Unit 5: Network Operations Planning

Module 5-1

Network Operations Planning Accessibility

Austroads

Today's presenter

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Defining Access

Access is Opportunity

Note: "Accessibility" is also a term used by and for people with disabilities in a similar way, how easy is it for those with disabilities to make use of facilities, including transport facilities like footpaths, buses, train stations, and so on. The idea of universal design helps achieve that. While very important, we are not talking about that type of accessibility here.

About what do people care?

- Jobs,
- Shops and Stores,
- Amenities,
- Health,
- the Outside World,
- …

Access is Opportunity

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Isochrones

- Access to Melbourne CBD by Railway or Tram 1923

restored by Cam Gordon
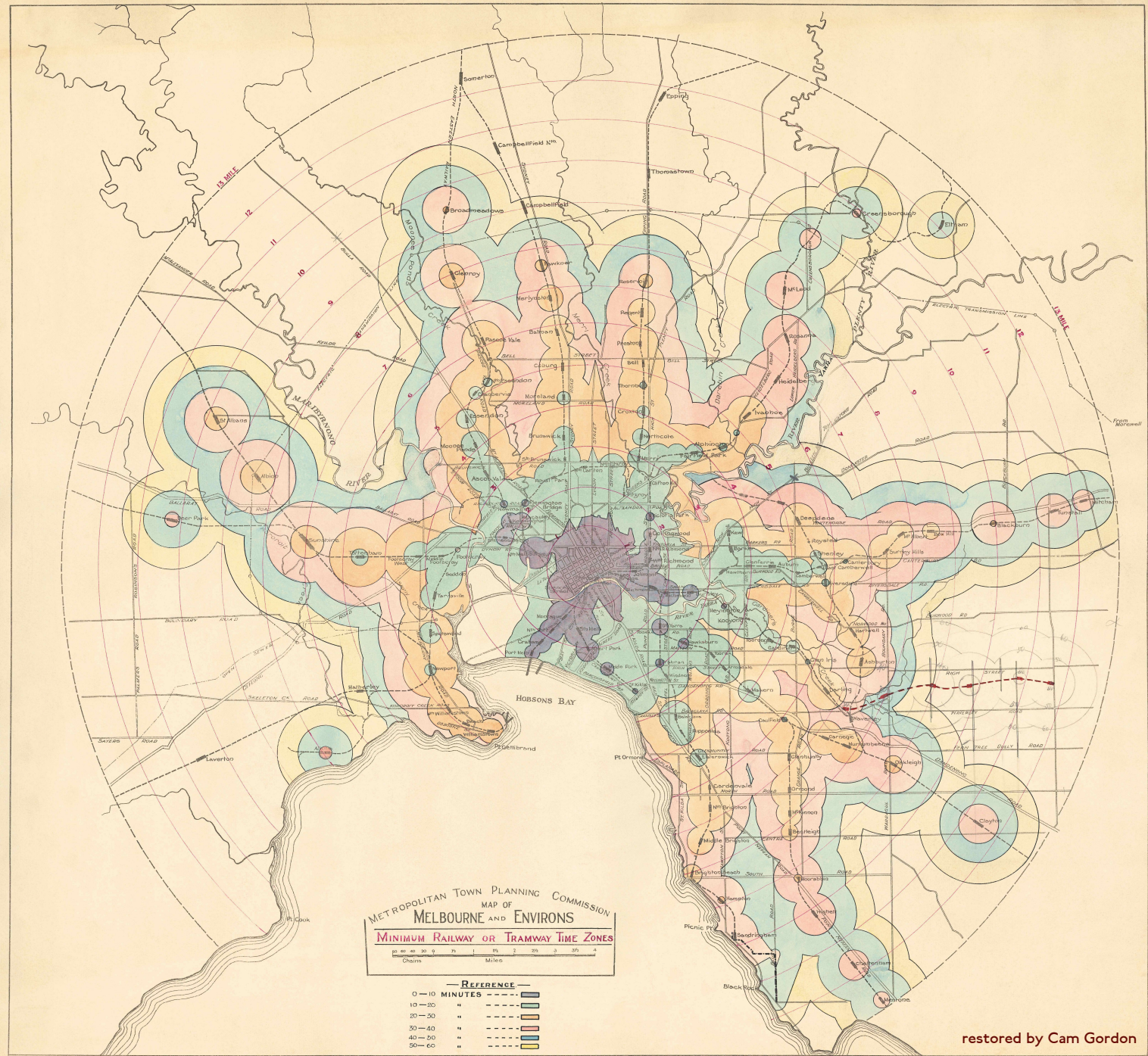
Cumulative Opportunities: how much *stuff* someone can reach from a particular point in a given travel time.

