

Framework and Research Roadmap for a Next-Generation Hyperconnected Logistics Hub

Presenter: Leon F. McGinnis

Professor Emeritus, Georgia Tech, School of Industrial and Systems Engineering

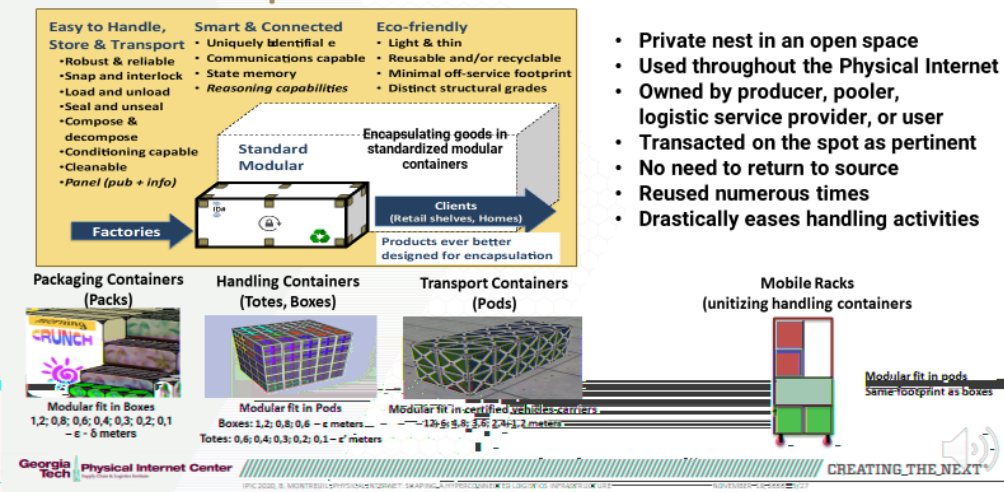
Co-Authors: Professor Benoit Montreuil, Shannon Buckley, Sevda Babalou, Wencang Bao, and Ali Beranji

*IPIC 2021, International Physical Internet Conference,
2021/06/16*

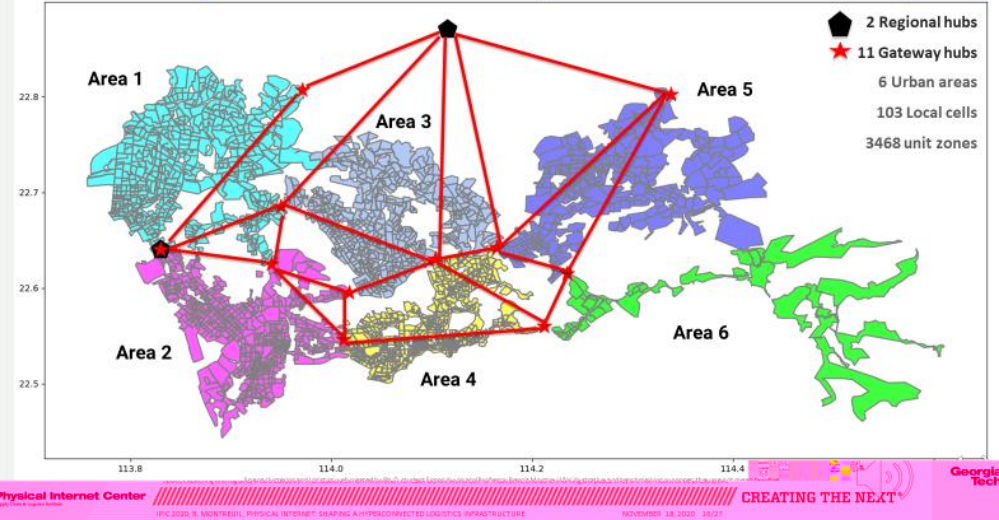
Bhf oeb

- Hf of t jt
- Cbt jd! efb
- Vt f!Dbt f
- Ef t jhojoh!ui f!! M
- Fwbmbujoh!ui f!! M !Dpodf qu
- Of yuTuf qt

Hyperconnected Logistics Infrastructure Ubiquitous Modular Containerization



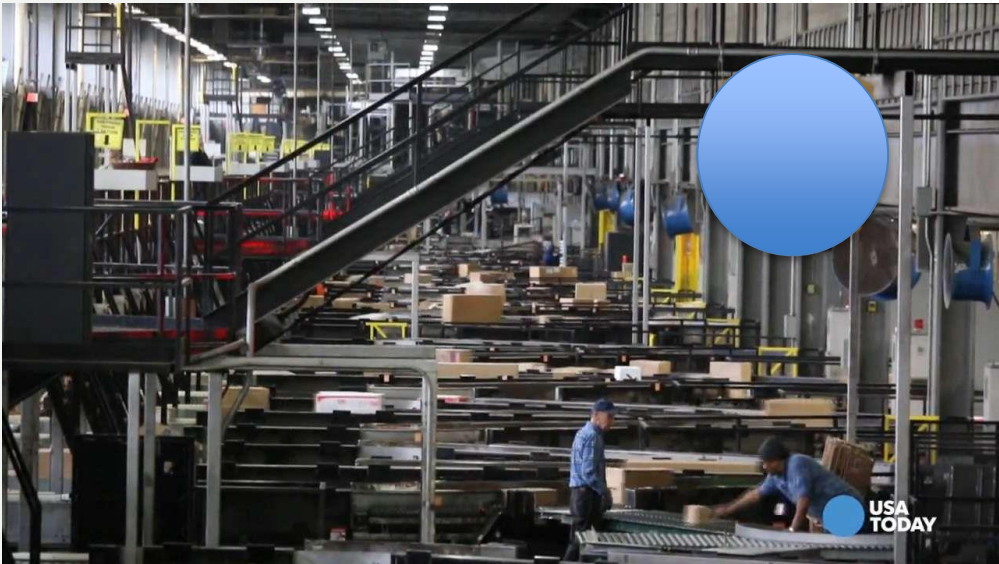
Urban Logistics Web: Gateway-Hub Network in Megacity



