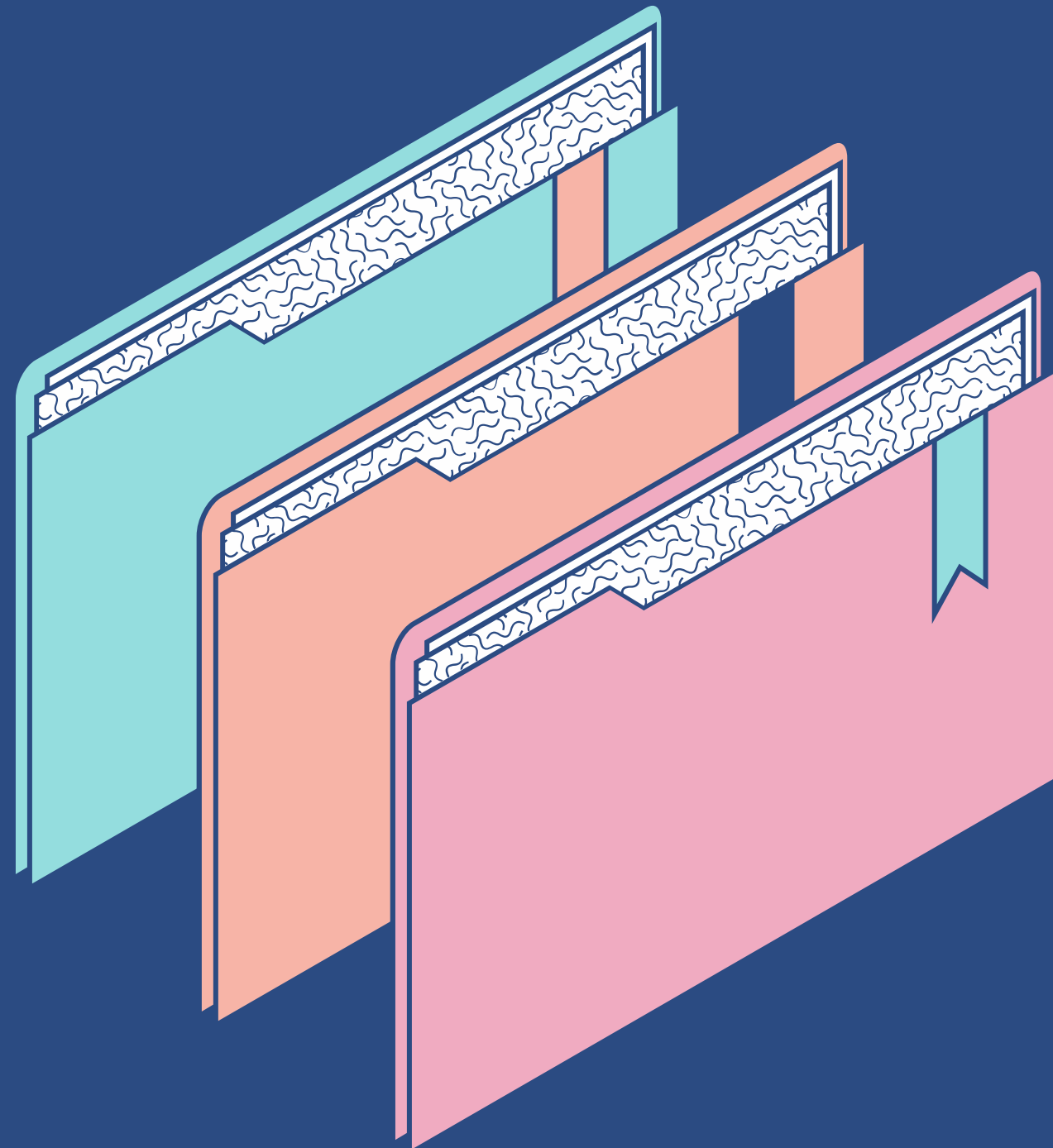# Implement and Compare performance of Modified-Largest Weighted Delay First with RR, PF, MT

