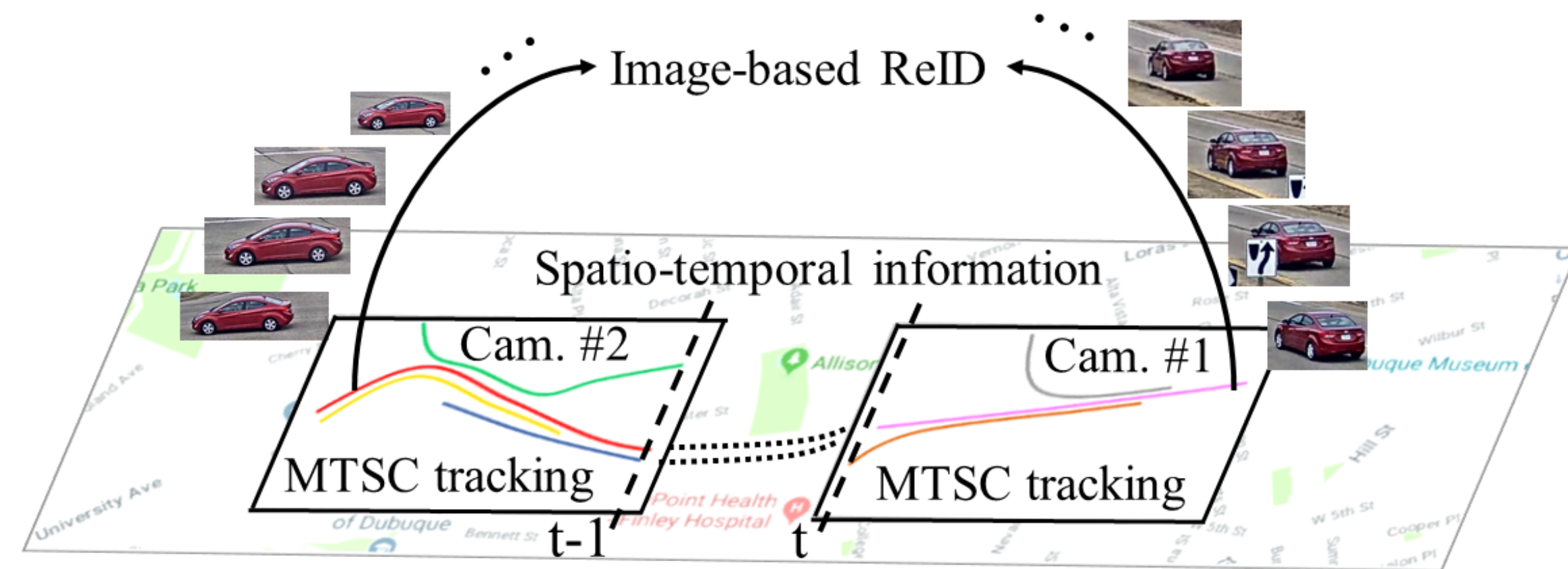


## Introduction

### ➤ Multi-target multi-camera (MTMC) tracking



### ➤ Major challenge of vehicle-based ReID

- Intra-class variability > inter-class variability