Hf of t jt

pi w t i u w t 4
ki t t m i o d m x i k m t
twoq d p tws t s m

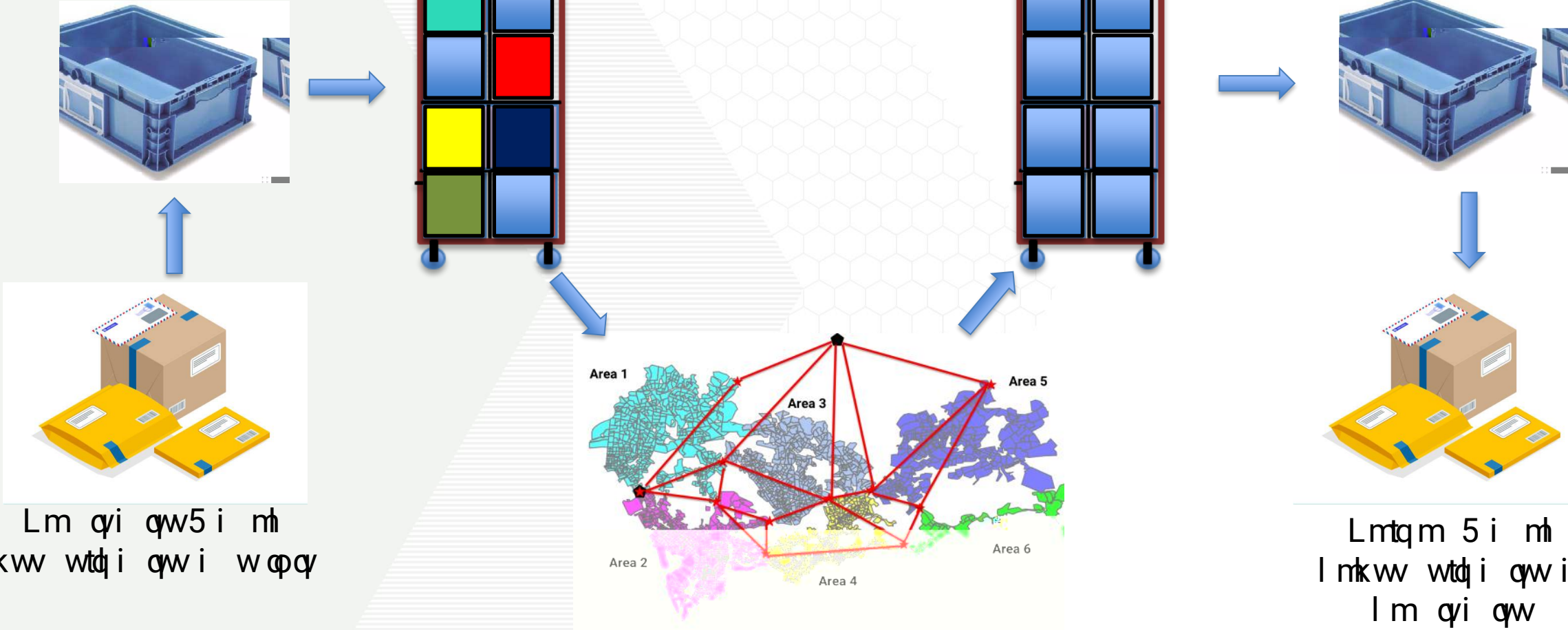
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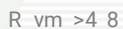


