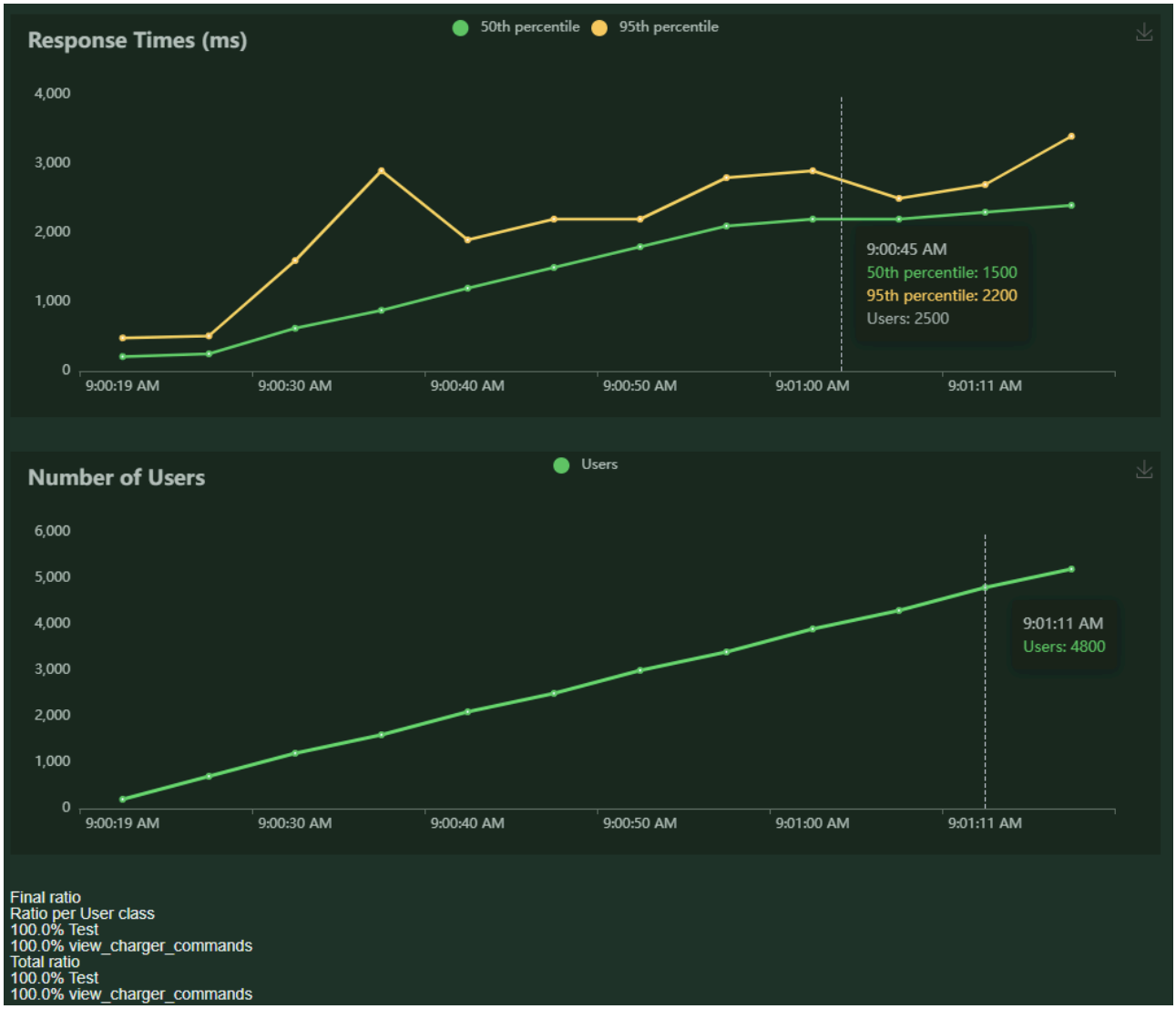
Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View charger commands	19235	0	2077	50	45256	1428	329.6	0.0
	Aggregated	**19235**	**0**	**2077**	**50**	**45256**	**1428**	**329.6**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View charger commands	1800	2100	2200	2400	2600	3000	21000	45000
	Aggregated	**1800**	**2100**	**2200**	**2400**	**2600**	**3000**	**21000**	**45000**

Charts





Final ratio
Ratio per User class
100.0% Test
100.0% view_charger_commands
Total ratio
100.0% Test
100.0% view_charger_commands