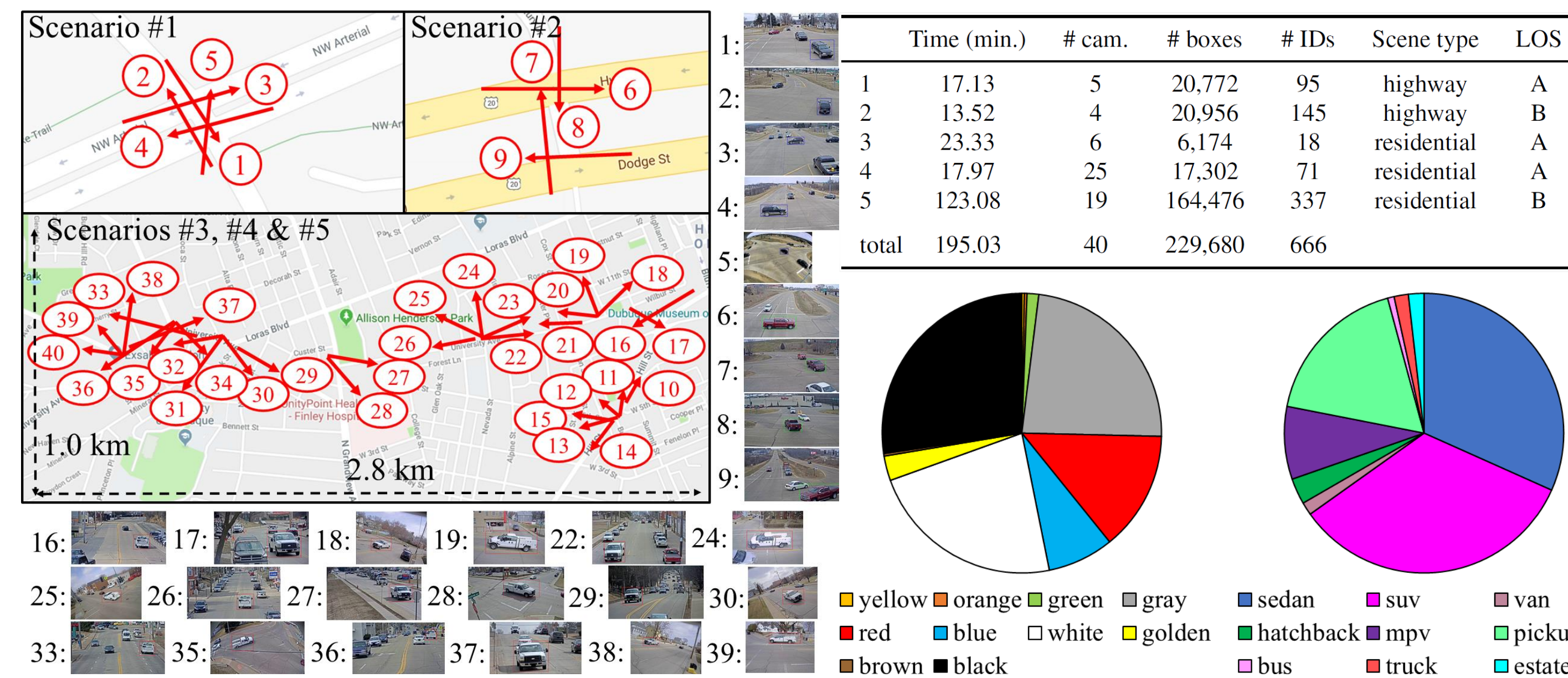
### ➤ Contributions

- City scale: 40 cameras over 10 intersections
- MTMC vehicle tracking: Videos and camera topology available
- Baselines: ReID, MTSC track., detection & spatio-temporal assoc.