- w i t vw tsm pqB
- =8 su wkw mw
 - > 488 u
 - 6 su q i w m

M mu nt mnk qm4 wpki xqi ti vl
ti w q mv qm4 qp tq qm ki xi qq nw
m xi v qw6

Cbt jd! ef b





- ?7 $\frac{6}{4}$



Vt f!Dbt f

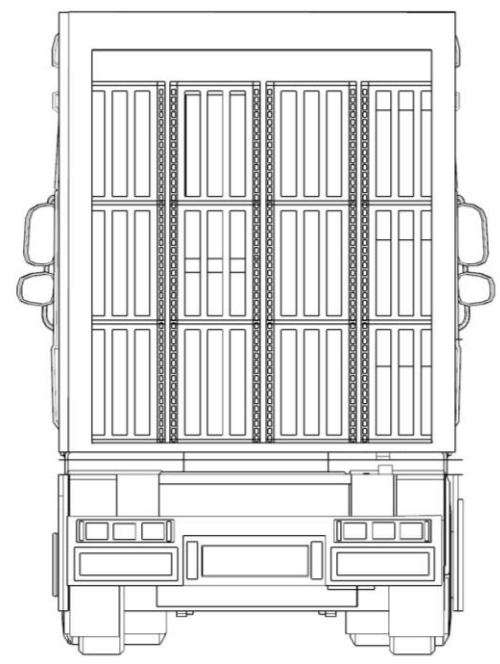
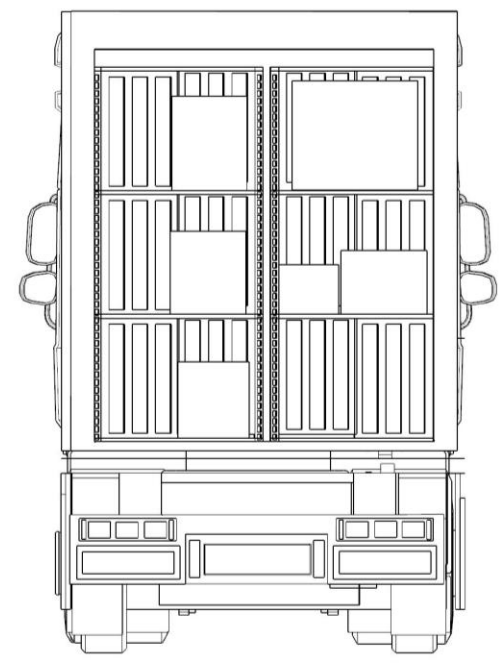
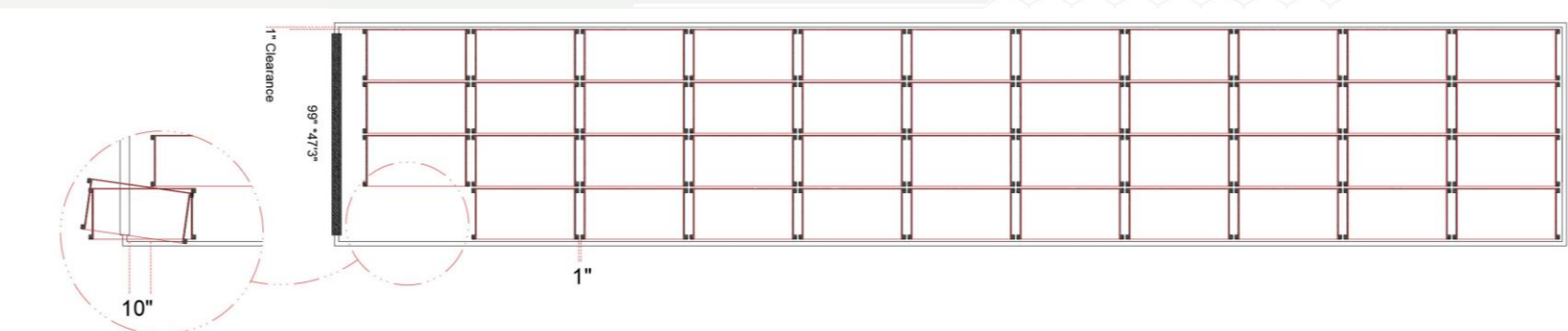
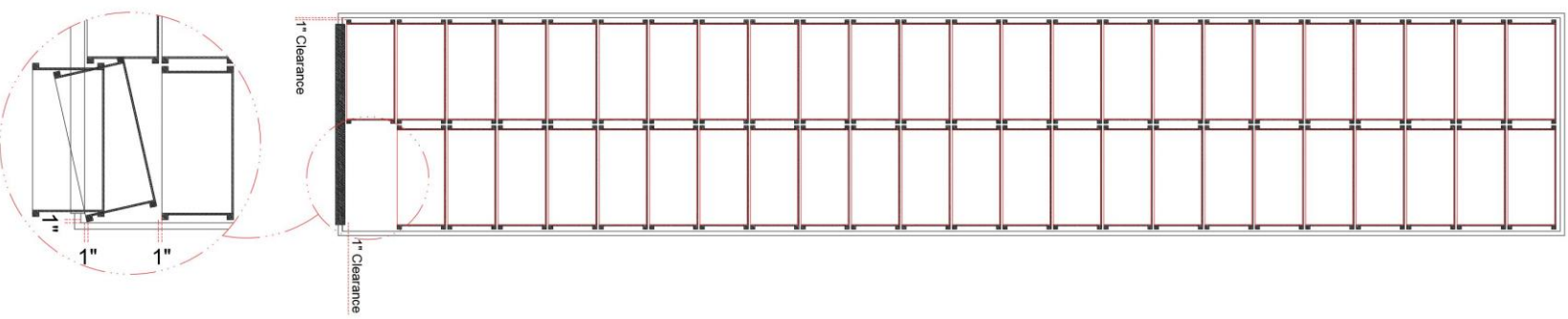
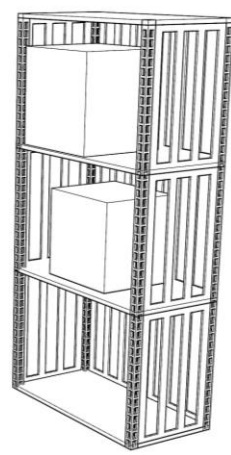
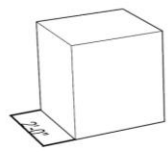
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 - 511-111!qbsdf rtt!qf slebz
 - 211!epdl t
 - /!ujm usbz!t psldpowf zp st -!f bdi !bu 2 1110i s
 - 41!qvux bmx ps t ubuip ot -!f bdi !bu 9110i s
 - ! 11!x ps f st

Mphjt ujd t! E f t j h o! t t v f t

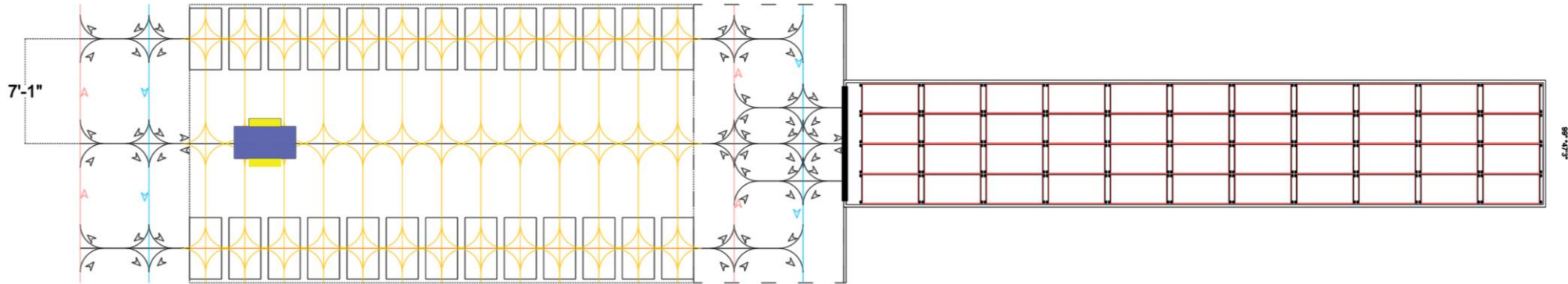
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- Ovn cf spgepdl t!boe!*LoadBots*
- Bn pvoulpg)vo rpb ejoh!tubh joh
- Ovn cf spg*ShuffleCells*
- *ShuffleCell* ef t j h o
- Ovn cf sboe!dpogjhvsbuipo!pg*BufferCells*
- Ovn cf spg*MoveBots* boe!*ToteBots*
- Dpousprthbsdi juf duvsf !qprjd jf t !ef d j t j p o. n bl joh!brhpsjui n t