Austroads

- How many

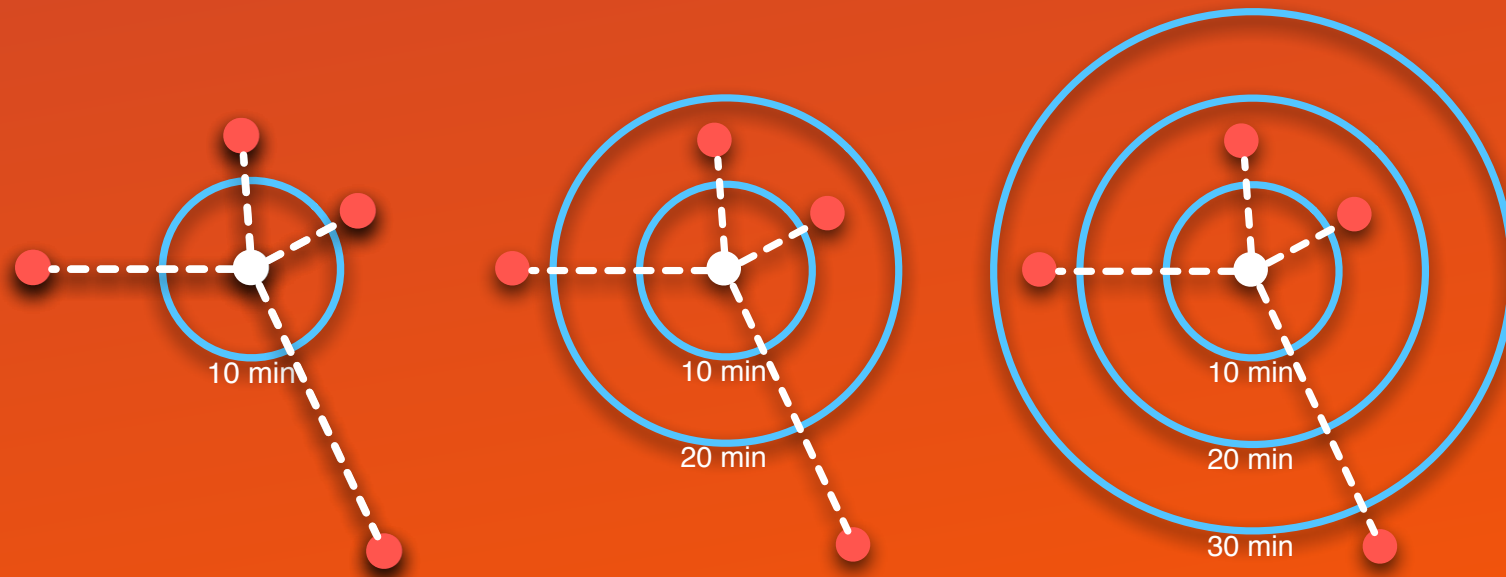| jobs	can be reached	in	10	minutes	by	car	at	12:00 AM
workers			20			transit		12:01 AM
people			30			carpool		...
stores			40			walking		8:00 AM
parks			50			bike		...
schools			60			truck		11:59 PM
acres						scooter		
airports						Segway		
hospitals								