Satvik Padhiyar | Pradhumn Kanase | Pallavi Saxena
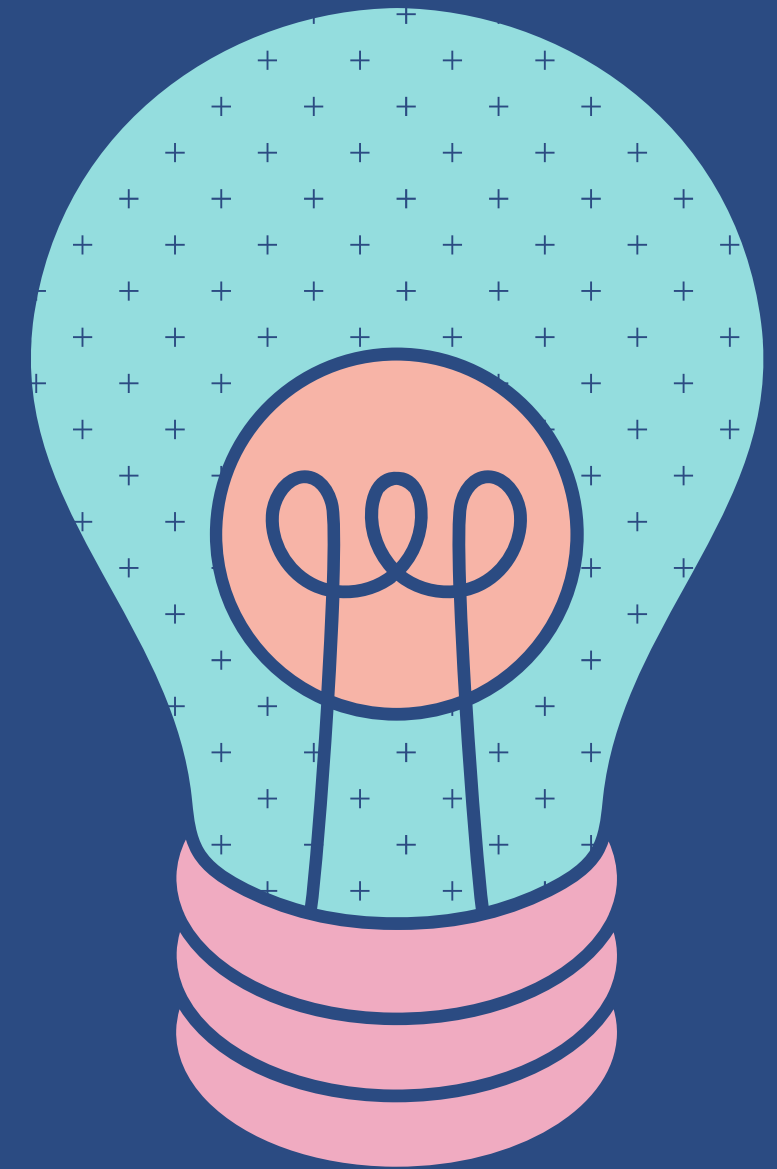CS21MTECH14011 | CS21MTECH11018 | CS21MTECH11020

Agenda

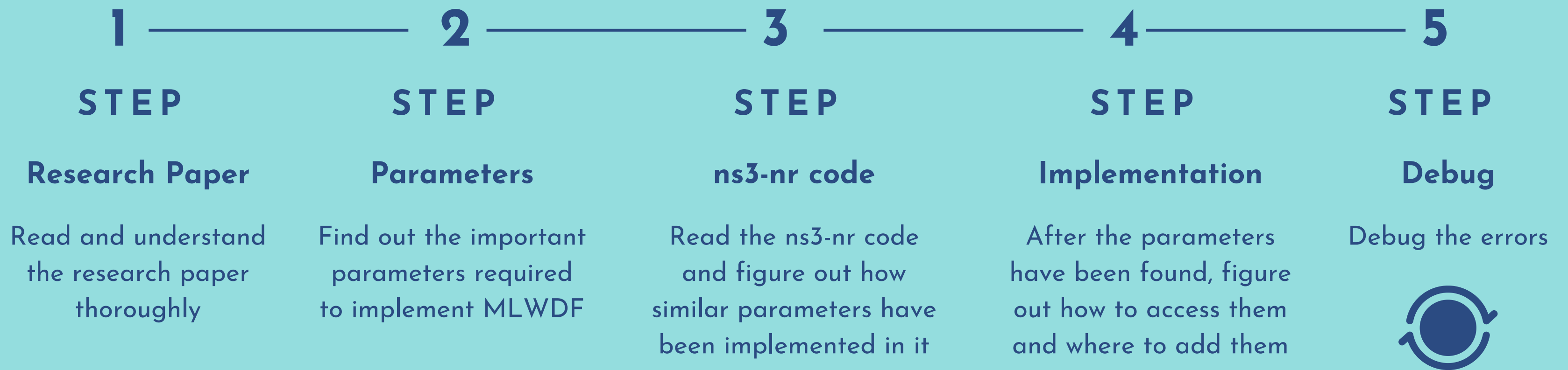KEY TOPICS DISCUSSED IN THIS PRESENTATION