Eft jho!pgUpuf t!boe!Sbdlt

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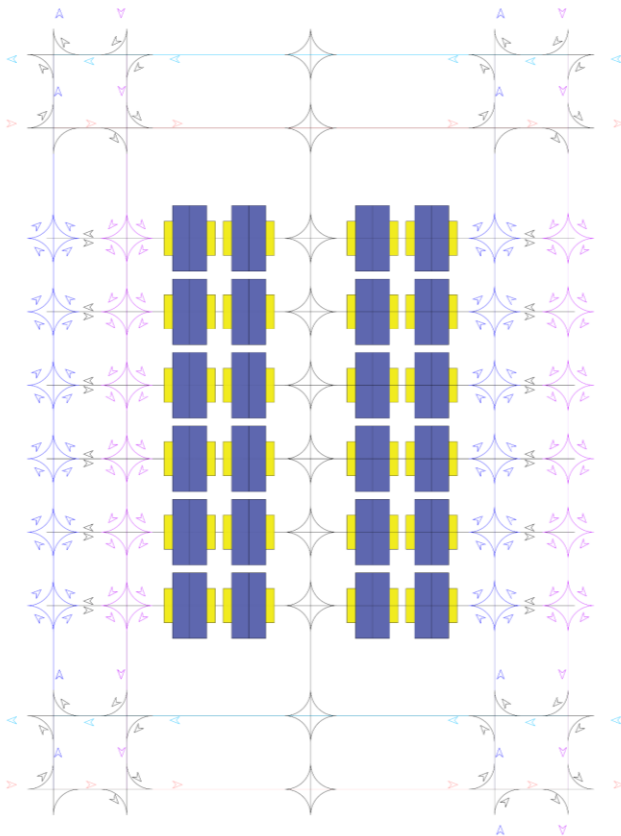
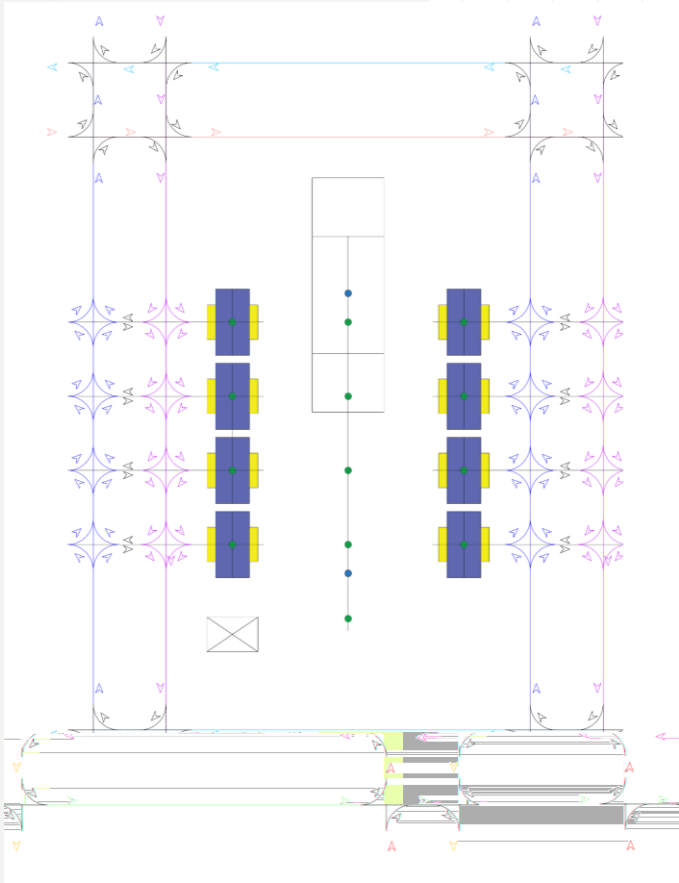


Efficiently Implementing a Tube Job



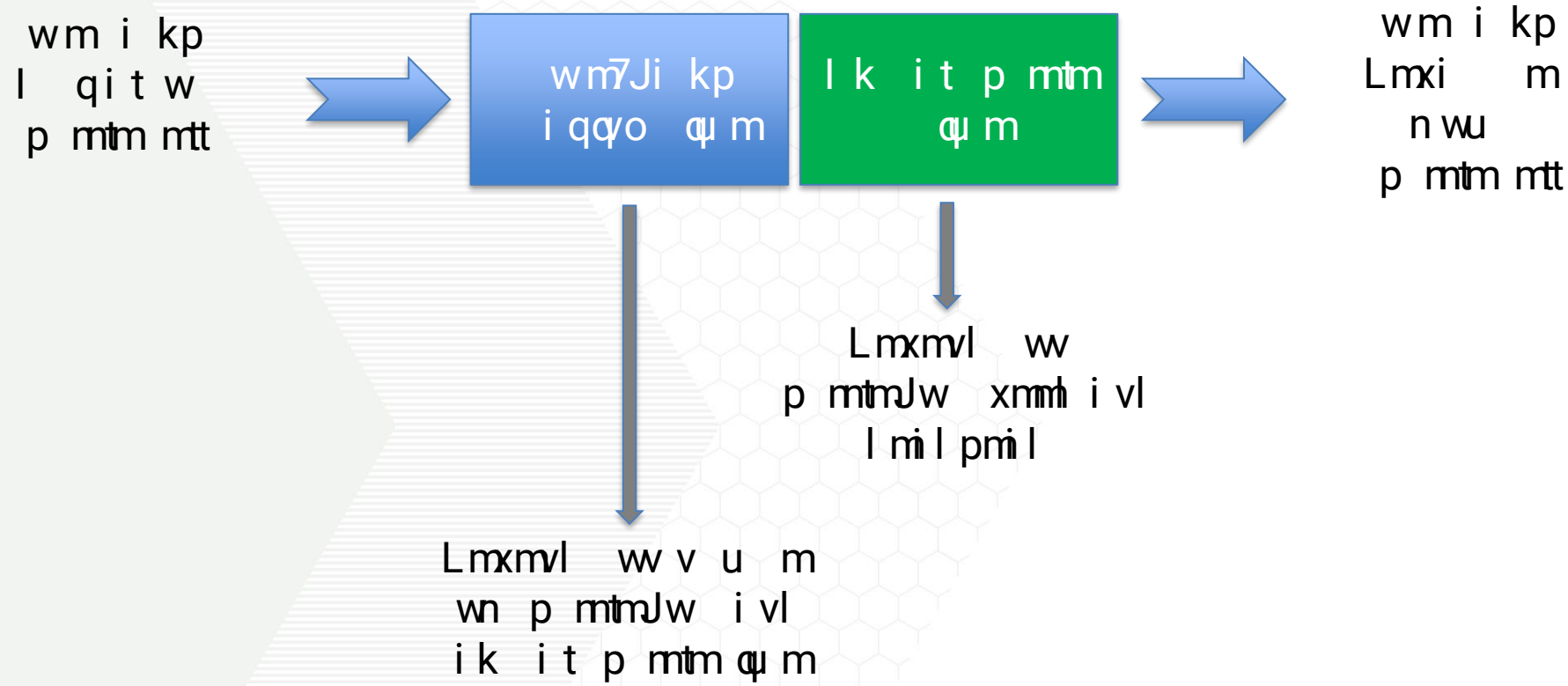
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q u m i p m l w k s i v l q l q m v p m x m i s x m q l k s i q i t i n b

