BIOMETRICS INSTITUTE

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NEC

NEC NeoFace Technology

NEC's approach to mitigating demographic variables in facial recognition algorithms

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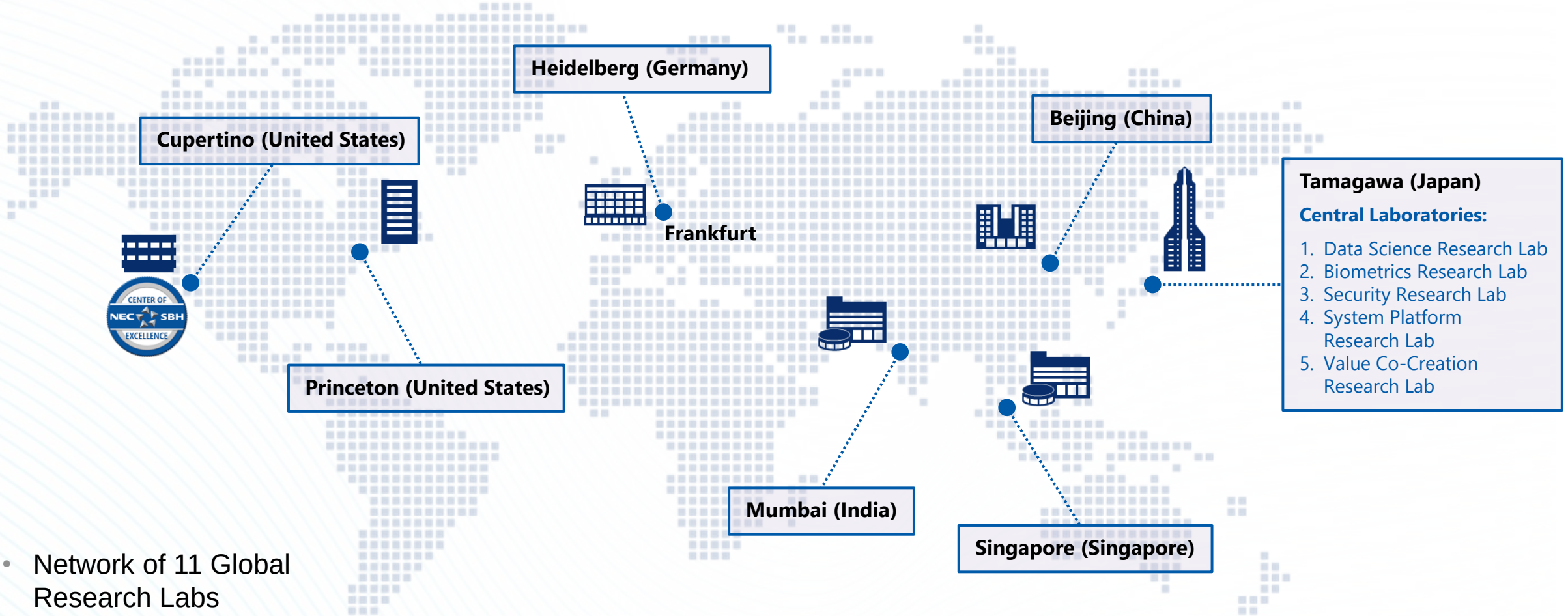
NEC R&D Organization