- What is MLWDF
- Stages of MLWDF Implementation
- Scope of work
- Division of work
- Conclusion
- Resources
- Questions

What is MLWDF(Maximum Largest Weighted Delay First)

MLWDF IS A MAC SCHEDULING ALGORITHM THAT ALSO TRIES TO BALANCE THE FAIRNESS AND THROUGHPUT INA GIVEN DATA FLOW,

Stages of MLWF Implementation

1 —— **2** —— **3** —— **4** —— **5**

STEP **STEP** **STEP** **STEP** **STEP**

Research Paper **Parameters** **ns3-nr code** **Implementation** **Debug**

Read and understand the research paper thoroughly

Find out the important parameters required to implement MLWDF

Read the ns3-nr code and figure out how similar parameters have been implemented in it

After the parameters have been found, figure out how to access them and where to add them

Debug the errors

Research Paper

https://dl.acm.org/doi/10.1145/3321349.3321350

An Improved MAC Layer for the 5G NR ns-3 Module

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ABSTRACT

In this paper, we present a novel 5G NR simulator aligned with Release 15 TS 38.300. The work relies on previous implementations of LTE and mmWave modules. The focus of the paper is on the MAC layer, where we present the refactoring and the improvements to support OFDMA as per standard. A novel, user-friendly and modular interface is also proposed for the scheduler part, that allows a symbol-level distribution of resources. We go through the

with the core network and the mobility of the users, without the support of a solid full-stack end-to-end simulation model.

While common low-level simulators focus on link level simulations, we are interested in having an overall view of the system, which starts from the application level to the PHY layer and includes an End-To-End (E2E) performance evaluation, from the User Equipment (UE) to the remote host. Our objective is to properly evaluate the performance of a sophisticated and flexible technology,