9	6	8	1440

$$9 \cdot 6 \cdot 8 \cdot 1440 = 622{,}080$$

Cumulative Opportunities: How many destinations can be reached within a given travel time threshold?
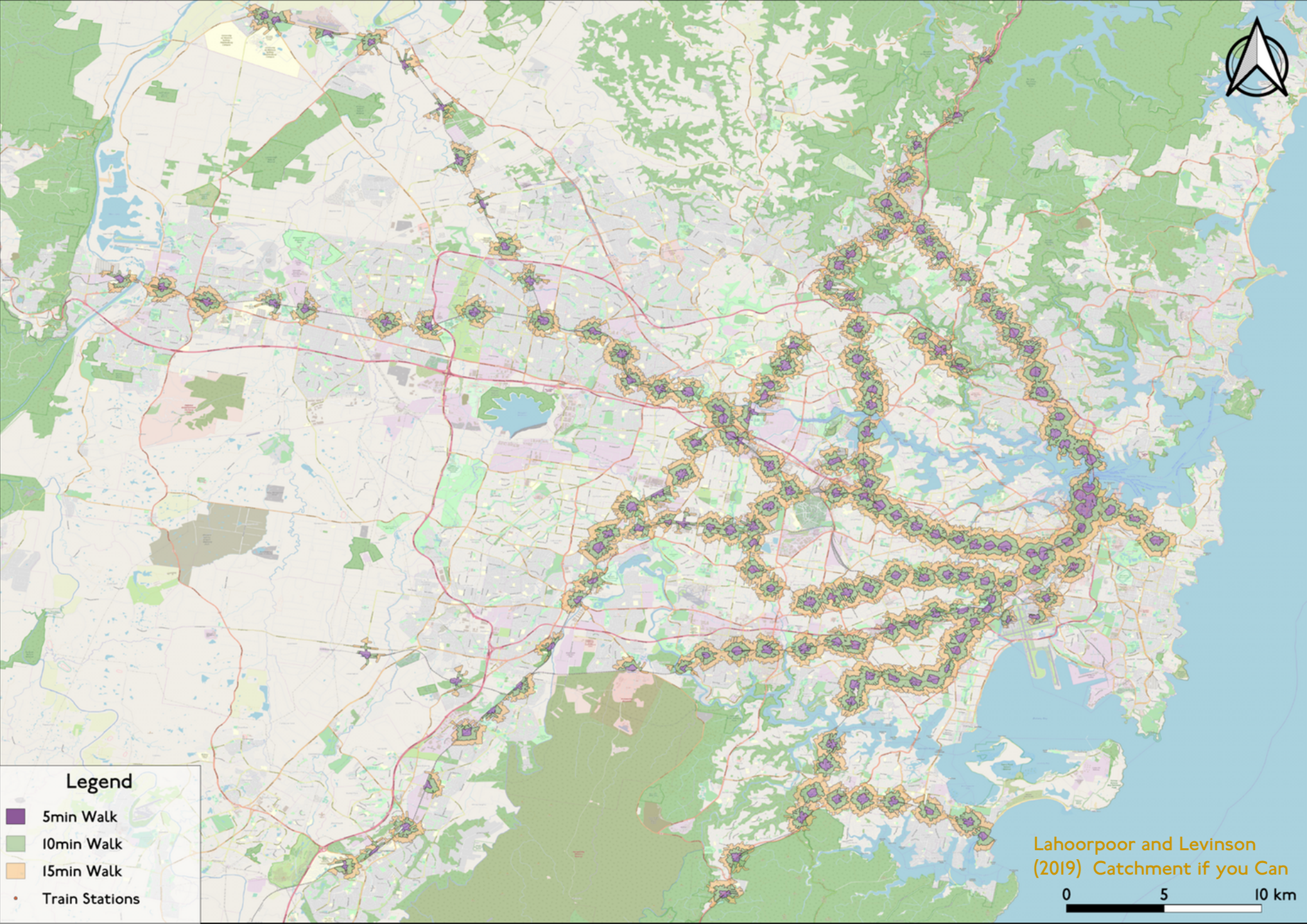

$$A_i = \sum_j O_j f(T_{ij})$$

Accessibility at point *i* is the sum of Opportunities (*O*) such as jobs or shops or labor multiplied by a function (*f*) of travel time (*T*) from point *i* to *j*. For cumulative opportunities, $f(T_{ij}) = 1$ if time < *t* , 0 otherwise (e.g. time budget (*t*) = 30 minutes)

10-minute accessibility: 0   20-minute accessibility: 2   30-minute accessibility: 3

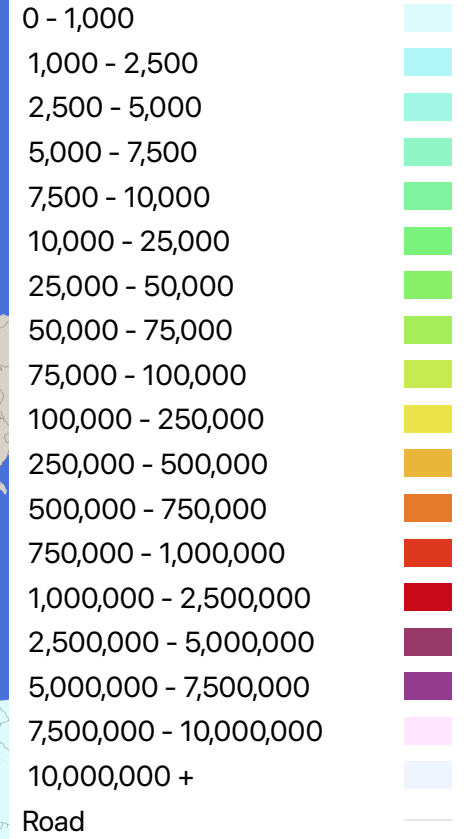Note: each red dot is an opportunity (e.g. a job)

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Cumulative Opportunities

- Simple count of destinations reachable within threshold.

