A match made in heaven:

Maximizing In-service hours using Route Pairing and other concepts

RYAN KENNETT, *SENIOR TRANSIT SCHEDULER & WORK LEAD*

NWTX SPOKANE 2024

BCTransit

Ice Breaker

Ice Breaker

Murray Kennett
Defense
Born Jun 28 1952 -- Kamloops, BC
[72 yrs. ago]
Height 5.10 -- Weight 175 [178 cm/79 kg]

			Regular Season						Playoffs				
Season	Team	Lge	GP	G	A	Pts	PIM	+/-	GP	G	A	Pts	PIM
1968-69	Victoria Cougars	BCJHL	Statistics Unavailable										
1969-70	Victoria Cougars	BCJHL	Statistics Unavailable										
1970-71	New Westminster Royals	BCJHL	Statistics Unavailable										
1970-71	Brandon Wheat Kings	WCHL	3	1	1	2	16						
1971-72	Victoria Cougars	WCHL	67	9	22	31	69						
1972-73	San Diego Gulls	WHL	70	3	12	15	67		6	0	0	0	4
1973-74	San Diego Gulls	WHL	76	6	25	31	35		4	1	1	2	2
1974-75	Edmonton Oilers	WHA	50	4	14	18	17		--	--	--	--	--
1974-75	Indianapolis Racers	WHA	28	1	3	4	8		--	--	--	--	--
1974-75	Mohawk Valley Comets	NAHL	1	0	0	0	0		--	--	--	--	--
1975-76	Edmonton Oilers	WHA	28	3	4	7	14		--	--	--	--	--
1975-76	Spokane Flyers	WIHL	27	9	29	38	34						
1976-77	Spokane Flyers	WIHL	--	0	3	3	0						
	WHA Totals		106	8	21	29	39						

Discussion Objectives

Share a few advanced scheduling concepts some agencies may already utilize in some way:

- **Cycle Time Analysis & Route Pairing**
- **unique evaluators to project resource use**
- **Trip Shifting & rules of encouragement**

Generate further dialogue with those interested in knowing more.

The Situation…

Victoria Regional Transit System

- **Population served: 402,000**
- **55 fixed routes** (Fall 2024)
- **884,000 annual service hours***
- **25 million boardings in FY2023/24**
- **308 buses**

The Situation…

Victoria Regional Transit System

Population served: 402,000

55 fixed routes (Fall 2024)

884,000 annual service hours*

25 million boardings in FY2023/24
~ 50% of provincial boardings

308 buses
~ 25% of provincial fleet

The Situation…

Victoria Regional Transit System

Population served: 402,000

55 fixed routes (Fall 2024)

884,000 annual service hours*

*20,000 approved expansion hours FY2024/25 yet to be delivered

25 million boardings in FY2023/24

~ 50% of provincial boardings

308 buses

~ 25% of provincial fleet

Fleet reliability issues hindering our ability to meet scheduled peak service

The challenges that brought us here

prolific structural issues on multiple vehicle types, a province-wide concern

supply chain challenges

workforce

Battery-electric bus delivery delays

delayed replacement of 20+ year old *high-capacity* buses

The ask…

Reduce the peak vehicle bookout

234

210

The ask…

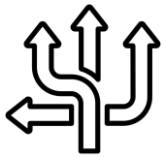
Reducing the peak vehicle bookout, the *high-capacity* component

50

35

The Schedulers are permitted to go wild!

All ideas and concepts have value when asked to do the impossible.



Flexible service specs from *Planning* with data driven recommendations.

Unique evaluators/tools to assess the impacts of what's changing.

The process must flow through each step smoothly; optimizers are expensive calculators that need to be guided (they aren't magical!).

The process we must follow to achieve our goals!

- Running Time Analysis
- Comprehensive Cycle Time Analysis → *Establishing the vision & using Route Pairing*
- Timetable Development → *Projecting Costs using two-year trends*
- Blocking Optimizer → *Trip Shifting / Deviations & rules of encouragement*
- Crewing Optimizer
- Measure success with KPIs

- Running Time Analysis
- **Comprehensive Cycle Time Analysis**
- Timetable Development
- Blocking Optimizer
- Crewing Optimizer
- Measure success with KPIs

The total duration of a round-trip or loop, *including minimum recovery (layover).*

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- **Comprehensive Cycle Time Analysis**
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The total duration of a round-trip or loop, *including minimum recovery (layover).*

What are the benefits? Why is it so crucial?