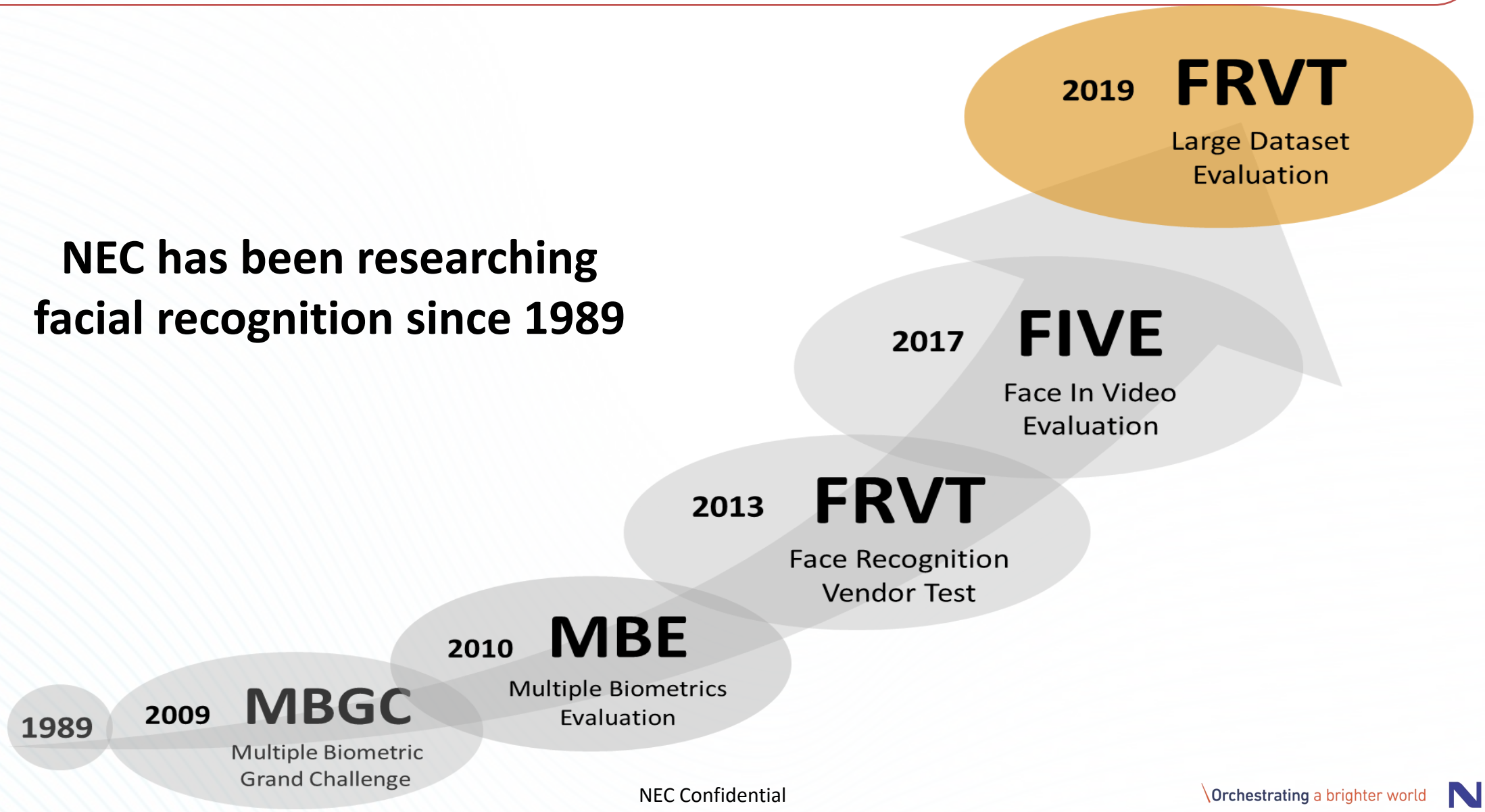
- **NEC R&D works closely with customers to enhance programs**