- It is not an index, it is an actual thing.

- "30-minute accessibility to 10,000 jobs"

- "Can reach 10,000 jobs within 30 minutes"

- Multiple metrics and maps for multiple thresholds
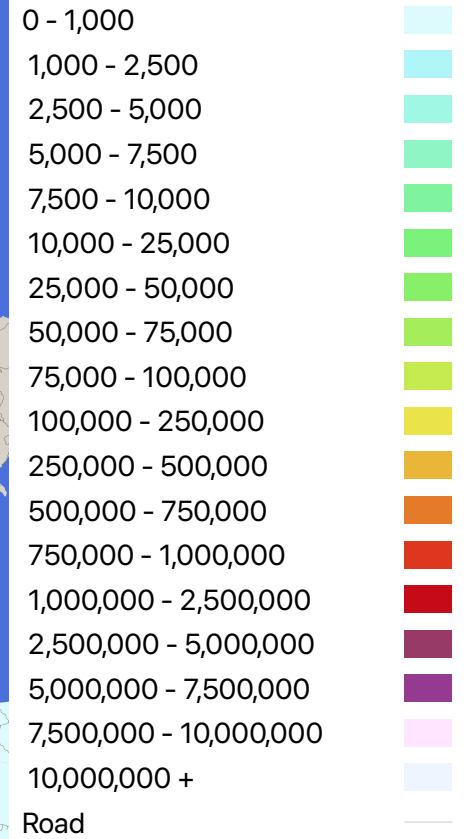
Access to
Train Stations
in Sydney
(2019)

Legend

5min Walk
10min Walk
15min Walk
Train Stations

Lahoorpoor and Levinson
(2019) Catchment if you Can

0   5   10 km

Auckland

Jobs within 30 Minutes
(Walking, AM Peak)

0 – 1,000	
1,000 – 2,500	
2,500 – 5,000	
5,000 – 7,500	
7,500 – 10,000	
10,000 – 25,000	
25,000 – 50,000	
50,000 – 75,000	
75,000 – 100,000	
100,000 – 250,000	
250,000 – 500,000	
500,000 – 750,000	
750,000 – 1,000,000	
1,000,000 – 2,500,000	
2,500,000 – 5,000,000	
5,000,000 – 7,500,000	
7,500,000 – 10,000,000	
10,000,000 +	
Road	

0 2 4 6 8 10 km

Wu and Levinson (2020)
Access Across New Zealand:
2019

10

Auckland

Jobs within 30 Minutes
(Transit, AM Peak)

0 - 1,000
1,000 - 2,500
2,500 - 5,000
5,000 - 7,500
7,500 - 10,000
10,000 - 25,000
25,000 - 50,000
50,000 - 75,000
75,000 - 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 750,000
750,000 - 1,000,000
1,000,000 - 2,500,000
2,500,000 - 5,000,000
5,000,000 - 7,500,000
7,500,000 - 10,000,000
10,000,000 +
Road

0   2   4   6   8   10 km

Wu and Levinson (2020)
Access Across New Zealand:
2019

11

Auckland

Jobs within 30 Minutes
(Cycling, AM Peak)

0 - 1,000
1,000 - 2,500
2,500 - 5,000
5,000 - 7,500
7,500 - 10,000
10,000 - 25,000
25,000 - 50,000
50,000 - 75,000
75,000 - 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 750,000
750,000 - 1,000,000
1,000,000 - 2,500,000
2,500,000 - 5,000,000
5,000,000 - 7,500,000
7,500,000 - 10,000,000
10,000,000 +
Road

0 2 4 6 8 10 km

Wu and Levinson (2020)
Access Across New Zealand:
2019

12

Auckland

Jobs within 30 Minutes
(Driving, AM Peak)

0 - 1,000
1,000 - 2,500
2,500 - 5,000
5,000 - 7,500
7,500 - 10,000
10,000 - 25,000
25,000 - 50,000
50,000 - 75,000
75,000 - 100,000
100,000 - 250,000
250,000 - 500,000
500,000 - 750,000
750,000 - 1,000,000
1,000,000 - 2,500,000
2,500,000 - 5,000,000
5,000,000 - 7,500,000
7,500,000 - 10,000,000
10,000,000 +
Road