Ti vggfhDf rm !Cvggf sDf mEf t jho

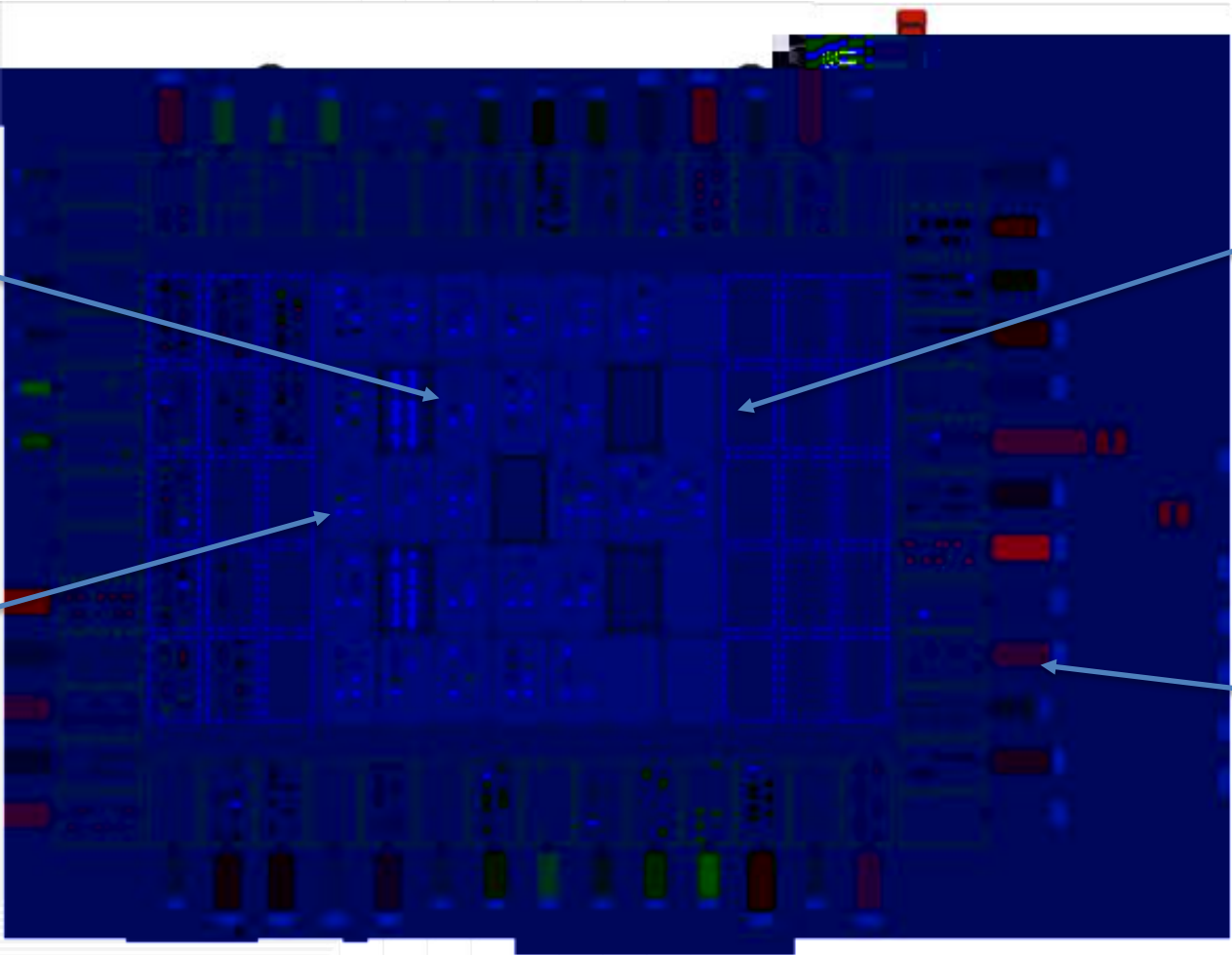


i u mnwx q E U w t q

Ovn cf dpgTi vgrhDf mh



Ti vggfhDf ouf sTqbdf!B t t jhon f ou



p mtn rtt

J mm rtt

n5i vl w 5
p mtn i oqo

Twl 7 vtwl
i oqo

DpousprB sdi juf duv sf

Wxmv 7ktw m p mtn ntt 4
i twki m Twil w i vl
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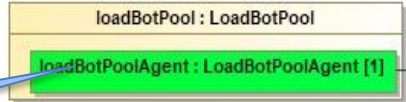
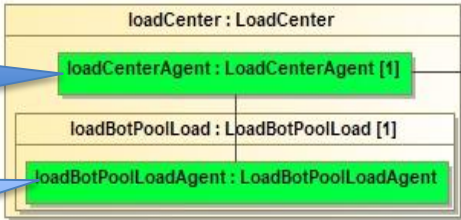
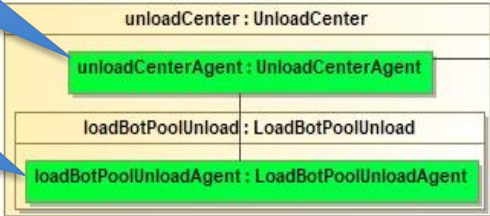
I øv vtwil
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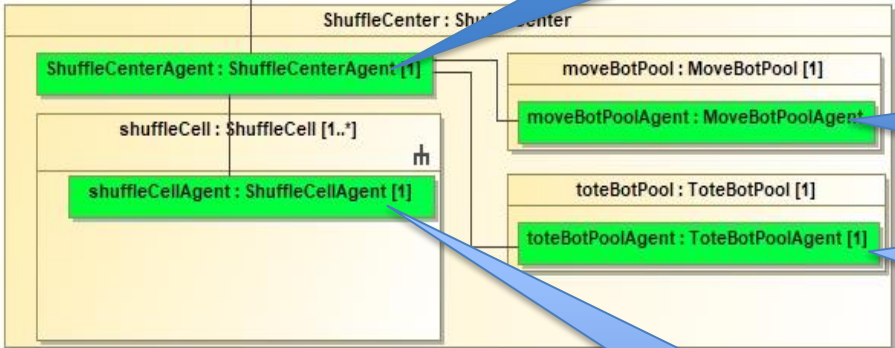
I øv twil i s
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m nmv xwvt