- Running Time Analysis
- **Comprehensive Cycle Time Analysis**
- Timetable Development
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Cycle Time Analysis

The benefits

- A decent understanding of what to expect before we even start
- High-level costing
- Headway & Frequency development
- Determining vehicle counts
- Identifying timetable/schedule inefficiencies
- Self-Sustaining Routes vs. Route Grouping vs. Route Pairing

Cycle Time Analysis

Type: Weekday
Effective: VIC2409

Route	Service Perio	Fron	To	Primary VehTy	HU	Dir 1 RunTir	Bus Minl	Operator Facility Acce	Operator Planned DH	Dir 2 RunTir	Bus Minl	Operator Facility Acce	Operator Planned DH	Minimum Cycle	Headwa	Fre	Actual Cycle	Scheduler Excess Layov	Scheduler Min VehR	Estimated Rev Hrs	Estimated Layove	Service / Reven
4	Early	5:55	6:44	HC-DD	UVIC	24	2			24	3	7		60	20	3.0	60	0	3	1.96 hrs	0.49 hrs	1.10
4	AM Peak	6:45	8:59	HC-DD	UVIC	29	2			31	5	7		74	15	4.0	75	1	5	8.93 hrs	2.23 hrs	1.13
4	Morning	9:00	11:59	HC-DD	UVIC	31	2			31	3	7		74	15	4.0	75	1	5	12.33 hrs	2.59 hrs	1.10
4	Early Aft	12:00	14:29	HC-DD	UVIC	33	2			32	3	7		77	15	4.0	90	13	6	10.76 hrs	4.14 hrs	1.28
4	PM Peak	14:30	17:44	HC-DD	UVIC	34	2			32	3	7		78	15	4.0	90	12	6	14.23 hrs	5.17 hrs	1.26
4	Early Eve	17:45	19:59	HC-DD	UVIC	29	2			28	3	7		69	15	4.0	75	6	5	8.49 hrs	2.68 hrs	1.19
4	Late Eve	20:00	23:59	HC-DD	UVIC	27	2			27	3	7		66	20	3.0	80	14	4	10.76 hrs	5.18 hrs	1.35
4	Owl	24:00	26:29	HC-DD	UVIC	24	2			24	3	7		60	30	2.0	60	0	2	3.97 hrs	0.99 hrs	1.10
4	Maximum estimated Peak Bookout:								6	Total Service Hours:				94.90 hrs						71.43 hrs	23.47 hrs	1.33

Cycle Time Analysis

Service Period

"Worst Case" Running Time, Layover and Deadhead, direction 1

"Worst Case" Running Time, Layover and Deadhead, direction 2

Proposed Headways

Vehicle Requirements

Type: Weekday

Effective: VIC2409

Route	Service Period	From	To	Primary VehTy	HU	Dir 1 RunTim	Bus Minl	Operator Facility Acce	Operator Planned DH	Dir 2 RunTim	Bus Minl	Operator Facility Acce	Operator Planned DH	Minimum Cycle	Headway	Fre	Actual Cycle	Scheduler Excess Layov	Scheduler Min VehR	Estimated Rev Hrs	Estimated Layove	Service / Reven
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4				Maximum estimated Peak Bookout:					6				Total Service Hours:		94.90 hrs					71.43 hrs	23.47 hrs	1.33

Veh Type

HUB

Required Cycle Time

Actual Cycle Time

Estimated In-service Hours

Service to Revenue KPI

Cycle Time Analysis

Excess Layover

Service to Revenue KPI

Type: Weekday
Effective: VIC2409

Route	Service Period	From	To	Primary VehType	HU	Dir 1 RunTime	Bus Min	Operator Facility Access	Operator Planned DH	Dir 2 RunTime	Bus Min	Operator Facility Access	Operator Planned DH	Minimum Cycle	Headway	Fre	Actual Cycle	Scheduler Excess Layover	Scheduler Min VehR	Estimated Rev Hrs	Estimated Layover	Service to Revenue
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- Running Time Analysis
- **Comprehensive Cycle Time Analysis**
- Timetable Development
- Blocking Optimizer
- Crewing Optimizer
- Measure success with KPIs

Route Pairing

The benefits

- To improve service without the use of additional resources
- To reduce redundancy for operators
- To share excess layover across multiple routes (share the wealth)
- To reduce excess layover

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Route Pairing

The benefits

- To improve service without the use of additional resources
- To reduce redundancy for operators
- To share excess layover across multiple routes (share the wealth)
- To reduce excess layover
- To save buses!

Route Pairing

Isolating routes (or portions of routes) and looking at three key indicators.

Type: Weekday
Effective: VIC2409

Route	Service Perio	Fron	To	Primary VehTy	HU	Dir 1 RunTin	Bus MinL	Operator Facility Acce	Operator Planned DH	Dir 2 RunTin	Bus MinL	Operator Facility Acce	Operator Planned DH	Minimum Cycle	Headwa	Fre	Actual Cycle	Scheduler Excess Layov	Scheduler Min VehR	Estimated Rev Hrs	Estimated Layove	Service / Reven
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26 short	PM Peak	14:30	17:44	HC-DD	UVIC	25	2	7		0	0		22	56	15	4.0	60	4	4	5.39 hrs	2.80 hrs	1.24

Common Vehicle Type?

Common Hub?

Matching Headways?

Can pairing routes yield a savings in vehicles/resources?

Route Pairing

Type: Weekday
Effective: VIC2409

Route	Service Perio	Fror	To	Primary VehTy	HU	Dir 1 RunTir	Bus MinL	Operator Facility Acce	Operator Planned DH	Dir 2 RunTir	Bus MinL	Operator Facility Acce	Operator Planned DH	Minimum Cycle	Headwa	Fre	Actual Cycle	Scheduler Excess Layov	Scheduler Min VehR	Estimated Rev Hrs	Estimated Layover	Service / Reven
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4/26short	PM Peak	14:30	17:44	HC-DD	UVIC	59	4	7	0	32	3	7	22	134	15	4.0	135	1	9	19.62 hrs	4.74 hrs	1.09

Sum up each column

Can pairing routes yield a savings in vehicles/resources?