0 2 4 6 8 10 km

Wu and Levinson (2020)
Access Across New Zealand:
2019

13
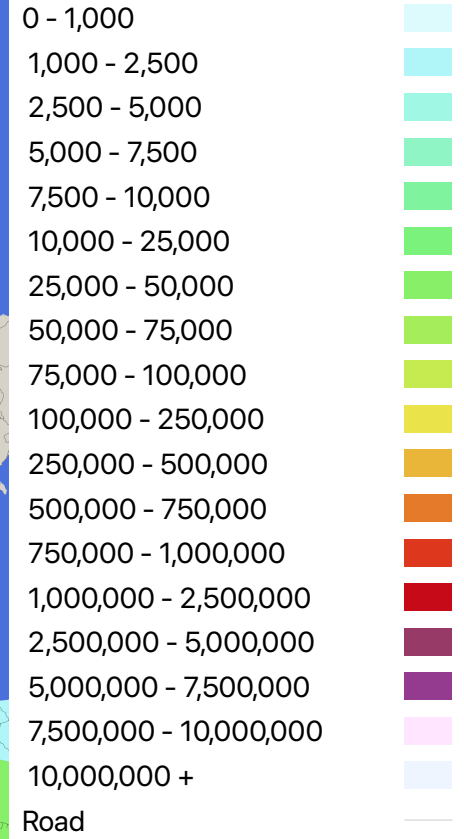
Accessibility Planning

Accessibility depends on both proximity to destinations (opportunities) and travel time.

Transport agencies can affect travel time.

Travel time depends on

directness (circuity) of the route

and the speed.

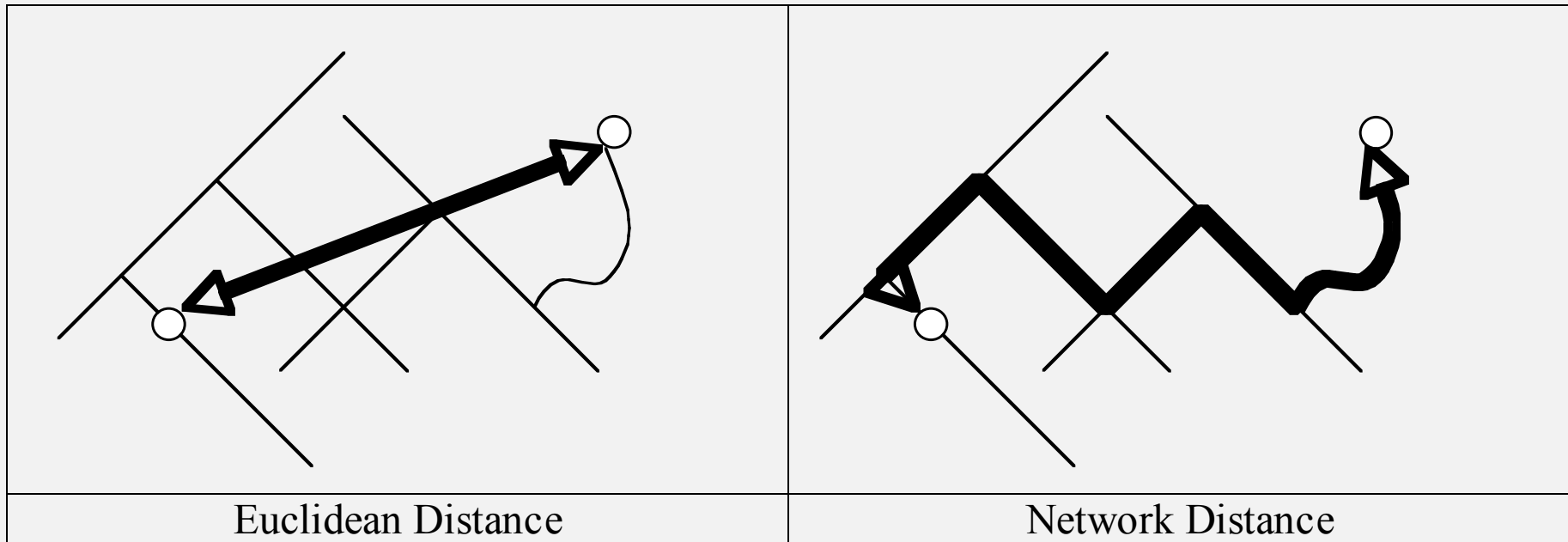The speed depends on

freeflow (design) speed and

congestion.