ibc [Block] HyConLogHub [HyConLogHubCtrlArch]



hLHAgent : HLHAgent



Lnkø m iksi vl wm
i v xw i vl i øv
i s C m x øv qøn nw
p mtn ntt

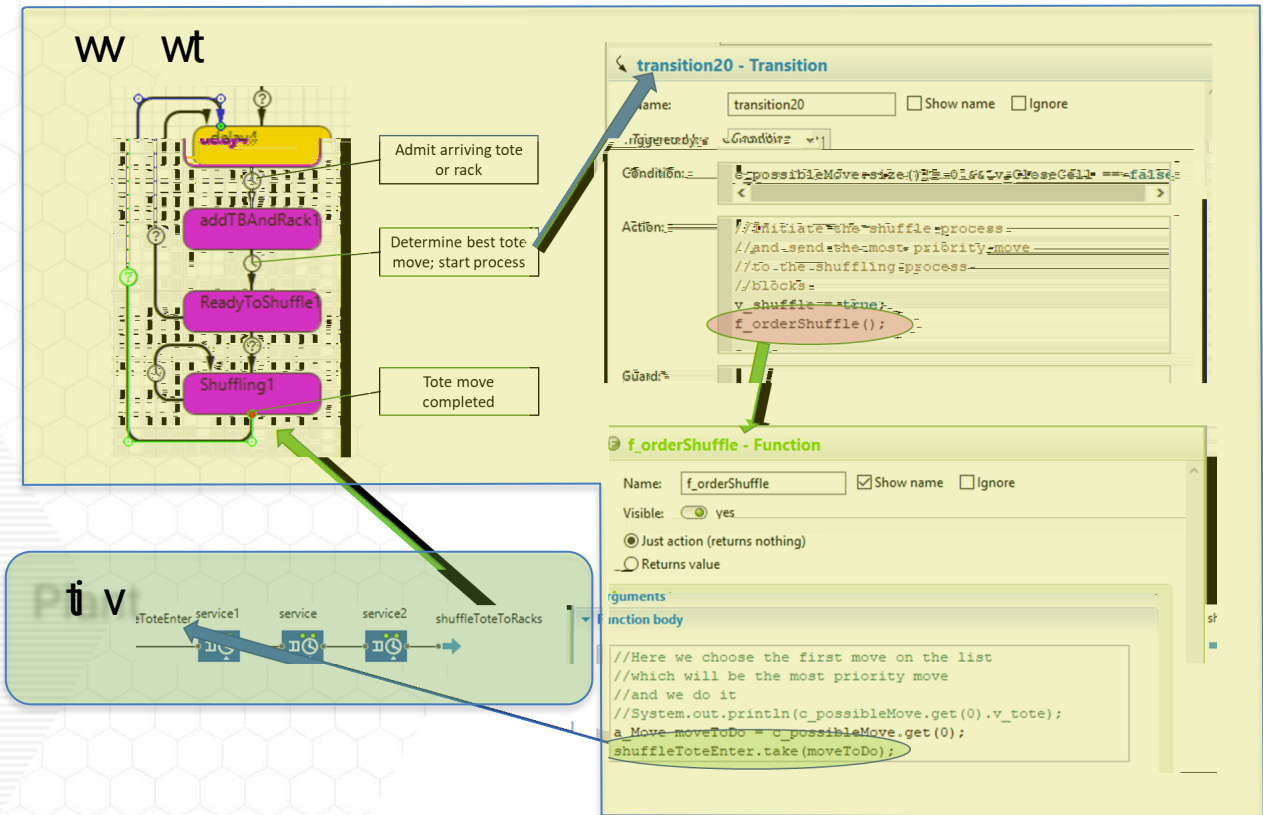
Lq xi kpm
U w mJw w
u w m i ks

Lq xi kpm
w mJw w
u w m w m

Lq xi kpm w w w
p mtn w m

Ti vggfhDf nBhf ou

- Uiqi q i mqnwui qw
 - l qvnh i s
 - iks i vl wm
- l qv i s w p mtrJw
 - Lmmu qmmi q tnu w m
 - mnk m vm u w m

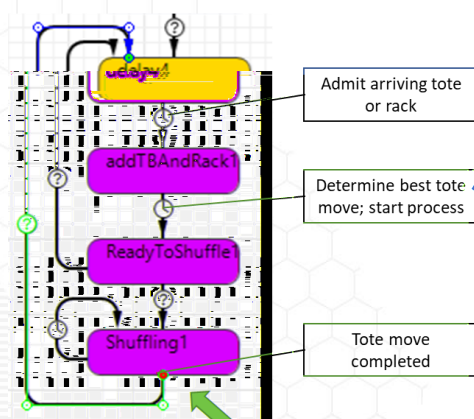
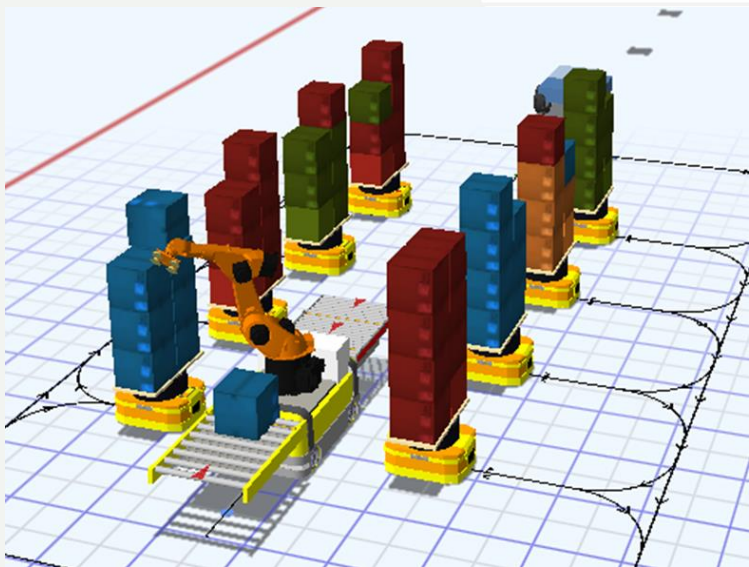


i no B p mtr m m l m qvi m q i vl iks iks C
p mtr mtr pm q q nw u w qo q l q q i t wm 6