Route Pairing

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Effective: VIC2409

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Sum up each column

Service : Revenue KPI indicates a more efficient use of resources

Route Pairing

There is an easier way…

Type: Weekday
Effective: VIC2409

Route	Service Perio	Fror	To	Primary VehTy	HU	Dir 1 RunTir	Bus MinL	Operator Facility Acce	Operator Planned DH	Dir 2 RunTir	Bus MinL	Operator Facility Acce	Operator Planned DH	Minimum Cycle	Headwa	Fre	Actual Cycle	Scheduler Excess Layov	Min VehR	Estimated Rev Hr	Estimated Layove	Service / Reven
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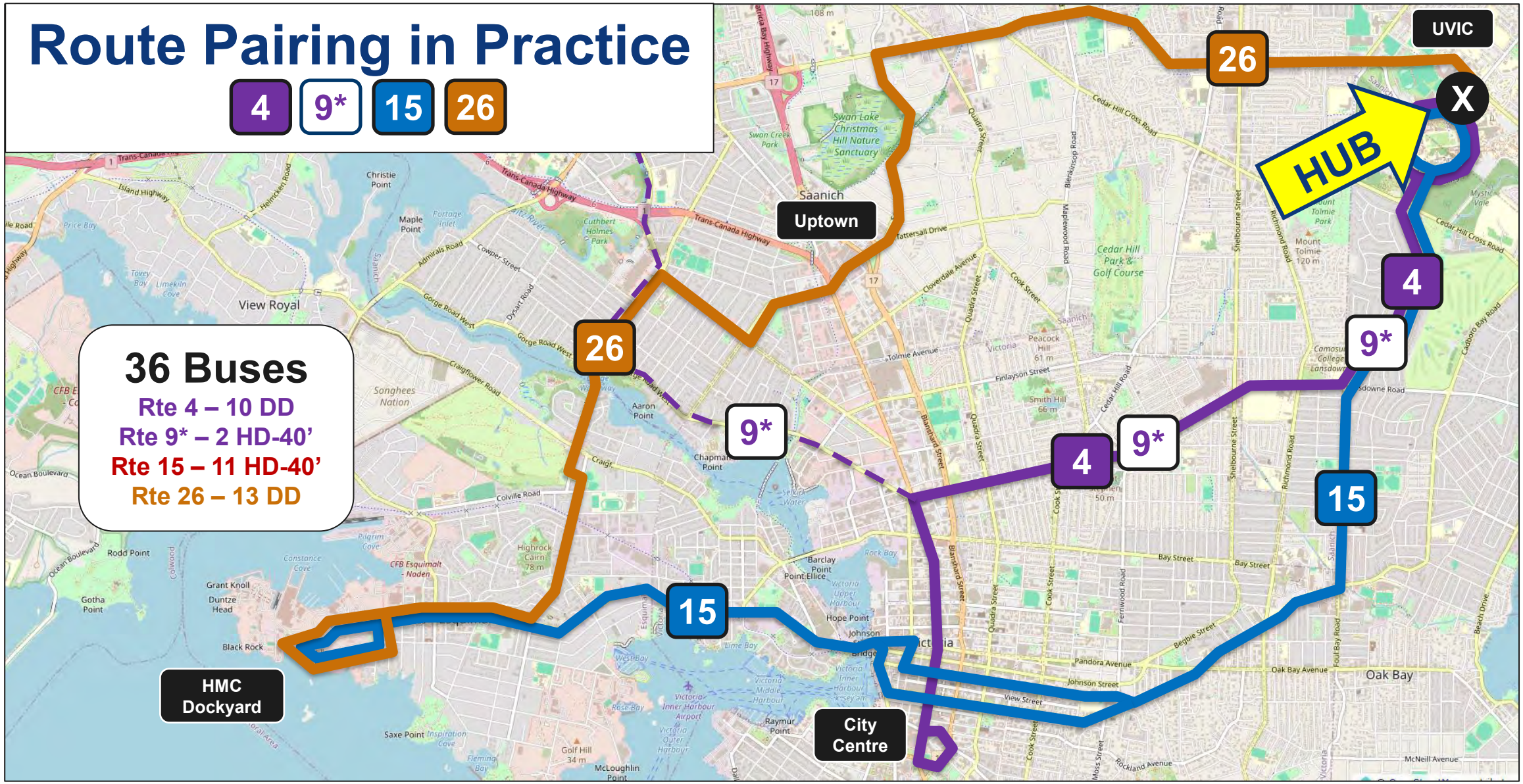
Sum up each column