Metrics
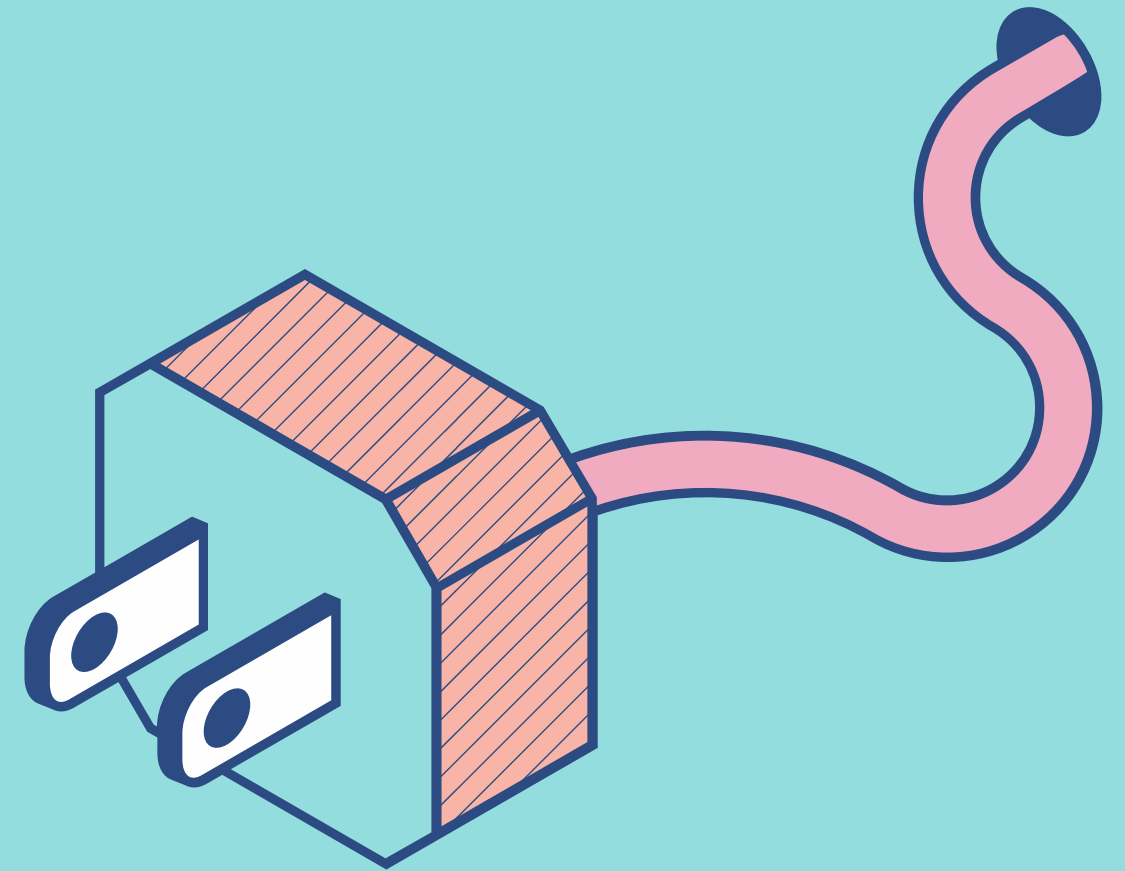
Drop Probability

HoL Delay

Max Target Delay

availableRate/averageRate

DROP PROBABILITY

This parameter is found in pie-queue-disc. "Pie-Queue-Disk" is a queuing discipline that uses a packet's sojourn time (time in queue) to make decisions on packet drops.
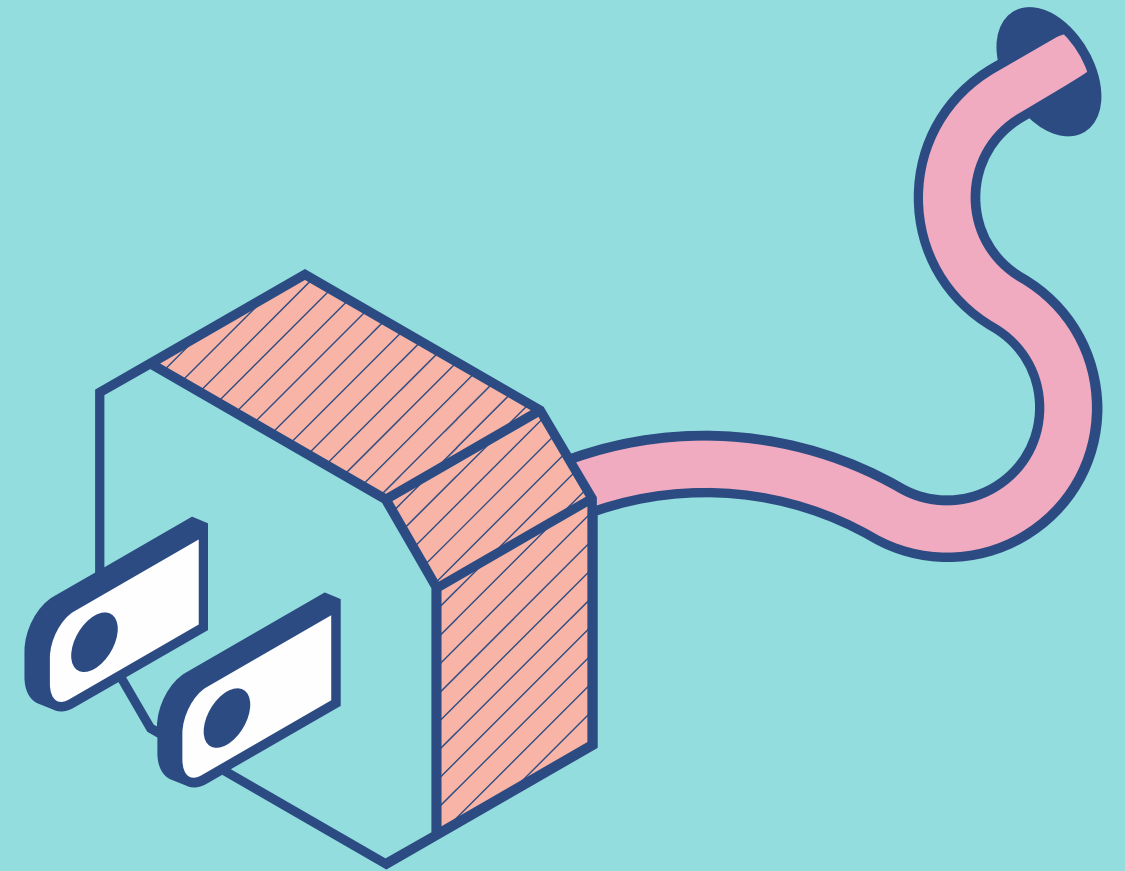
https://www.nsnam.org/doxygen/classns3_1_1_pie_queue_disc.html#a532858948ab061df8daceaa7c798814d