9. Registracija solarnog panela kao korisnik

Locust Test Report
During: 2/4/2024, 9:29:43 AM - 2/4/2024, 9:30:24 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Download the Report

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
POST	/api/devices/registerSolarPanelSystem	1117	102	4058	80	10999	43	27.3	2.5
	Aggregated	**1117**	**102**	**4058**	**80**	**10999**	**43**	**27.3**	**2.5**

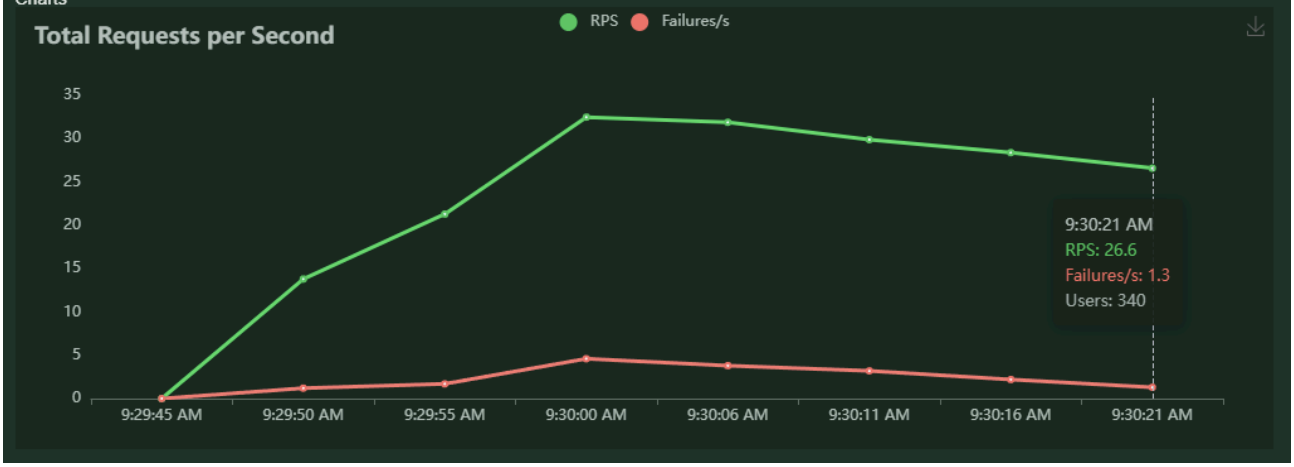
Response Time Statistics

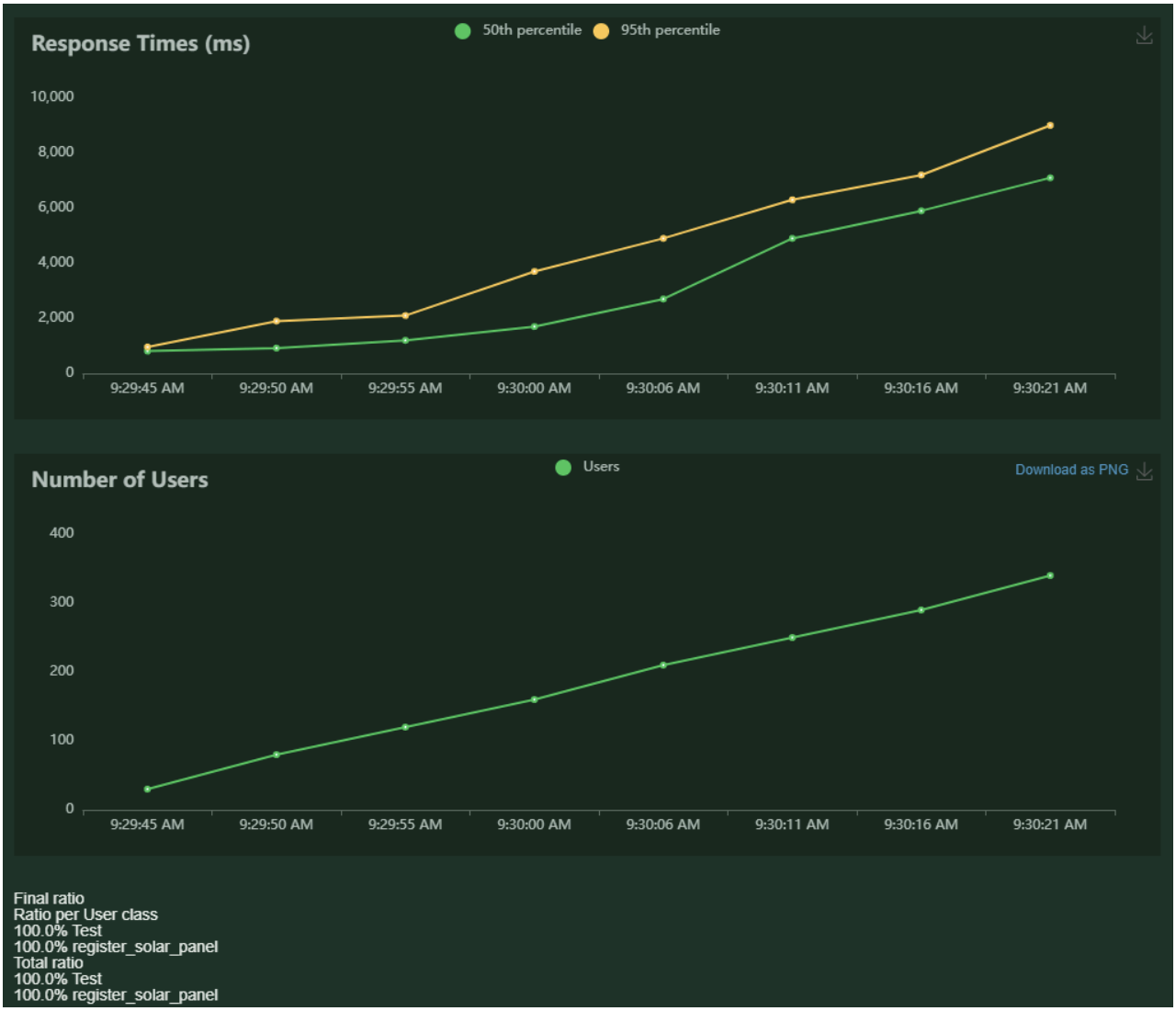
Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
POST	/api/devices/registerSolarPanelSystem	3600	5000	5800	6700	8100	9000	10000	11000
	Aggregated	**3600**	**5000**	**5800**	**6700**	**8100**	**9000**	**10000**	**11000**