If… $\sum$ **Excess layover** **>** **headway** *Then…*

Route Pairing in Practice

4 | 9* | 15 | 26



36 Buses

Rte 4 – 10 DD

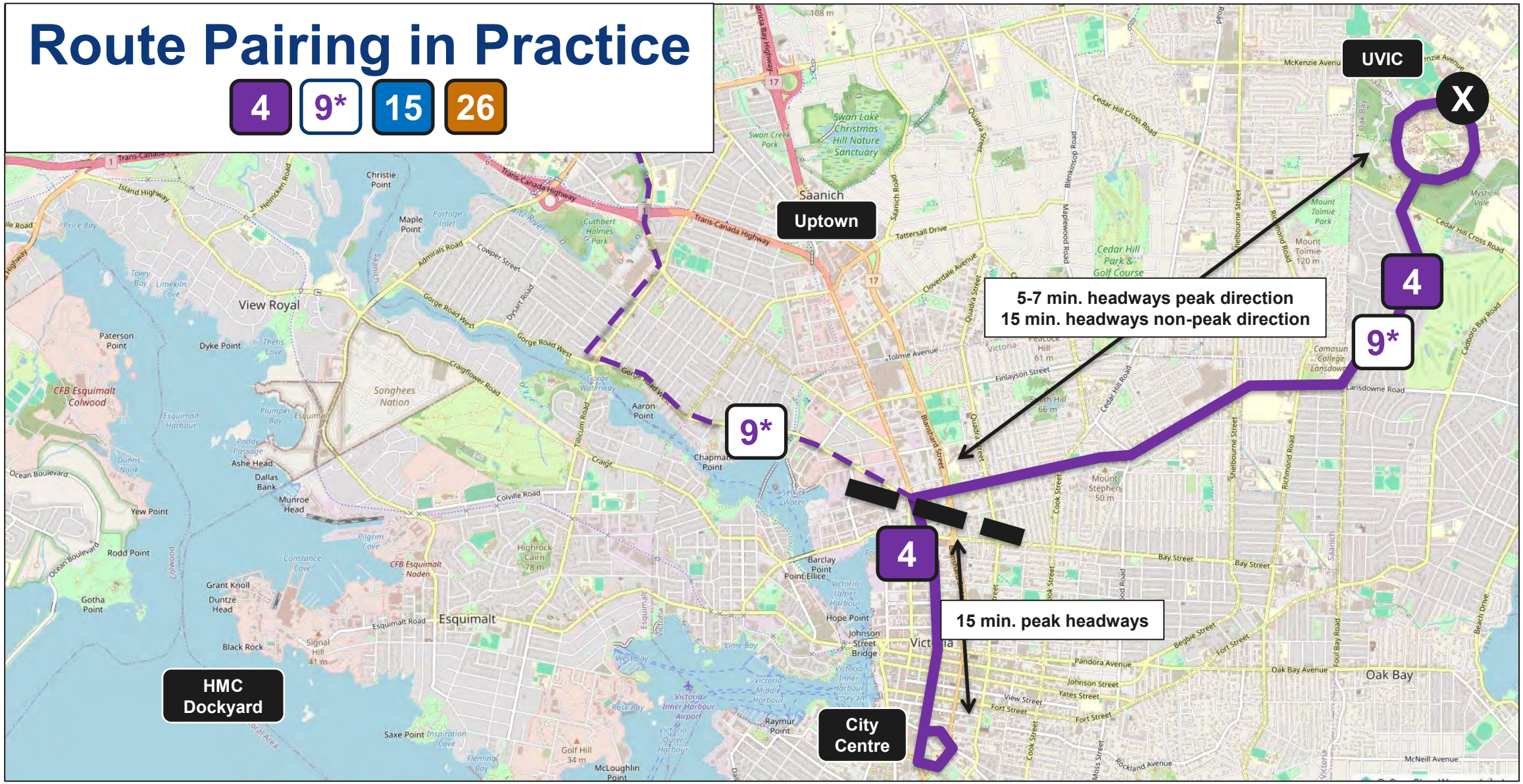
Rte 9* – 2 HD-40'

Rte 15 – 11 HD-40'