Quality of accessibility based on travel time and proximity
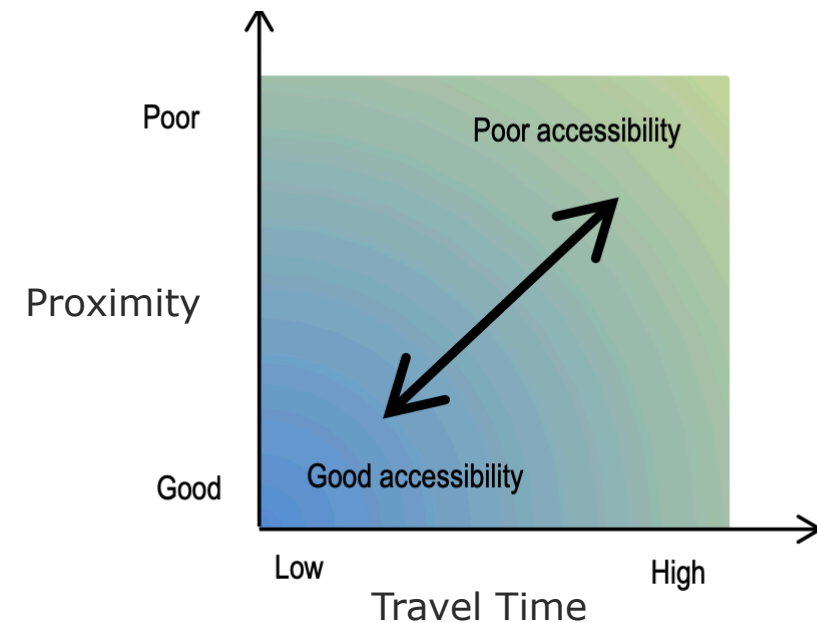

Source: Austroads (2015d). *Adapted and Modified*

Circuity: The Ratio of Network to Euclidean Distance

- Circuity always greater than or equal to 1.

| Euclidean Distance | Network Distance |

Example

- 1.414 - On 'Manhattan Grid' - Maximum Circuity

- 1.2 - Typical values from random samples of urban networks (Newell 1980)

- 1.21 - 1.23 at Transit station catchment areas (O'Sullivan and Morral)

- Higher for pedestrian and bike travel than auto (Dill 2004)

- Actual routes from GPS measurements higher than would be expected from shortest path analysis (Axhausen 2004)
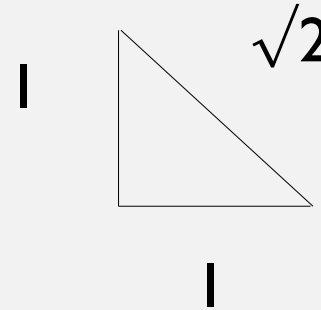
Typical worst case for regular network patterns though irregular networks may have higher circuity.

$\sqrt{2}$

1

1

Decisions that affect circuity

- Directionality (is the road one-way vs. two-way?)

- Connectivity (is the road open or closed to a mode?)