HOL DELAY

Head-of-line blocking (HOL blocking) in computer networking is a performance-limiting phenomenon that occurs when a line of packets is held up by the first packet.It is found in nr-mac-sched-sap.h. It is Service Access Point (SAP) offered by the MAC to the RLC

https://github.com/Asthonak/VANET-and-Nodal-Communication-in-a-Adaptive-Environment/blob/dd50b98ee9f5fe82d4b4327d218d632c19c564cf/ns-3-win/src/lte/model/bearer-qos-parameters.cc
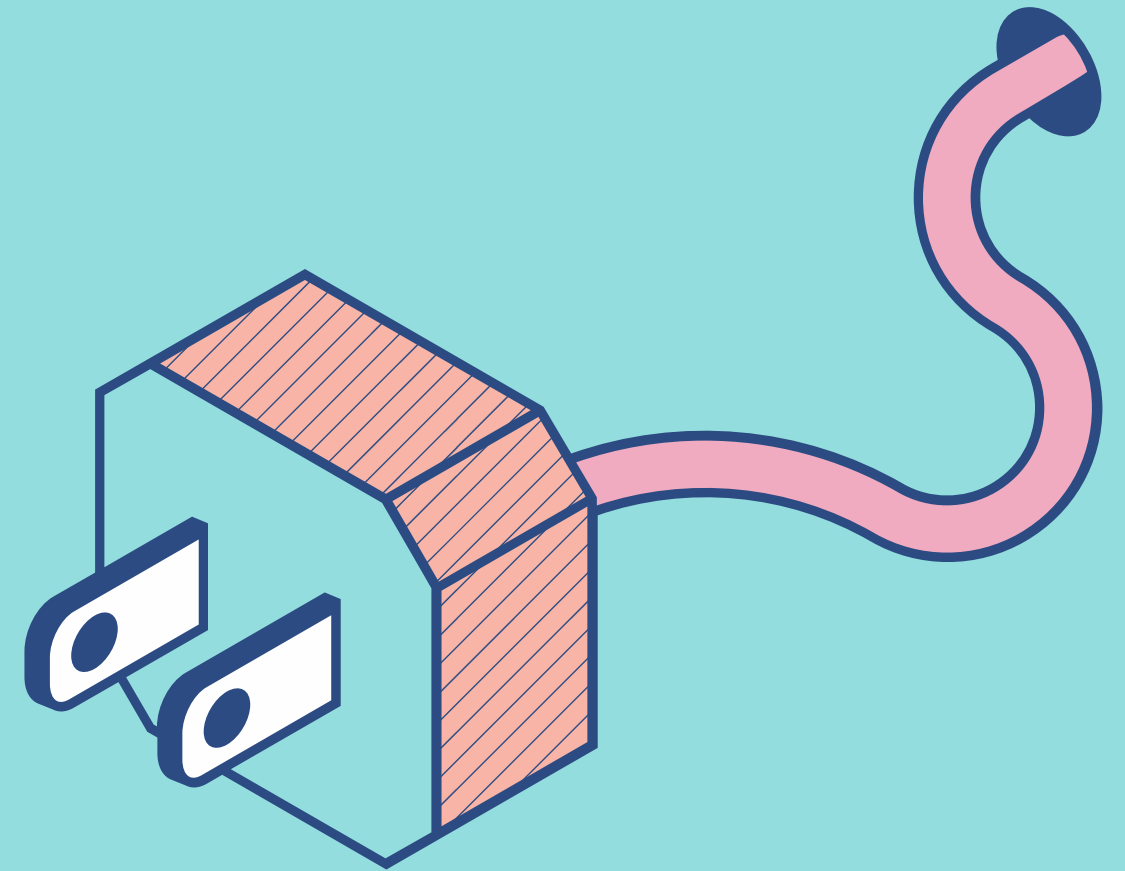
MAX TARGET DELAY