Rte 26 – 13 DD

Route Pairing in Practice

4 | 9* | 15 | 26



Route Pairing in Practice

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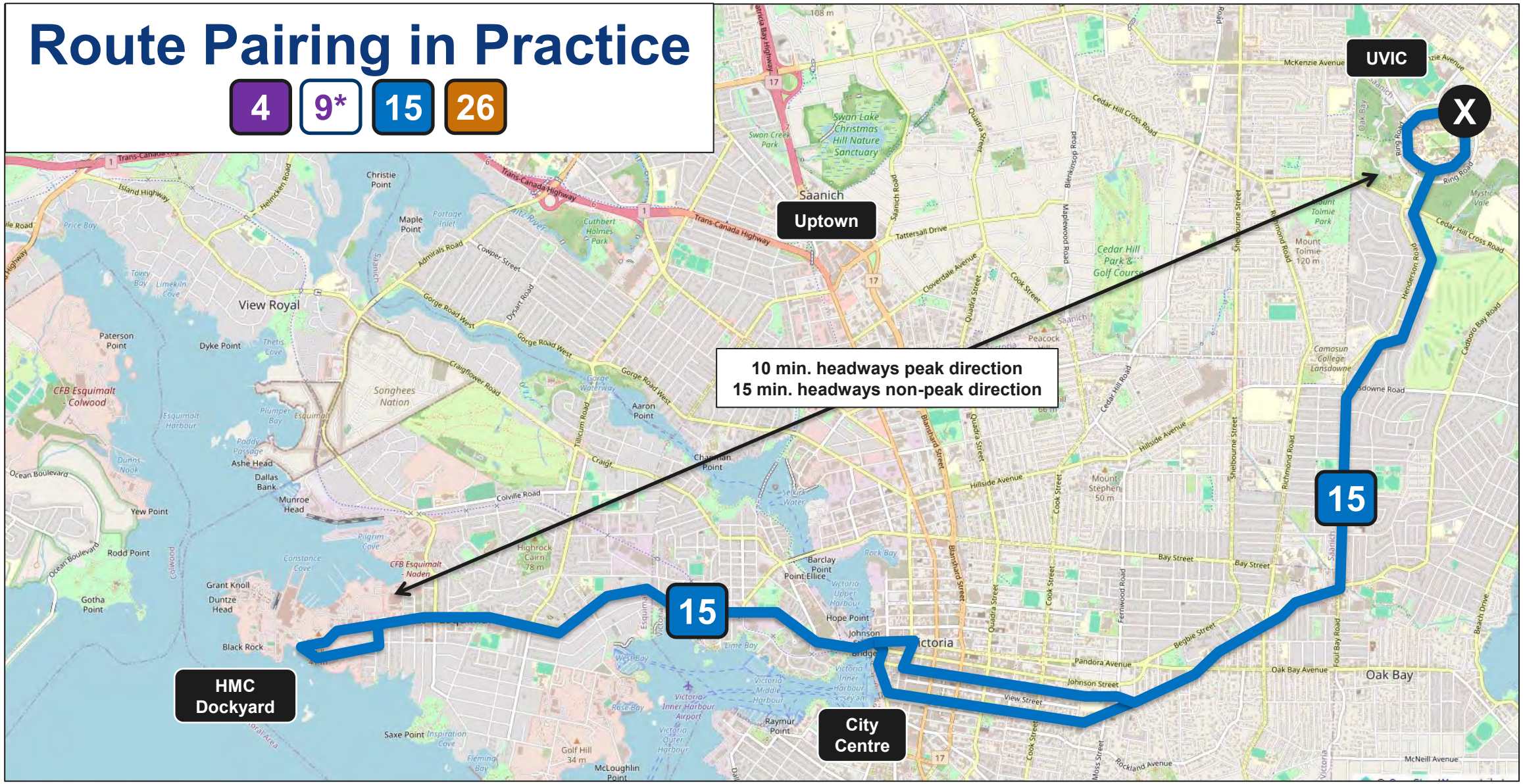

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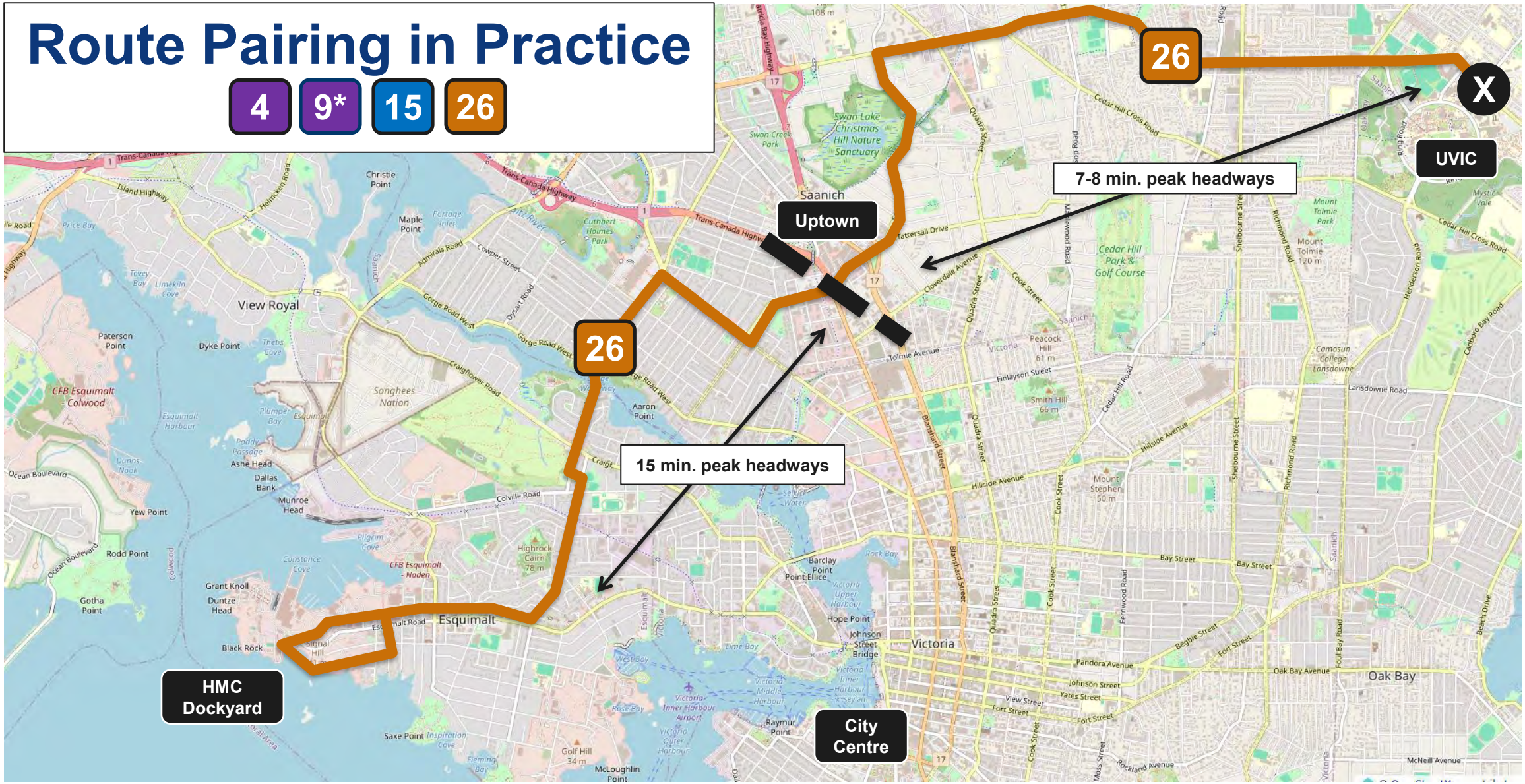