- Network of 11 Global Research Labs

NEC Facial Research & NIST Evaluation Participation

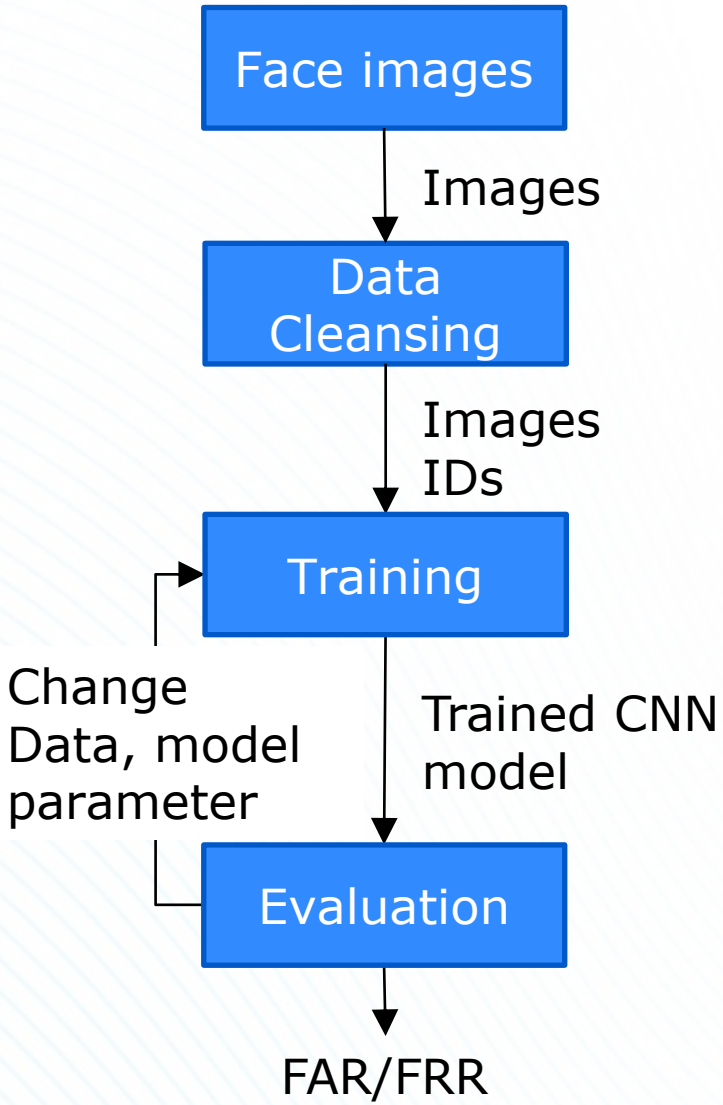
NEC has been researching facial recognition since 1989