A constant value of 100ms.

AVAILABLE RATE / AVERAGE RATE

This metric has already been used in the PF scheduler as its metric. The value has been extracted from PF module.

EQUATION USED

-log(dropProbability)/targetDelay *
* HOL * availableRate/averageRate

WORK PROGRESS

- FIGURING OUT THE EQUATION OF MLWDF SCHEDULER
- FINDING THE MODULE INTEGRATION METHOD
- FIGURING OUT THE PARAMETERS AND FROM WHERE THEY NEED TO BE EXTRACTED
- FIGURING OUT THE FUNCTIONS FOR PARAMETER INCLUSION
- DEFINING THE PARAMETERS AND FUNCTION IN THE CODE MODULE
- DEBUGGING THE ENCOUNTERED ERRORS

PARAMETERS INCLUSION

```cpp
  double m_currTputUl {0.0};      //!< Current slot throughput in uplink
  double m_avgTputUl  {0.0};      //!< Average throughput in uplink during all the slot
  double m_lastAvgTputUl {0.0};   //!< Last average throughput in uplink
  double m_potentialTputUl {0.0}; //!< Potential throughput in uplink in one assignab
  double metric {0.0};
  double m_HolDelay {99.0};
  double m_availableRate {0.0};
  double m_dProb {0.0};
  double m_tDelay {0.1};
  //PieQueueDisc pie;
};
```

FUNCTION DECLARATION

```cpp
int
NrMacSchedulerNs3::GetHoLDelay() const
{
    return m_holDelay;
}
```

```cpp
double
PieQueueDisc::GetDropProb ()
{
    return m_dropProb;
}
```

```
double lPfMetric = log(m_prob)*(luePtr->m_tDelay) *std::pow (luePtr->m_potentialTputDl,
double rPfMetric = log(m_prob)*(ruePtr->m_tDelay )*std::pow (ruePtr->m_potentialTputDl,
```

```
static bool
CompareUeWeightsDl (const NrMacSchedulerNs3::UePtrAndBufferReq &lue,
                    const NrMacSchedulerNs3::UePtrAndBufferReq &rue )
{
  int m_prob = ns3::dropProbns3;
  //std::cout<<m_prob<<std::endl;
  //delete &drop;

  auto luePtr = dynamic_cast<NrMacSchedulerUeInfoMLWDF *> (lue.first.get ());
  auto ruePtr = dynamic_cast<NrMacSchedulerUeInfoMLWDF *> (rue.first.get ());


  double lPfMetric = log(m_prob)*(luePtr->m_tDelay) *std::pow (luePtr->m_potentialTputD
  double rPfMetric = log(m_prob)*(ruePtr->m_tDelay )*std::pow (ruePtr->m_potentialTputD


  return (lPfMetric > rPfMetric);
}
```