- Road space allocation (how is scarce road space allocated between modes? (this affects congestion, and thus routing, and thus circuity in practice))
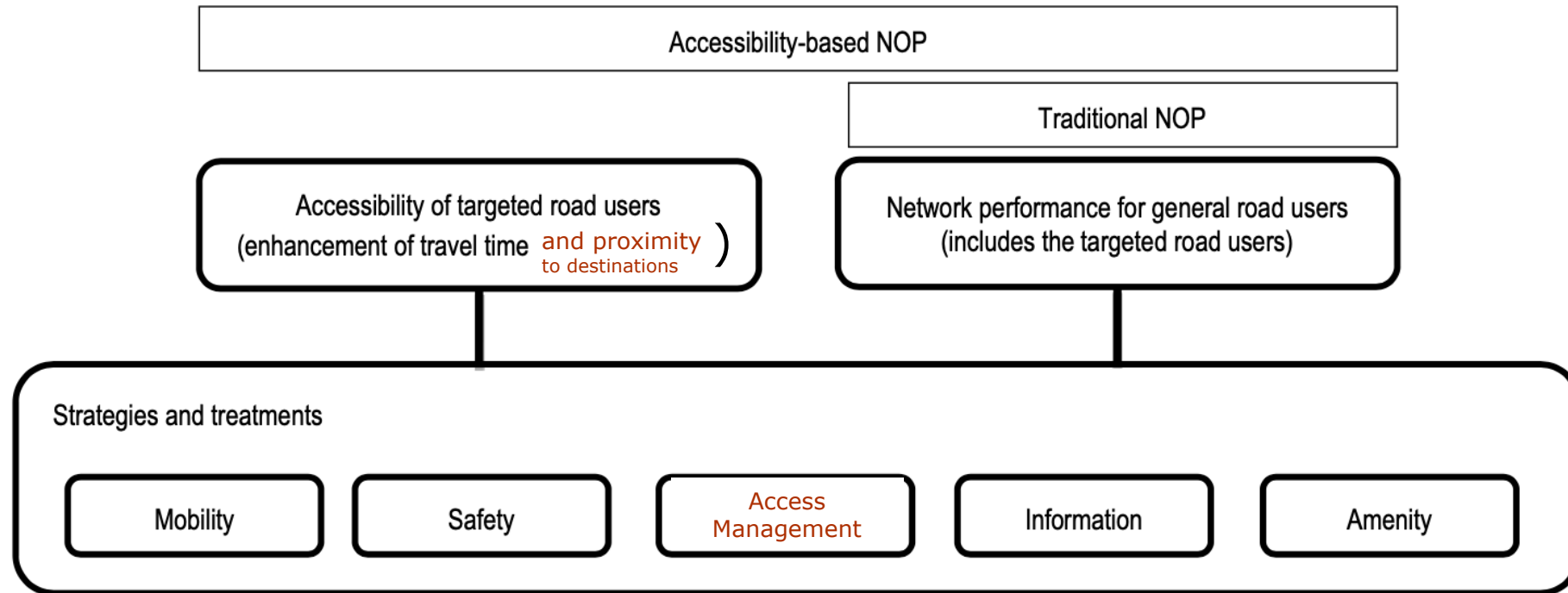
Decisions that affect speed

- What is the design (freeflow) speed of the road?

- What is the speed limit on the road?

- Is the speed limit enforced?

- Is traffic calming used?

- Is the road congested?

- What modes use the road? Are these modes separated or is the space shared?

Decisions that affect congestion

- How much road space is given to each mode?

- Are there spill backs from downstream bottlenecks?

- Is on-street parking permitted?

- How is traffic controlled?

- How are traffic signals timed?

- Are incidents avoided because the road is safe?

- Are incidents (collisions, breakdowns) cleared quickly?

- How is loading and unloading (freight, bus and tram passengers, taxi passengers) handled?

- Are road rules enforced?

Accessibility Needs of Targeted Road Users

Figure 4.1:   Network Operation Plan with consideration of accessibility needs of targeted road users

Accessibility-based NOP

Traditional NOP

Accessibility of targeted road users (enhancement of travel time and proximity to destinations)

Network performance for general road users (includes the targeted road users)

Strategies and treatments

| Mobility | Safety | Access Management | Information | Amenity |

Source: Austroads (2015d).