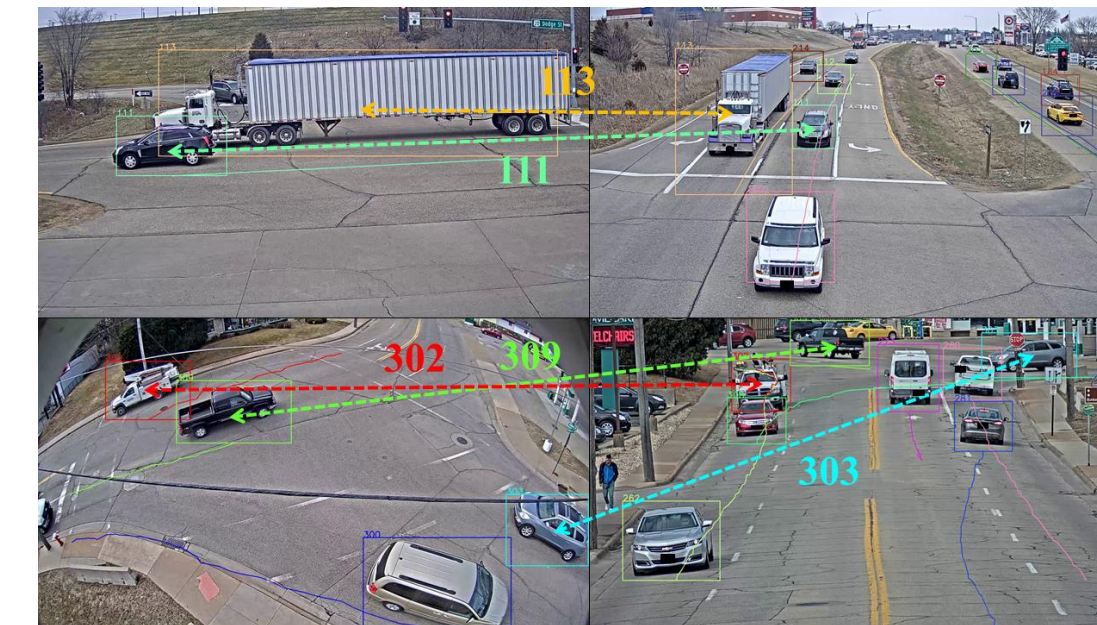
## Related Benchmarks

	Benchmark	# cameras	# boxes	# boxes/ID	Video	Geom.	Multiview
person	ReID						
	Market1501 [59]	6	32,668	30.8	×	×	✓
	DukeMTMC-reID [35, 63]	8	36,411	20.1	×	×	✓
	MSMT17 [47]	15	126,441	21.8	×	×	✓
	CUHK03 [23]	2	13,164	19.3	×	×	×
	CUHK01 [22]	2	3,884	4.0	×	×	×
	VIPeR [12]	2	1,264	2.0	×	×	×
	PRID [15]	2	1,134	1.2	×	×	×
CAVIAR [9]	2	610	8.5	×	×	×	
MTMC	MARS [58]	6	1,191,003	944.5	×	×	✓
	DukeMTMC [35, 53]	8	4,077,132	571.2	✓	✓	✓
	NLPR_MCT [8]	12	36,411	65.8	✓	✓	✓
vehicle	ReID						
	VeRi-776 [29]	20	49,357	63.6	×	✓	✓
	VehicleID [27]	2	221,763	8.4	×	×	×
	PKU-VD1 [55]	-	846,358	6.0	×	×	×
	PKU-VD2 [55]	-	807,260	10.1	×	×	×
MTMC	CityFlow (proposed)	40	229,680	344.9	✓	✓	✓