OUTPUT

```
[3120/3162] Linking build/scratch/task2
[3121/3162] Linking build/scratch/Task3
[3122/3162] Linking build/scratch/Q_8_9
Waf: Leaving directory `/home/ubuntu/ns-3-dev/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (2m30.978s)
AnimationInterface WARNING:Node:0 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:1 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:2 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:10 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:0 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:1 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:2 Does not have a mobility model. Use SetConstantPosition if it is stationary
AnimationInterface WARNING:Node:10 Does not have a mobility model. Use SetConstantPosition if it is stationary

 Total UDP throughput (bps):120000

 Total UDP throughput (bps):120000

 Total UDP throughput (bps):120000

 Total UDP throughput (bps):120000

 Total UDP throughput (bps):120000
```
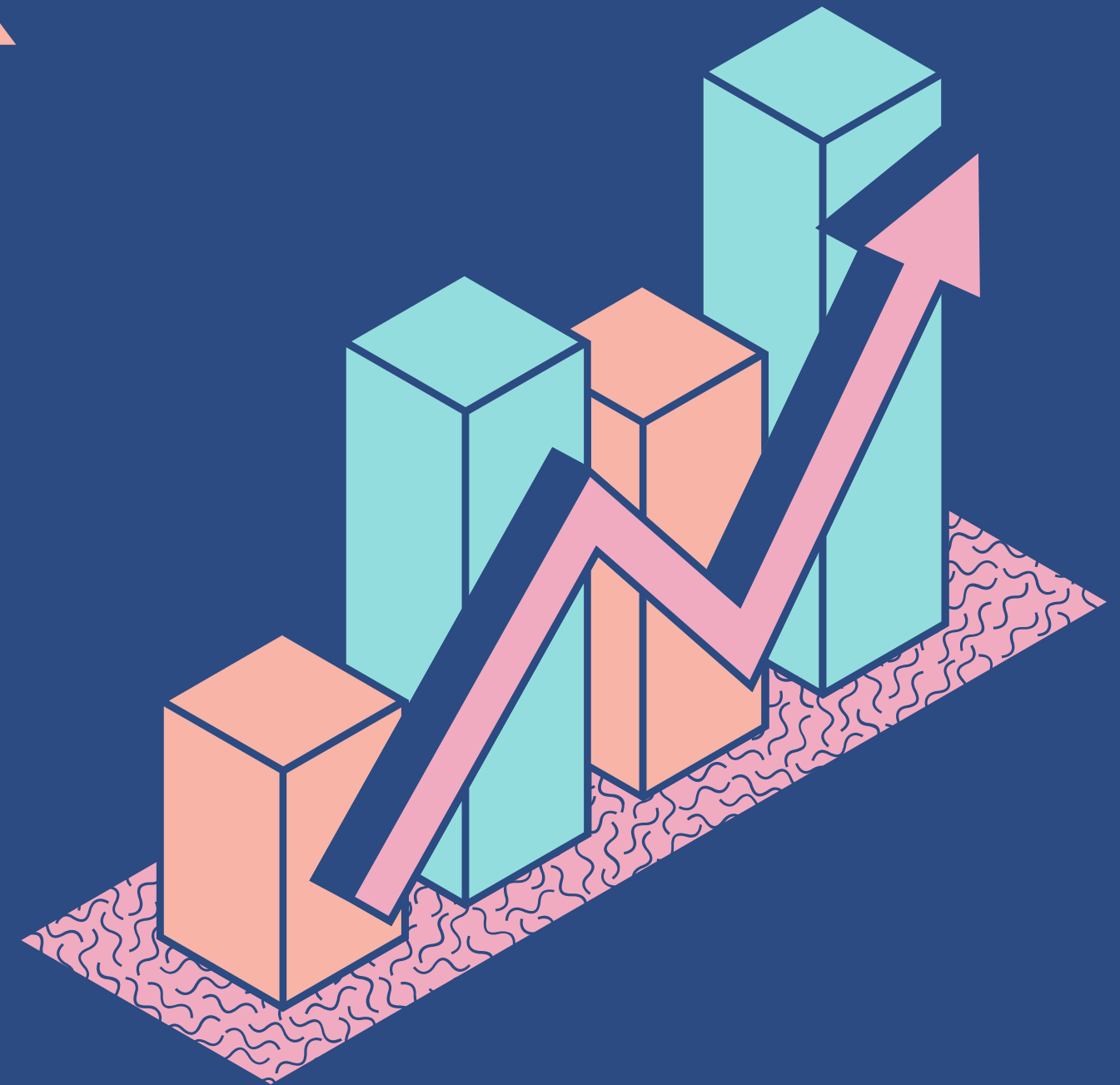
CONCLUSION

MLWDF OUT PERFORMS PF AND RR BUT IS NOT BETTER THAN MAX CQI

SCOPE OF WORK

To test the designed scheduler on basics of average packet loss, fairness index, average throughput

To test the designed scheduler for various topologies and user positions

Division of Work

Pallavi Saxena
To research about the project, come up with equation for scheduler, find related source code references, construct topological model for testing

Satvik Padhiyar
To design a c++ or pseudo code layout for the code, implement thetopology for scheduler testing

Pradhumn Kanase
Translate the obtained c++ or pseudo code to the ns3 program.