Questions

Question 1

- Cumulative Opportunities measures how many things can be reached in a given

  - A. Travel Time

  - B. Travel Distance

  - C. Travel Speed

Answer 1

- Cumulative Opportunities measures how many things can be reached in a given

  - A. Travel Time

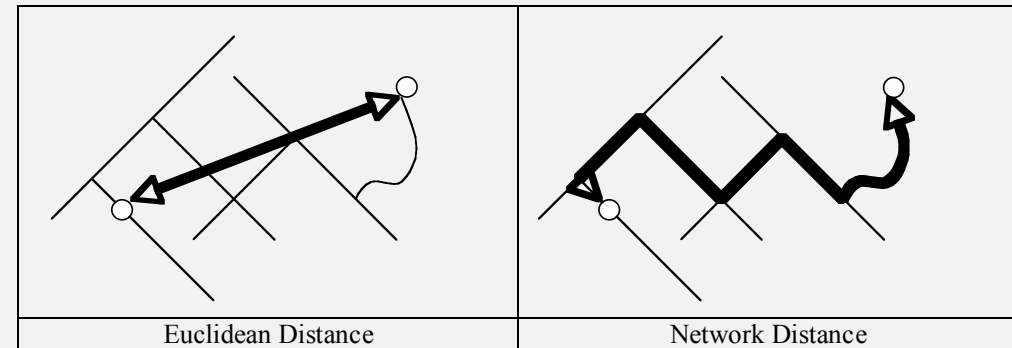 - ~~B. Travel Distance~~

  - ~~C. Travel Speed~~
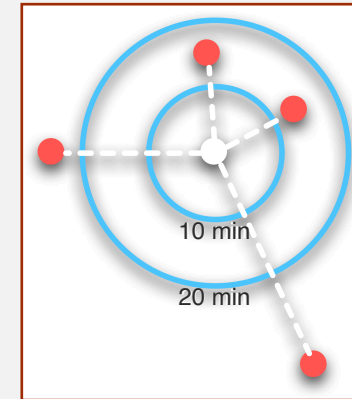
Question 2

- Circuity is defined as

  A. Network Distance/Euclidean Distance

  B. Euclidean Distance/Network Distance

  C. Network Distance - Euclidean Distance

  D. Euclidean Distance + Network Distance

| Euclidean Distance | Network Distance |
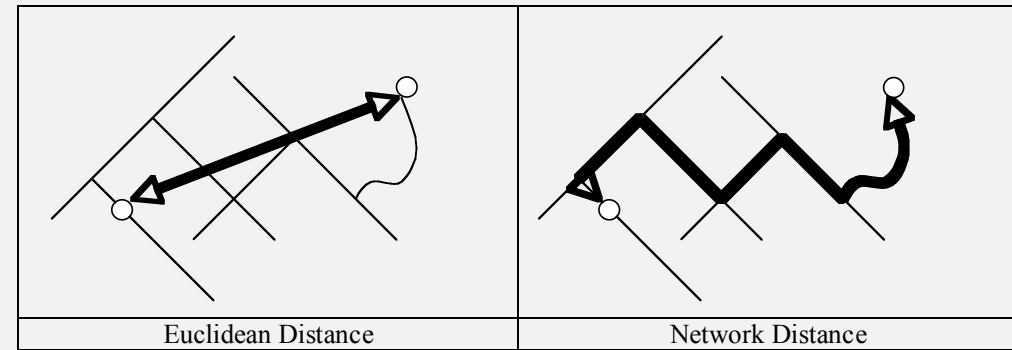
Answer 2

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  B. ~~Euclidean Distance/Network Distance~~

  C. ~~Network Distance - Euclidean Distance~~

  D. ~~Euclidean Distance + Network Distance~~

| Euclidean Distance | Network Distance |

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Question 3

- Accessibility depends on which two factors:

    A. Density and Speed

    B. Proximity and Mobility

    C. Speed and Distance

    D. Level of Service and Travel Time

Answer 3

- Accessibility depends on which two factors:

  A. ~~Density and Speed~~

  B. Proximity and Mobility

  C. ~~Speed and Distance~~

  D. ~~Level of Service and Travel Time~~

$$A_i = \sum_j O_j f(T_{ij})$$

Proximity · Mobility

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For cumulative opportunities,
 $f(T_{ij})$ = 1 if time < *t* , 0 otherwise
(e.g. time budget (*t*) = 30 minutes)

Austroads report
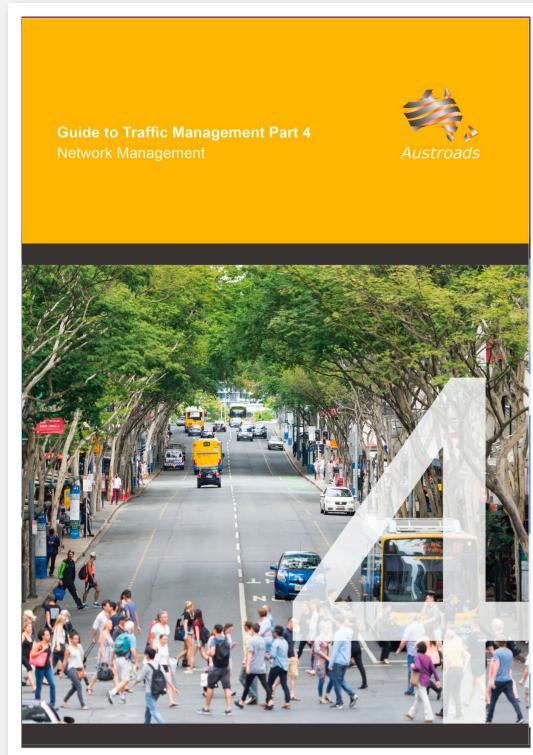
Some of the information from this presentation is conveyed in the Austroads Report: Guide to Traffic Management Part 4: Network Management.

This report can be downloaded from Austroads Website:

https://austroads.com.au/publications/traffic-management/agtm04

References

Levinson, D. M., & Krizek, K. J. (2018). *Metropolitan Transport and Land Use: Planning for Place and Plexus*. Routledge.

Lahoorpoor, B., & Levinson, D. M. (2020). Catchment if you can: The effect of station entrance and exit locations on accessibility. *Journal of Transport Geography*, 82, 102556.

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