Failures Statistics

Method	Name	Error	Occurrences
POST	/api/devices/registerSolarPanelSystem	Failed to register solar panel system because of status code: 500	101
POST	/api/devices/registerSolarPanelSystem	Failed to register solar panel system because of status code: 400	1

Charts





Final ratio
Ratio per User class
100.0% Test
100.0% register_solar_panel
Total ratio
100.0% Test
100.0% register_solar_panel

10. Pregled uređaja kao korisnik

Testiranje je izvršeno sa 6 uređaja vezano za nekretninu.

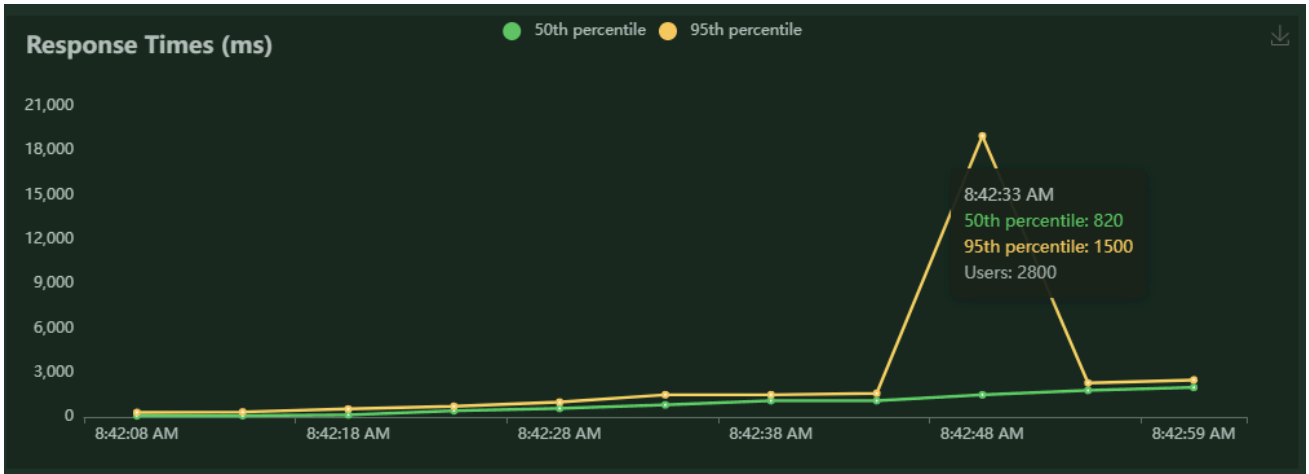
Locust Test Report
During: 2/4/2024, 8:42:05 AM - 2/4/2024, 8:43:01 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