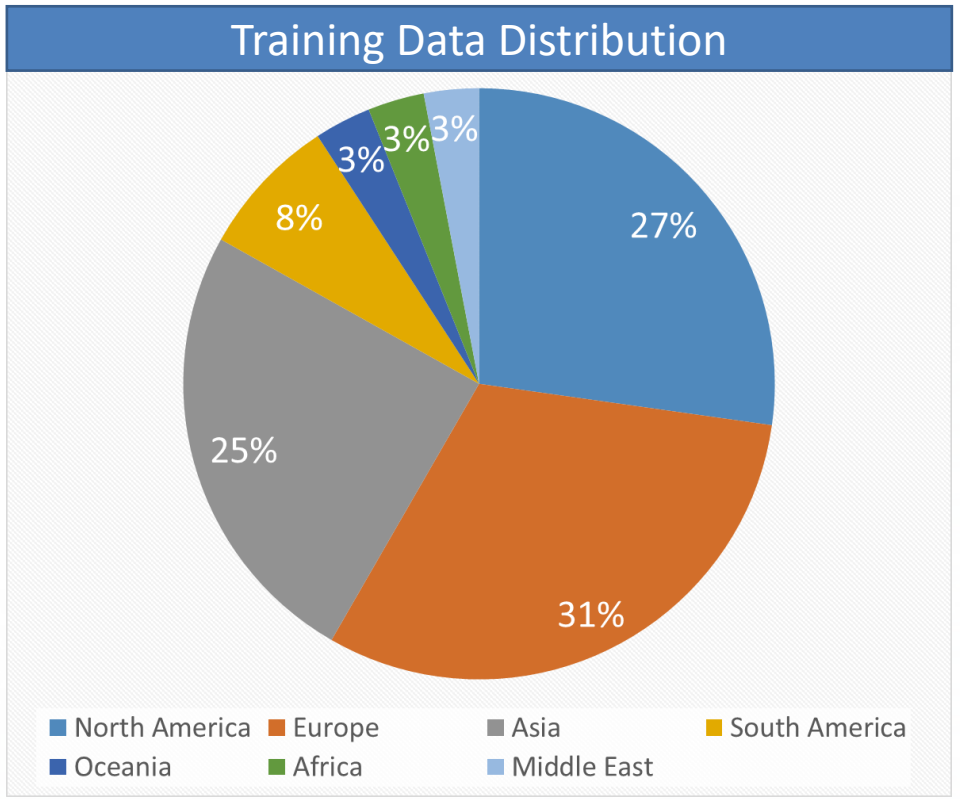


Continuous R&D to Enhance Customer Solutions

- **NEC has delivered several large scale FR solutions**
  - Credential programs in many countries
  - Real-time screening solutions
  - Identity solutions
  - Immigration solutions
- **Through these programs we have continuously addressed FR related issues**
  - Environmental issues (lighting, camera…)
  - Behavior issues (pose, quality…)
  - Demographic issues (detection, accuracy…)

NEC Algorithm Development Process





- Use annotated mugshot data collected.
- Annotated attributes are ID, Gender, Age, Race

NEC Continuously Enhances Training Datasets

- **NEC keeps appending training dataset**
  - Based on practical issues observed in field deployments
  - Collects data from paid volunteers around the world
    - NEC has over 150 subsidiaries around the world
- **Algorithm is re-trained from the beginning if there is any change to training dataset**
  - Goes through re-validation to ensure algorithm accuracy