Fwbnrbujpo !Tjn vrbujpo!B qqspbdi

Mu ti m4L xp q 5i m

I v twok p q i omv 7l qk mn5m



transition20 - Transition

Name: transition20 ☐ Show name ☐ Ignore

Condition: `c_possibleMove.size() > 0 && !v_reserveCell`

Action: `//Initiate the shuffle process -
//and send the most priority move
//to the shuffling process -
//blocks -
v_shuffle = true;
f_orderShuffle();`

Guard: %

f_orderShuffle - Function

Name: f_orderShuffle ☒ Show name ☐ Ignore

Visible: ☒ yes

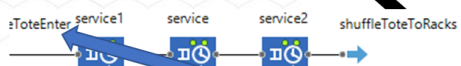
☒ Just action (returns nothing)

☐ Returns value

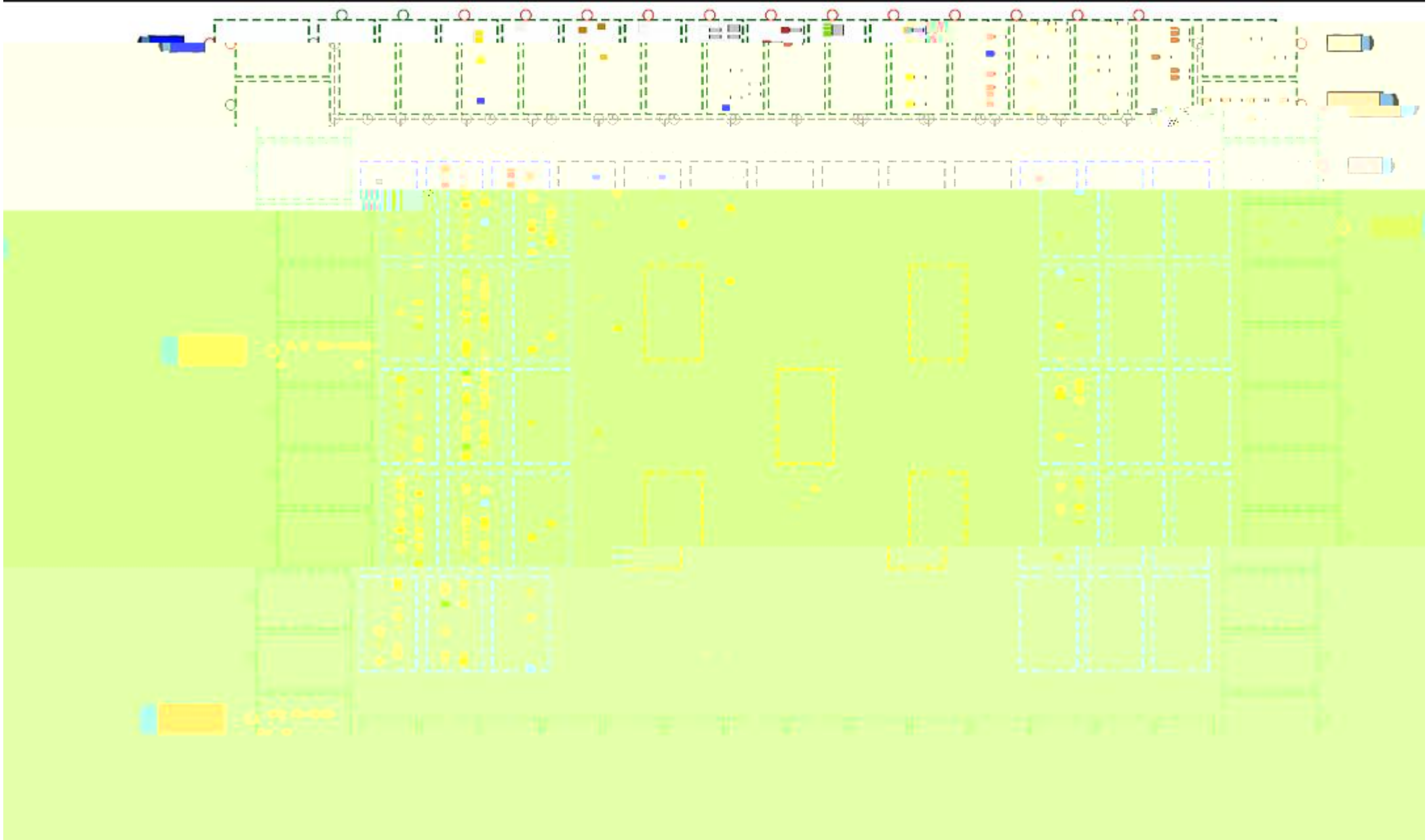
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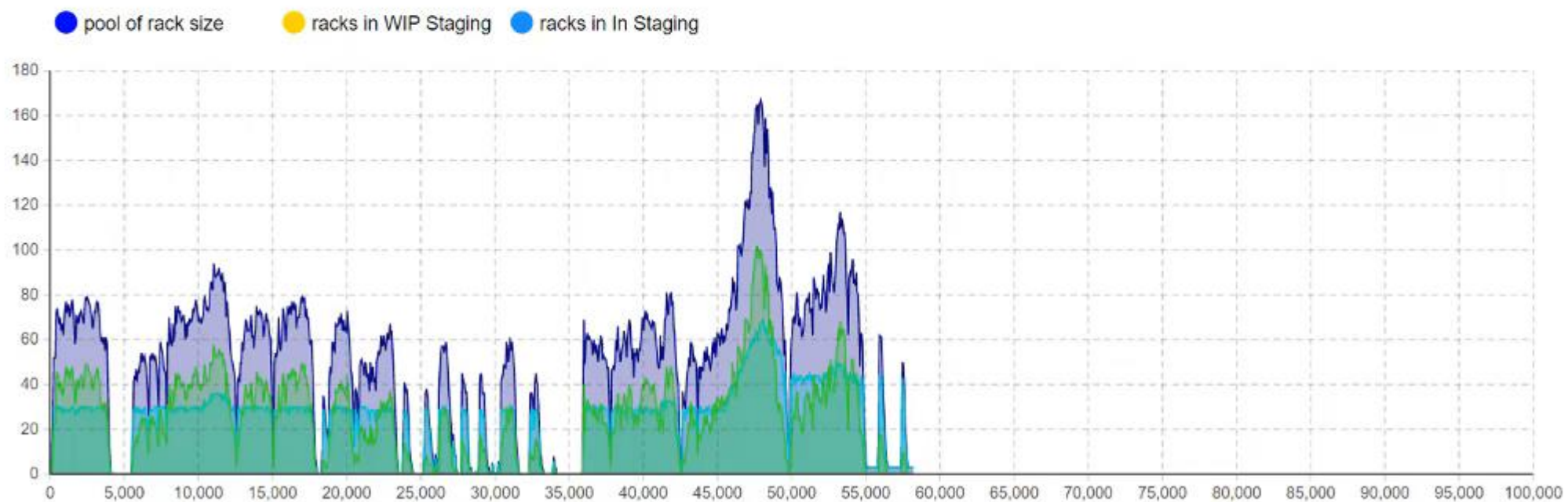
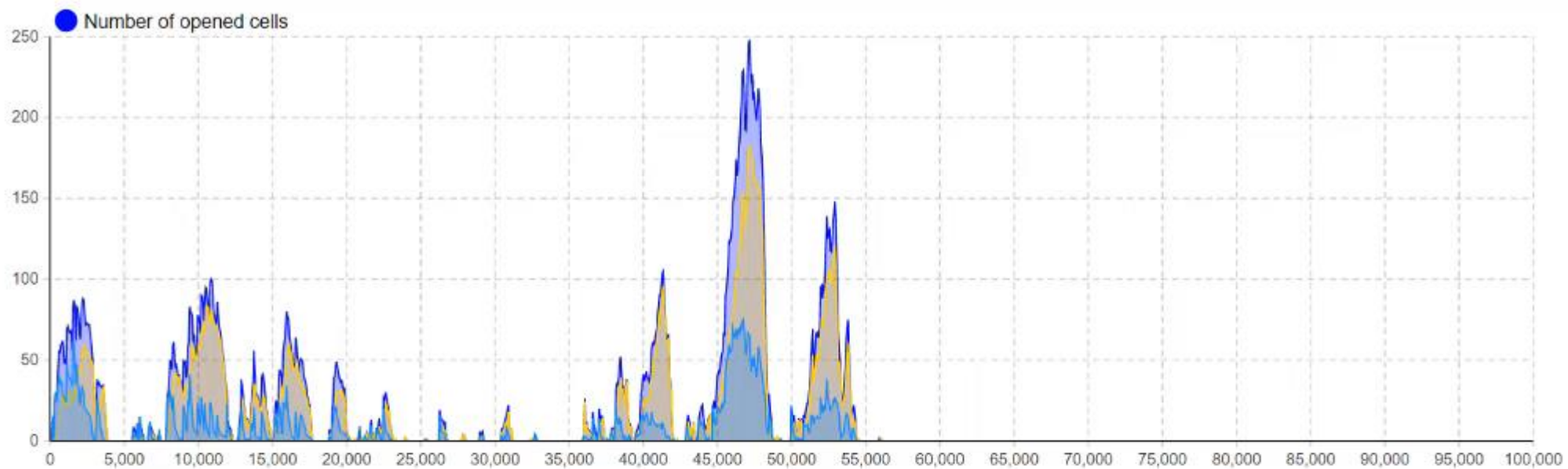
Function body:

```
//Here we choose the first move on the list  
//which will be the most priority move  
//and we do it  
//System.out.println(c_possibleMove.get(0).v_tote);  
a_Move moveToDo = c_possibleMove.get(0);  
shuffleToteEnter.take(moveToDo);
```