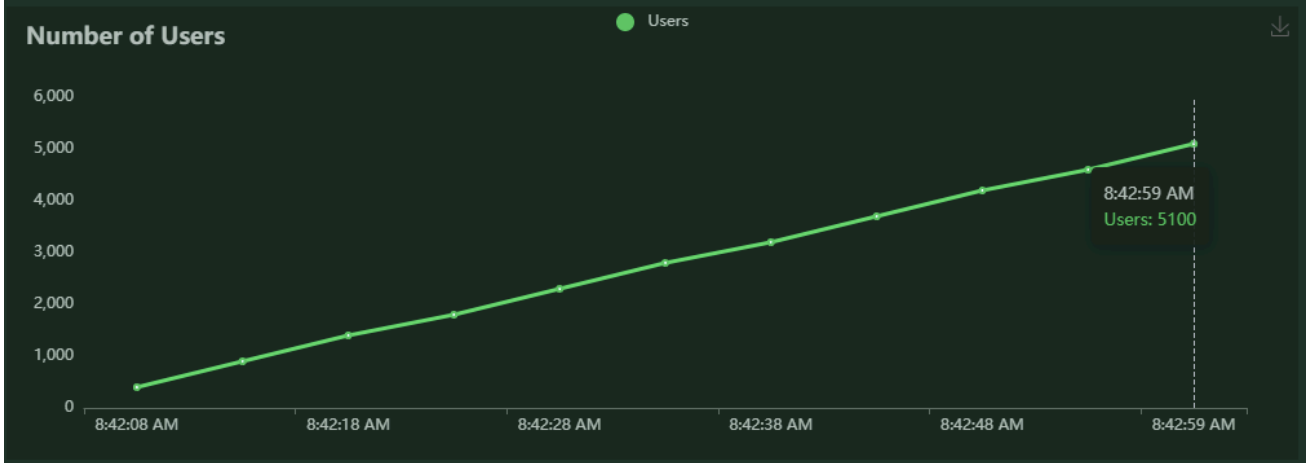
Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View devices	37619	0	1494	5	33011	1086	670.4	0.0
	Aggregated	**37619**	**0**	**1494**	**5**	**33011**	**1086**	**670.4**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View devices	950	1200	1500	1700	2100	2300	23000	33000
	Aggregated	**950**	**1200**	**1500**	**1700**	**2100**	**2300**	**23000**	**33000**

Charts





Final ratio
Ratio per User class
100.0% Test
100.0% view_devices
Total ratio
100.0% Test
100.0% view_devices

Testiranje sa preko 1000 uređaja vezanih za nekretninu

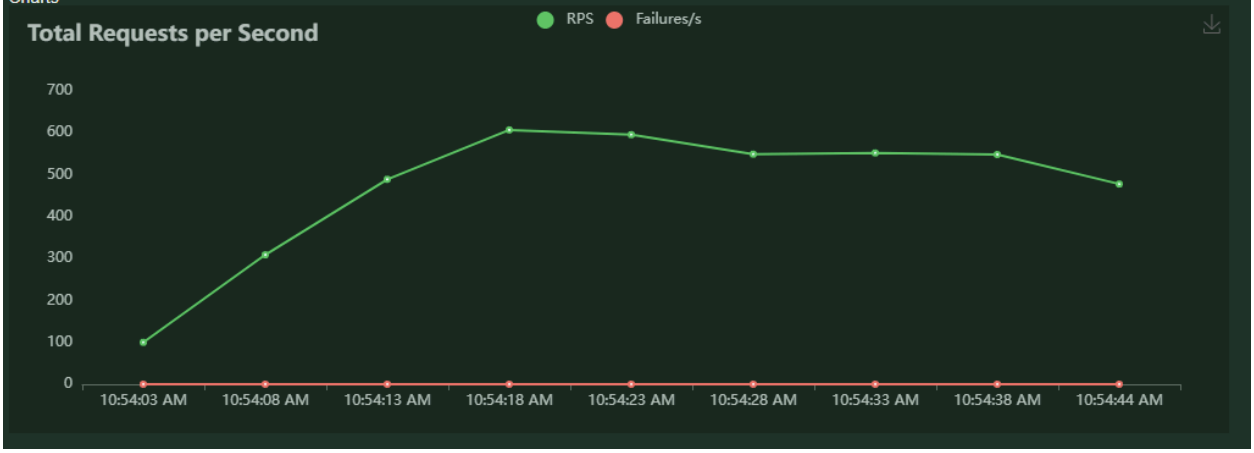
Locust Test Report
During: 2/4/2024, 10:53:59 AM - 2/4/2024, 10:54:43 AM
Target Host: http://localhost:8080
Script: locustfile.py
Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	View devices	22309	0	1100	4	30475	191191	501.9	0.0
	Aggregated	**22309**	**0**	**1100**	**4**	**30475**	**191191**	**501.9**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	View devices	840	980	1200	1300	1700	2000	11000	30000
	Aggregated	**840**	**980**	**1200**	**1300**	**1700**	**2000**	**11000**	**30000**