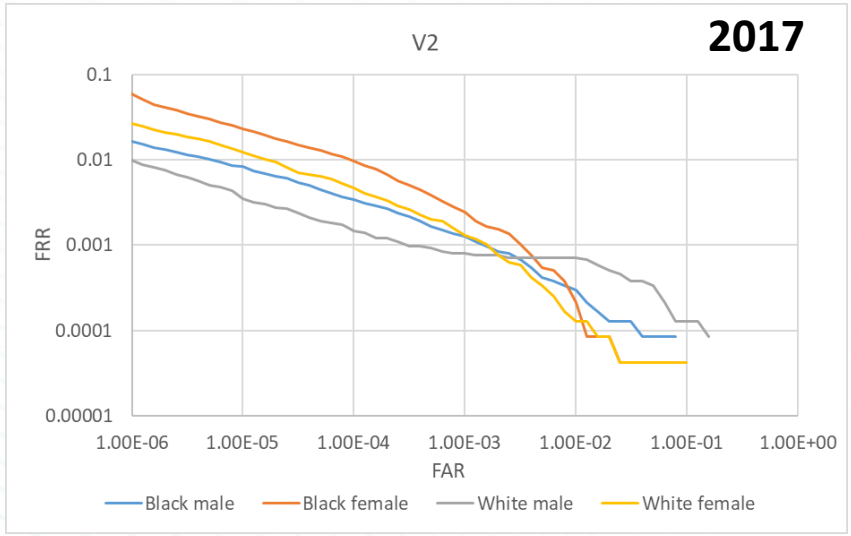
Normalizing Demographics Variables

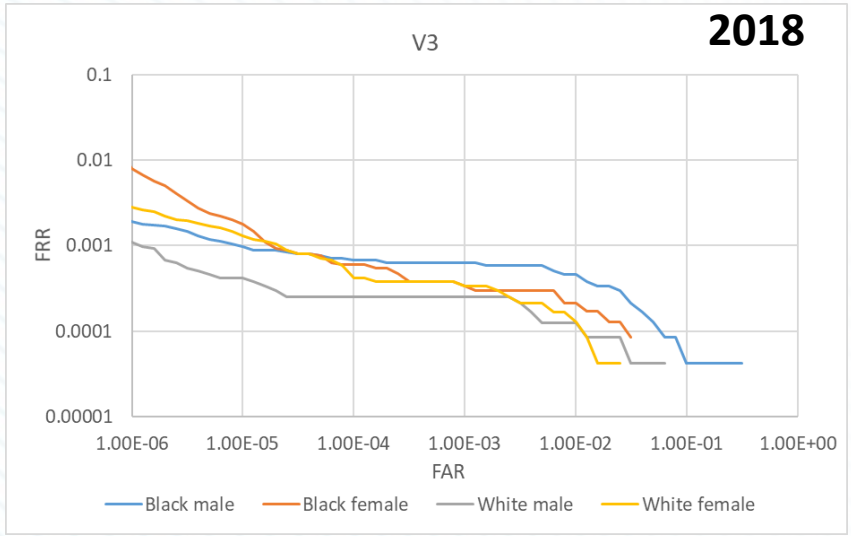
- **Address issues with detection and matching**
  - Environmental issues and image quality further degrades algorithms
- **Selection of diverse training dataset is important**
  - Inclusion of global dataset and correct sampling is important
- **Better loss estimation in algorithm is important**
  - Training data distribution should avoid loss underestimates for specific demographics
- **Selection of validation data with proper demographics distribution is important**

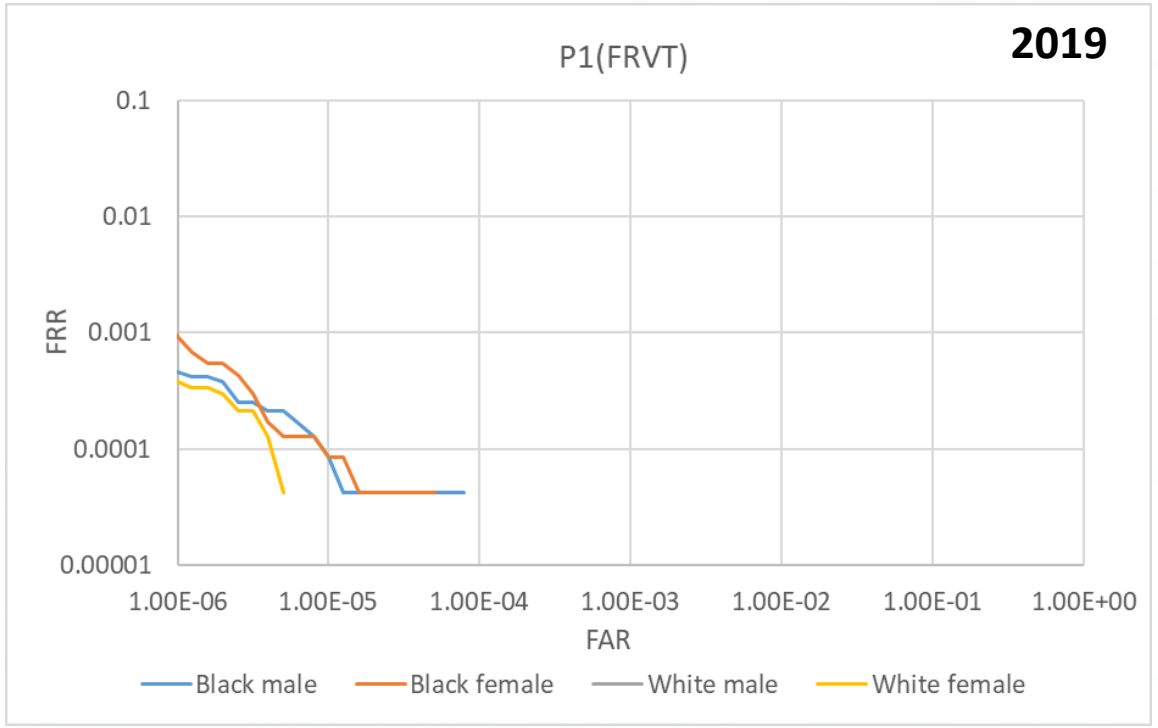
NEC Internal Evaluation Dataset		
	# of IDs	# of images
Black male	5,280	13,121
Black female	5,268	13,148
White male	5,294	13,146
White female	5,292	13,150