Route Pairing in Practice

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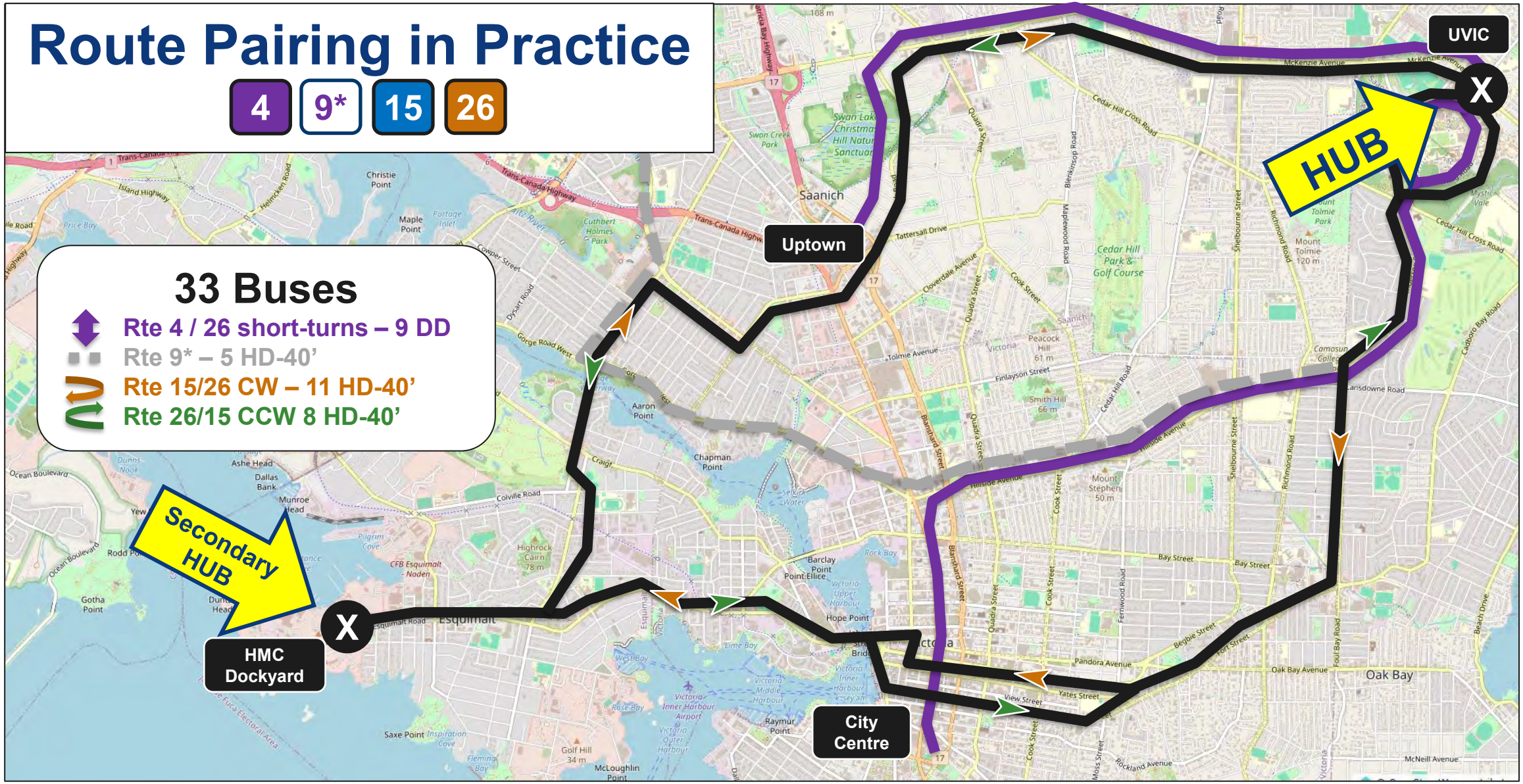
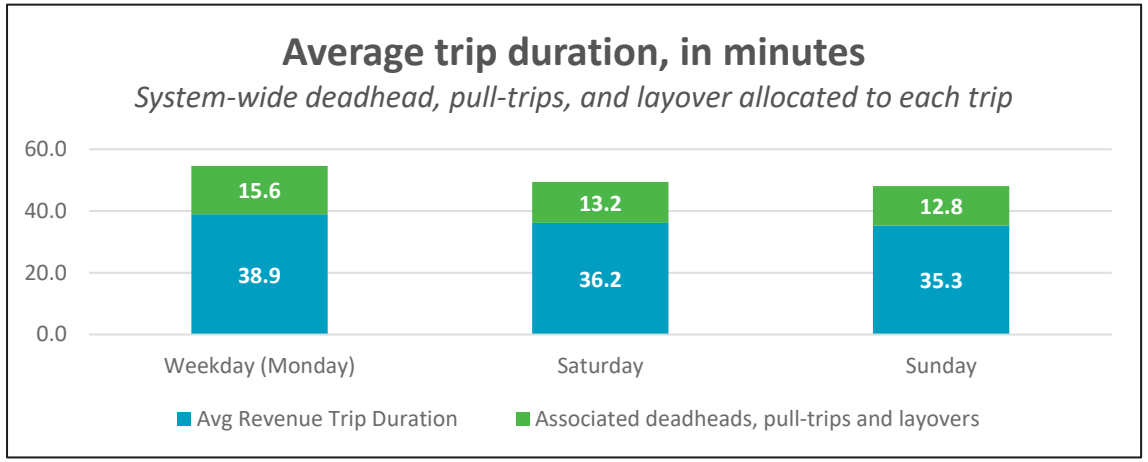