Charts



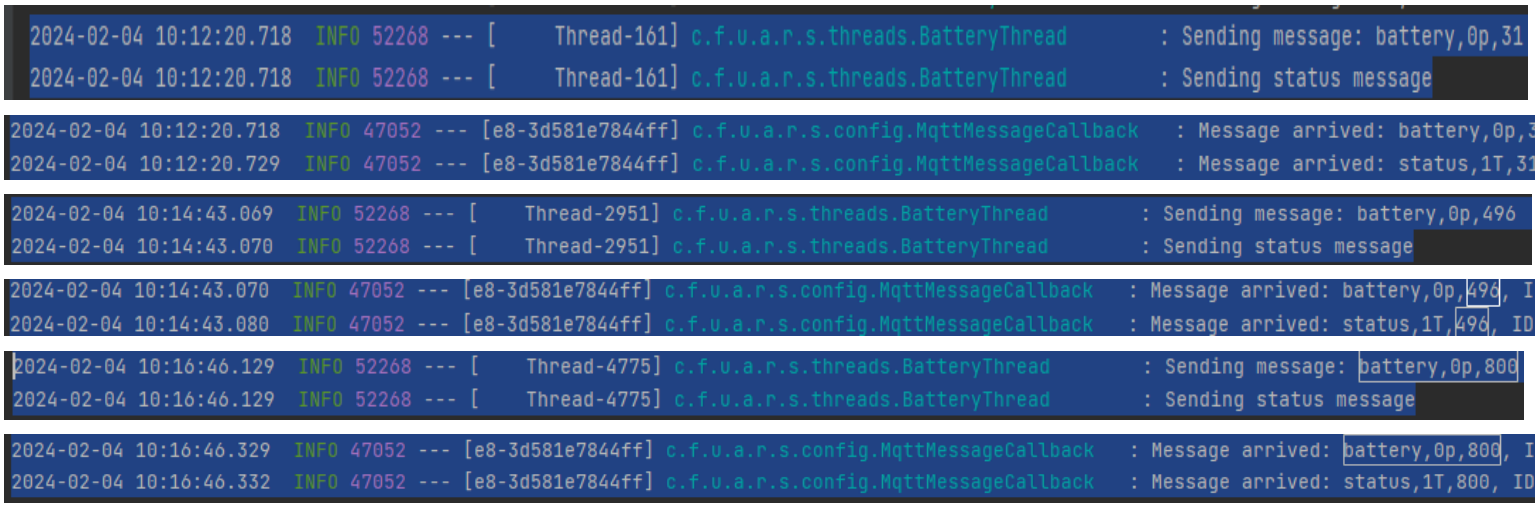
2. Testiranje performansi sistema usled povećanja broja uređaja (simulatora) koji komuniciraju sa platformom

Izvršeno je testiranje performansi sistema prilikom rada sa simulatorima, specifično simulatora za punjač, bateriju i sistem solarnih panela. Testirano je kako se te performanse menjaju pri povećanju broja simulatora koji su istovremeno pokrenuti.