p mtn q mm q i m





● Racks in Cells ● Consol Racks in Cells ● Feeder Racks in Cells ● Buffer Racks in Cells

Hub Visualization

Cell KPI

Cell Visualisation

Hub KPI above

Racks in Staging

Racks in Buffer

Racks in Cell

Dpn qbsjt po!up! Cbt f njof! Vt f! Dbt f

- I M !bdi jf wf t!dpn qbsbcrf!t f swjdf!rfwf m
- owf tun f ouldptut!bsf!spvhi rz!dpn qbsbcrf
- Mbcpstdptut!bsf!esbn bujdbnz!rpx f s
- Sfr vjsf t!t n brfhsrbcpsdpsdf!cvuln psf!i jhi rz!r vbrjgjf e
- Sf rbujwf rz!f bt z!up!bee0sf n pwf!cput!up!di boh f!ui spvhi qvuldbqbdjuz
- Sf rbujwf rz!f bt z!up!sf rpdbuf!cput!up!sf .brmpdbuf!i vc!dbqbdjuz!bdspt t!ui f!of ux psl

Dbwf but "

- Ui f t f!bsf!dpodnrt jpot!gspn!)jojubnrt jn vrbuijpot
- Of f e!up!sf gjof!qspdf t t!ujn f!n pef rti!gspn !Fn vrbuf 4E
 - Cfuf dcpuleft jho!pqijn j f e!usbkf dupsz!qrbuojoh
- Mbzpvulopulpqujn j f e
- Dpnrt jpo!bwp jebodf!gpdcpur!jo!bjt rht!opulzfu jn qrfn f ouf e
- sppgpgdpodf qldpousprfst

Sf t f bœdi !boe!Ef wf rpn f ouP qqpænojujf t

- Fyqpsjoh!usbef .pggt -!f /h/-
 - Tqf f e!wt!ovn cf spgcpuf
 - Gsf r vf odz!wt!dbqbdjuz!pgusvdl t
- Sf gjo joh!pqf sbujpobnef djt jpo. n bl joh
 - Ti vggfDf mpqf sbujpo
 - N pwjoh!sddl t!wt!n pwjoh!upuf t
 - Ti vggfDf m !Cvggf sDf mt qbdf!bt t jhon f ou
- Cf uf s voef st uoe joh
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- Ef t jho!pqujn j bujpo
- Boe!n psf

Ui bol !zpv"