Deliverables

Ns3MacSchedulerMLWFD.hh - A code file consisting of the implemented scheduler that will be mounted with other Ns3 scheduling algorithm files

Report- A precise documentation consisting of the theoretical aspects and result based observations.

CHALLENGES

- Figuring out dependencies.

- Contribution of other models- pf,rr,tdma,mr-mac.

- Addition of self made functions.

- Debugging

CHALLENGES

```
ubuntu@ubuntu-HP-Pavilion-Notebook:~/ns-3-dev$ ./waf --run "scratch/3gpp.cc --RngRun=24"
Waf: Entering directory `/home/ubuntu/ns-3-dev/build'
[2010/3162] Compiling src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc
[2397/3162] Compiling src/nr/test/nr-system-test-configurations.cc
[2402/3162] Compiling src/nr/test/nr-uplink-power-control-test.cc
[2405/3162] Compiling src/nr/test/nr-realistic-beamforming-test.cc
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc: In static member function 'static ns3::TypeId ns3::NrMacSchedulerTdmaMLWDF::GetTypeId()':
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:52:66: error: 'SetDropProb' is not a member of 'ns3::NrMacSchedulerTdmaMLWDF'
   52 |              MakeDoubleAccessor (&NrMacSchedulerTdmaMLWDF::SetDropProb,
      |                                                           ^~~~~~~~~~~
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:53:66: error: 'GetDropProb' is not a member of 'ns3::NrMacSchedulerTdmaMLWDF'
   53 |                                 &NrMacSchedulerTdmaMLWDF::GetDropProb),
      |                                                          ^~~~~~~~~~~
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc: At global scope:
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:93:1: error: no declaration matches 'void ns3::NrMacSchedulerTdmaMLWDF::SetDropProb(double)'
   93 | NrMacSchedulerTdmaMLWDF::SetDropProb(double v)
      | ^~~~~~~~~~~~~~~~~~~~~~~
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:93:1: note: no functions named 'void ns3::NrMacSchedulerTdmaMLWDF::SetDropProb(double)'
In file included from ../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:19:
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.h:32:7: note: 'class ns3::NrMacSchedulerTdmaMLWDF' defined here
   32 | class NrMacSchedulerTdmaMLWDF : public NrMacSchedulerTdmaRR
      |       ^~~~~~~~~~~~~~~~~~~~~~~
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:99:1: error: no declaration matches 'double ns3::NrMacSchedulerTdmaMLWDF::GetDropProb()'
   99 | NrMacSchedulerTdmaMLWDF:: GetDropProb()
      | ^~~~~~~~~~~~~~~~~~~~~~~
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:99:1: note: no functions named 'double ns3::NrMacSchedulerTdmaMLWDF::GetDropProb()'
In file included from ../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.cc:19:
../src/nr/model/nr-mac-scheduler-tdma-m_lwdf.h:32:7: note: 'class ns3::NrMacSchedulerTdmaMLWDF' defined here
   32 | class NrMacSchedulerTdmaMLWDF : public NrMacSchedulerTdmaRR
      |       ^~~~~~~~~~~~~~~~~~~~~~~

Waf: Leaving directory `/home/ubuntu/ns-3-dev/build'
Build failed
 -> task in 'ns3-nr' failed with exit status 1 (run with -v to display more information)
ubuntu@ubuntu-HP-Pavilion-Notebook:~/ns-3-dev$
```

CHALLENGES

References

Mac scheduling algorithm files present in Ns3-dev

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5340336

https://opus.lib.uts.edu.au/bitstream/10453/10894/1/2009000660.pdf

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1400171

THANK YOU