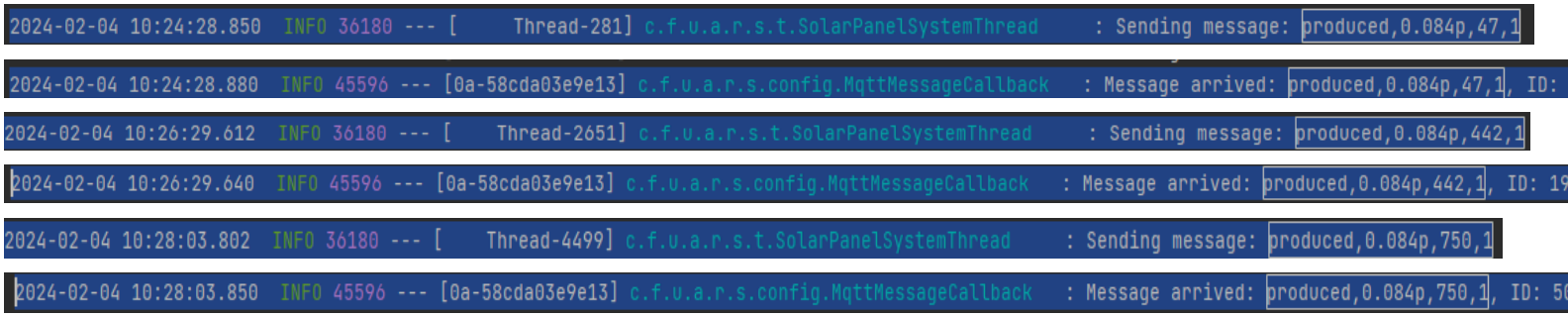
Prvo je testiran sistem sa 1000 simulatora električnih punjača. Bez obzira na broj simulatora, komunikacija između simulatora i servera tekla je praktično instantno. Ne treba očekivati da bi se ovo promenilo sa većim brojem simulatora, uzimajući u obzir brzinu prenosa poruke i činjenicu da punjači imaju mali broj retkih promena stanja.

```
2024-02-04 10:04:07.612  INFO 30752 --- [     Thread-725] c.f.u.a.r.s.threads.ChargerThread        : Message sent: START,1,80.0,6306.0,123
2024-02-04 10:04:07.612  INFO 30752 --- [     Thread-725] c.f.u.a.r.s.threads.ChargerThread        : New car came: PortInfo(chargeStart=Sun Feb 04 10:04:
2024-02-04 10:04:07.612  INFO 21296 --- [49-b6c3aa0a9e33] c.f.u.a.r.s.config.MqttMessageCallback    : Message arrived: START,1,80.0,6306.0,123, ID: 1
```

Zatim je testiran sistem sa 1000 simulatora baterija. Veći deo procesa smo imali praktično instantno slanje poruka, ali se viđa usporenje sa vremenom kako se unosi veći broj baterija i prilazi broju od 1000. Ovo se dešava zbog relativno dosta češće frekvencije slanja poruka baterije u odnosu na punjač. Naravno, i sa usporenjem kašnjenje je samo 200ms što nije značajno pogotovo u kontekstu naše aplikacije.



Na kraju je testiran sistem sa 1000 sistema solarnih panela. Od početka se vidi malo, neznatno kašnjenje. Kako vreme odmiče i veći broj panela se uključuje, kašnjenje se povećava ali bez problema ostaje u neznatnim granicama, sa oko 50 ms kašnjenja pri kraju.



Primećuje se da za konkretne uređaje koji su bili testirani nije potrebna neka specijalna optimizacija. Korišćeni MQTT protokol je već bio prilično efikasan u brzom prenosu podataka bez puno overheada.

Ipak, jedna potencijalna metoda optimizacije koja je bila generalno razmatrana i pre testiranja jeste keširanje. Funkcionalnosti koje su pogodne za optimizaciju keširanjem su one koje uključuju često pristupanje podacima ali retko menjanje. Utvrđeno je da su sledeće funkcionalnosti pogodne za keširanje: dobavljanje svih vlastitih kao i deljenih uređaja korisnika, dobavljanje odobrenih nekretnina korisnika i dobavljanje informacija o korisnicima.

Implementiranjem keširanja performanse za te funkcionalnosti su značajno poboljšane. Kao primer, dobavljanje 10 odobrenih nekretnina bez keširanja traje oko 10ms, dok sa keširanjem manje od 1ms. Kada god se odobri nova nekretnina tom korisniku, potrebno je ponovo oko 10ms za dobavljanje tih nekretnina pre nego što se podaci keširaju i performanse se ponovo poboljšaju. Treba imati u vidu da je odobrenje nove nekretnine veoma redak slučaj i da je zbog toga ovo uspešna i efikasna optimizacija.

- Vuk Radmilović SV73/2020