- Running Time Analysis
- Comprehensive Cycle Time Analysis
- **Timetable Development**
- Blocking Optimizer
- Crewing Optimizer
- Measure success with KPIs

Evaluate the available resources

Ridership is up! Asking for more with less!



Do we have hours available to add service?

For a weekday, an average 38.9-minute in-service trip incurs 15.6 minutes of layover, deadheads and pull-trips, totaling 54.5 minutes per added trip! (+/- 1.5%)

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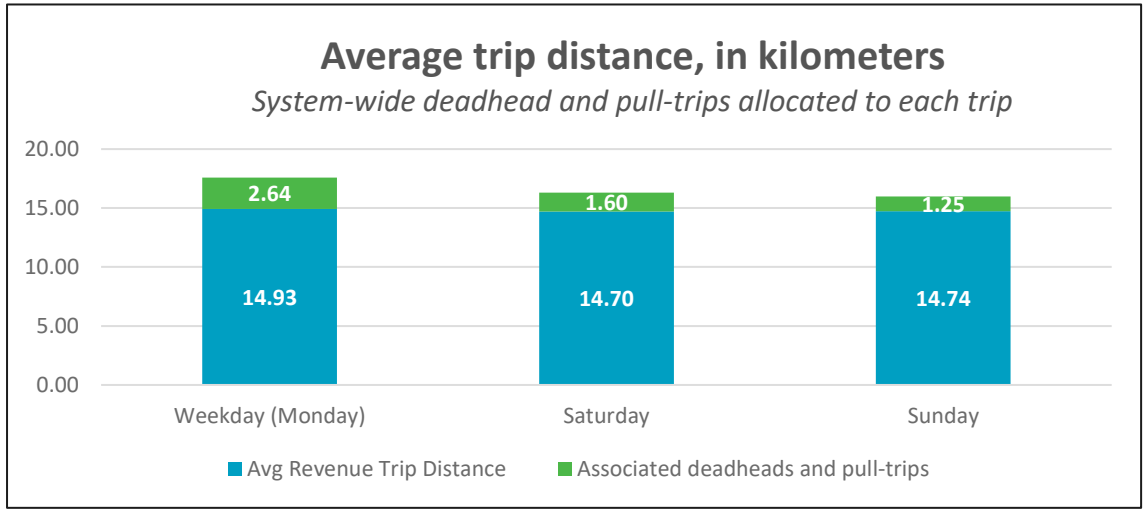
Evaluate the available resources

Ridership is up! Asking for more with less!



What is the remaining fleet capable of?

For a weekday, an average 14.93km in-service trip incurs 2.64km of deadheads and pull-trips, totaling 17.57km per added trip! (+/- 1.5%)

What else can we massage?