## CityFlow Benchmark



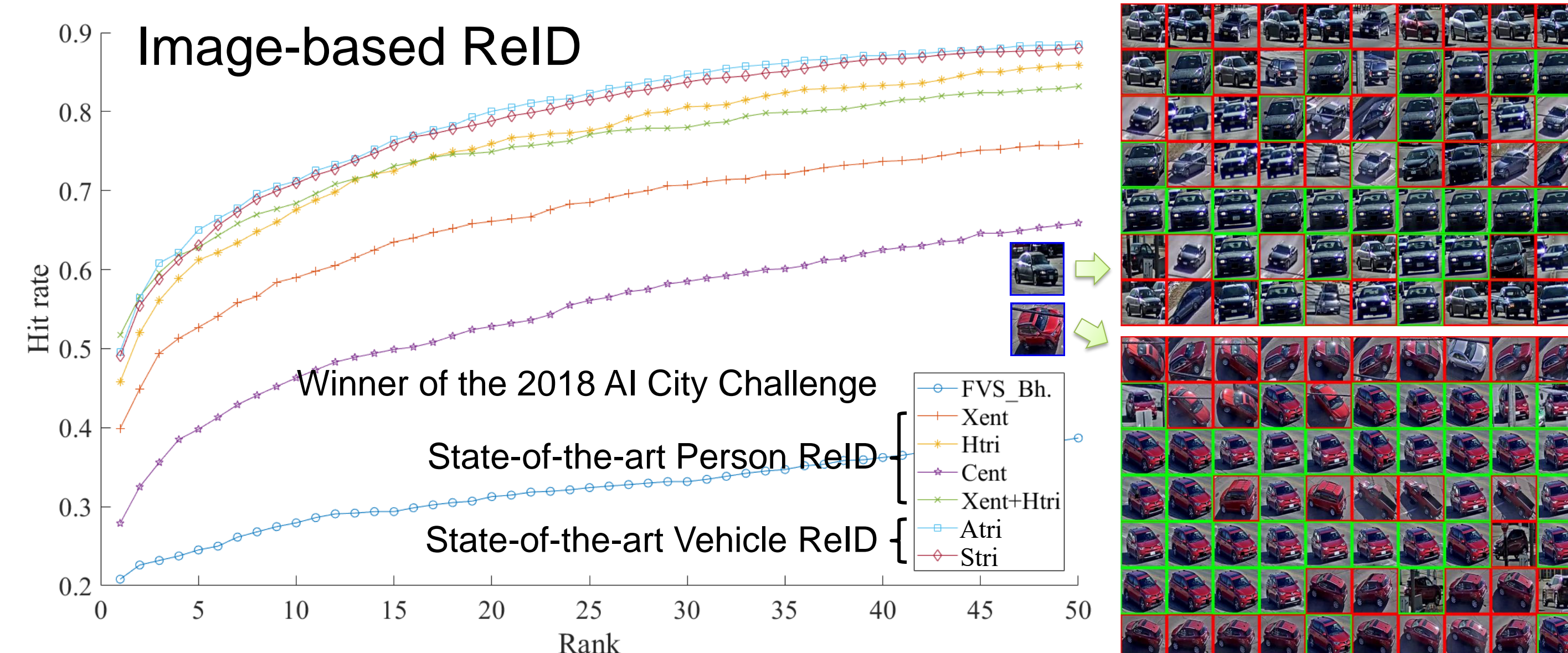
### Annotation



### Camera calibration



## Evaluation of Baselines



## MTSC tracking & object detection

Method	IDF1	Recall	FAR	MT	MOTA	MOTP
DS+YOLO	78.9%	67.6%	8.6	778	67.4%	65.8%
DS+SSD	79.5%	69.2%	8.3	756	68.9%	65.5%
DS+FRCNN	78.9%	66.9%	15.3	761	66.7%	65.5%
TC+YOLO	79.1%	68.1%	8.5	871	68.0%	66.0%
TC+SSD	79.7%	70.4%	7.4	895	70.3%	65.6%
TC+FRCNN	78.7%	68.5%	12.0	957	68.4%	65.9%
MO+YOLO	77.8%	69.0%	8.5	965	68.6%	66.0%
MO+SSD	72.8%	68.0%	6.3	980	67.0%	65.9%
MO+FRCNN	75.6%	69.5%	10.8	1094	68.6%	66.0%

**MTSC tracking:**  
DS: DeepSORT  
TC: Tracklet clustering  
MO: MOANA  
**Object detection:**  
YOLO: YOLOv3  
SSD: SSD512  
FRCNN: Faster R-CNN  
**Spatio-temporal assoc.:**  
PROVID: Spatio-temporal-based re-ranking  
2WGMFMF: Learning transition distributions  
FVS: Manually set transition distributions

## MTMC tracking

Spatio-temporal association	MTSC tracking	Image-based ReID						
		FVS_Bh.	Xent	Htri	Cent	Xent+Htri	BA	BS
PROVID [29]	DeepSORT [50]	21.5%	31.3%	35.3%	27.6%	34.5%	35.6%	33.6%
	TC [43]	22.1%	35.2%	39.4%	32.7%	39.9%	40.6%	39.0%
	MOANA [40]	21.7%	29.1%	33.0%	26.1%	31.9%	34.4%	31.8%
2WGMFMF [20]	DeepSORT [50]	25.0%	35.3%	38.4%	31.2%	37.5%	40.3%	39.8%
	TC [43]	27.6%	39.5%	41.7%	34.7%	43.3%	44.1%	45.1%
	MOANA [40]	20.2%	32.2%	35.9%	28.2%	36.5%	38.1%	37.7%
FVS [43]	DeepSORT [50]	24.9%	36.4%	40.0%	30.8%	39.0%	41.3%	41.4%
	TC [43]	27.6%	40.5%	42.7%	36.6%	42.4%	46.3%	46.0%
	MOANA [40]	21.2%	32.7%	36.4%	29.2%	37.5%	39.5%	36.9%

## AI City Challenge Workshop @ CVPR 2019

- Track 1 (MTMC tracking) & Track 2 (ReID) based on CityFlow
- Online evaluation server with public leader board provided
- 334 participating teams from 44 countries around the world

Track	Winner	Runner-up
MTMC tracking	U. Washington	DiDi Global
Vehicle ReID	Baidu ZeroOne	U. Washington