Trip Shifting and Rule Encouragement

- Running Time Analysis
- Comprehensive Cycle Time Analysis
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- Crewing Optimizer
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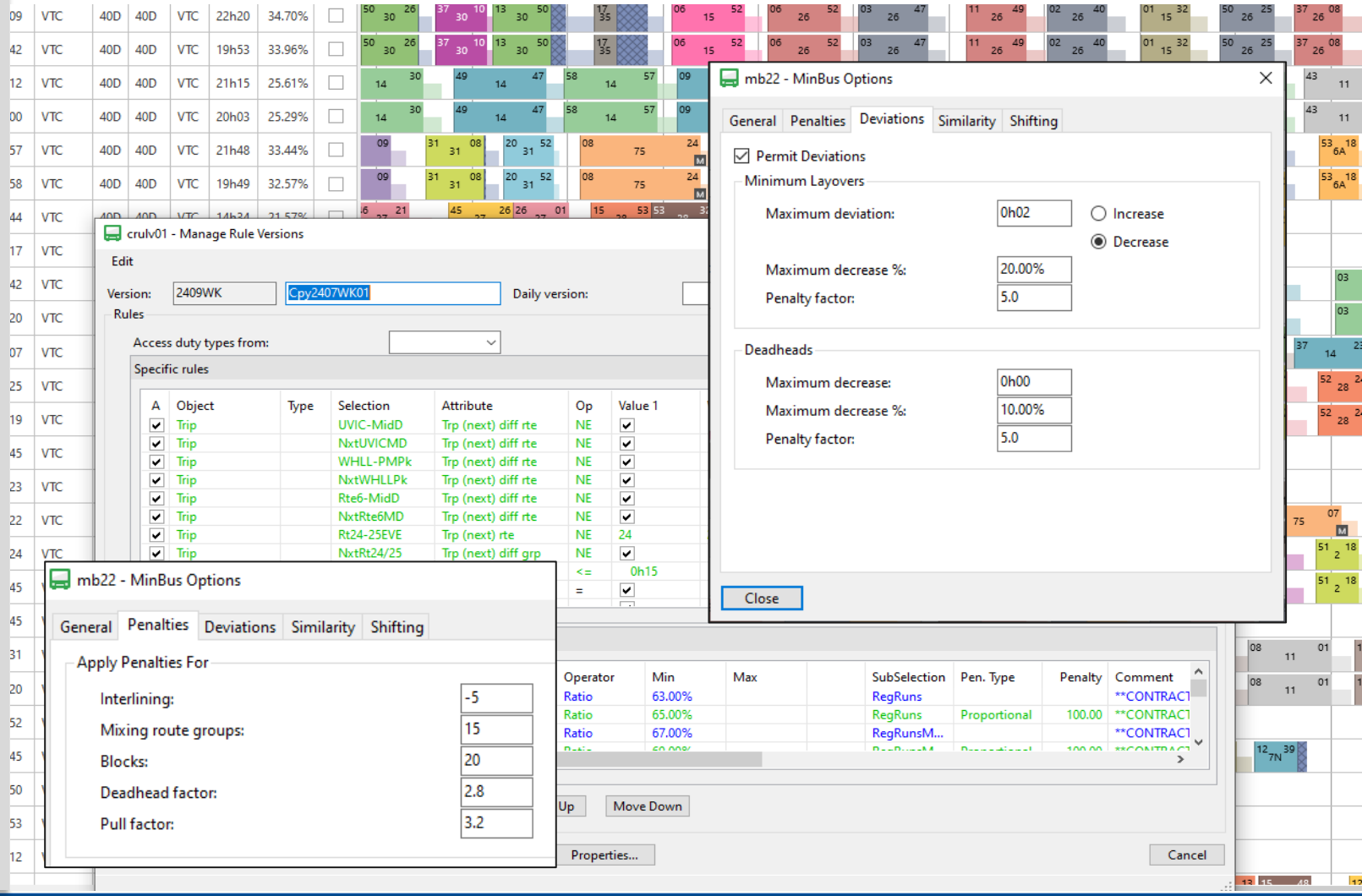

The outcome. Did we get there?

Specific to the Case Study, but not limited to…

- **Cycle-time analysis revealed the route pairing opportunities, a 3-bus savings on 4 9* 15 26 prior to optimizing *(Hastus MinBus)*.**
- **Peak directional service levels maintained or improved on routes 4 26 impacted by a reduced *high-capacity* vehicle availability.**
- **Reducing costly peak deadheads (15) and non-peak directional service is key.**
- **Moving as much excess layover (schedulers dream!) to a strategic HUB yields efficiency opportunities optimizers can take advantage of.**
- **Advanced costing tools (Avg Trip Duration…) and trip shifting works!**

The outcome. Did we get there?

…and from the network/system perspective

The ask

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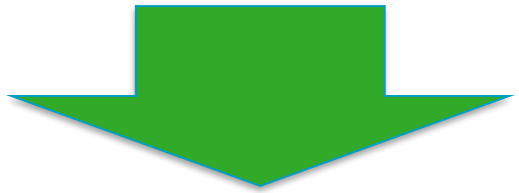

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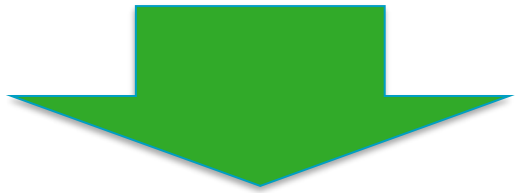
The outcome. Did we get there?

…and from the network/system perspective

The ask

234



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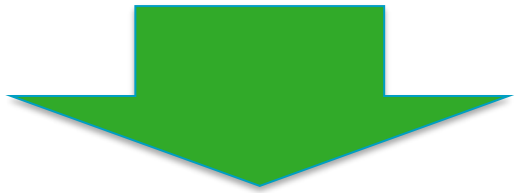
The result

234



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Thank you!

Key takeaways

If… $\sum$ **Excess layover** **>** **headway** *Then…*

Know the "why" before traversing the path ahead