NEC Demographics Enhancements Since NIST-V

NEC Internal Evaluation (1:1)

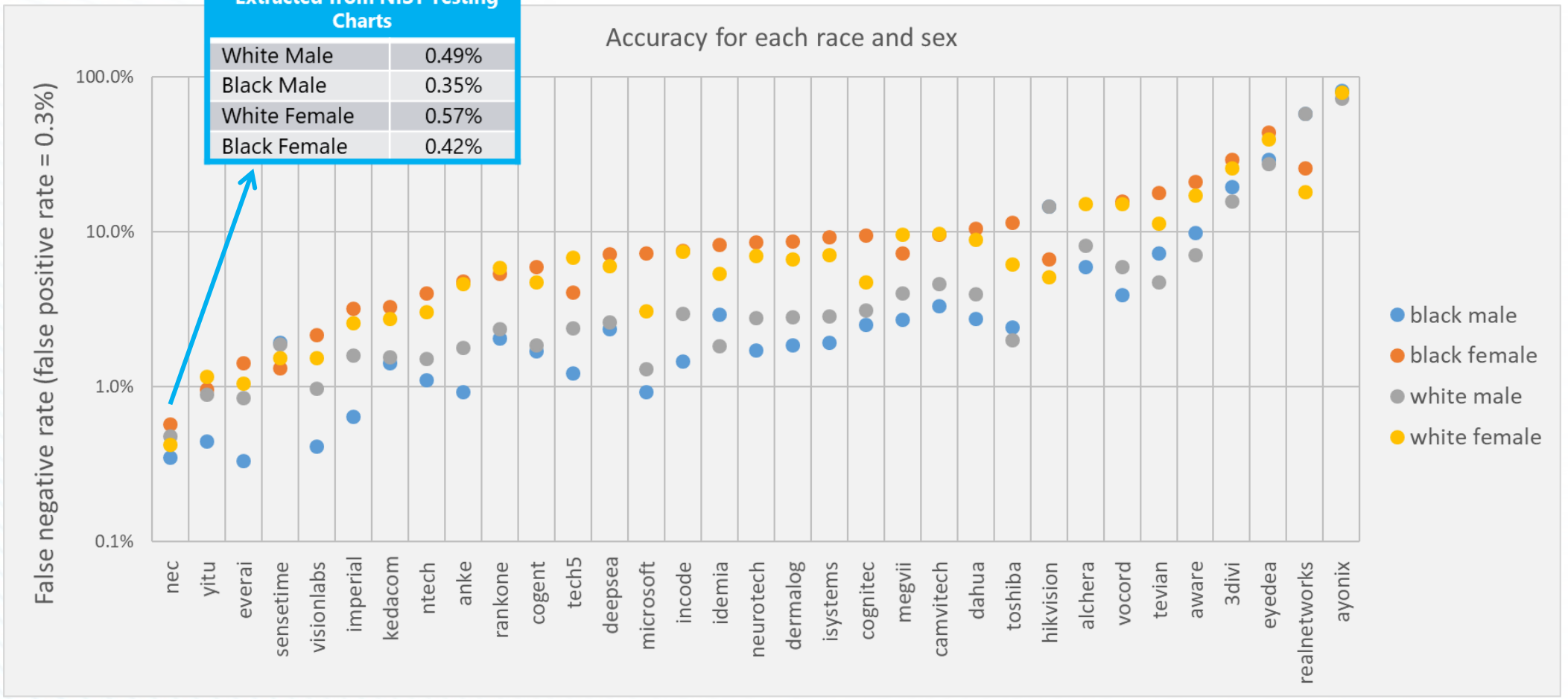






NEC FRVT2018 Algorithm Demographics Performance

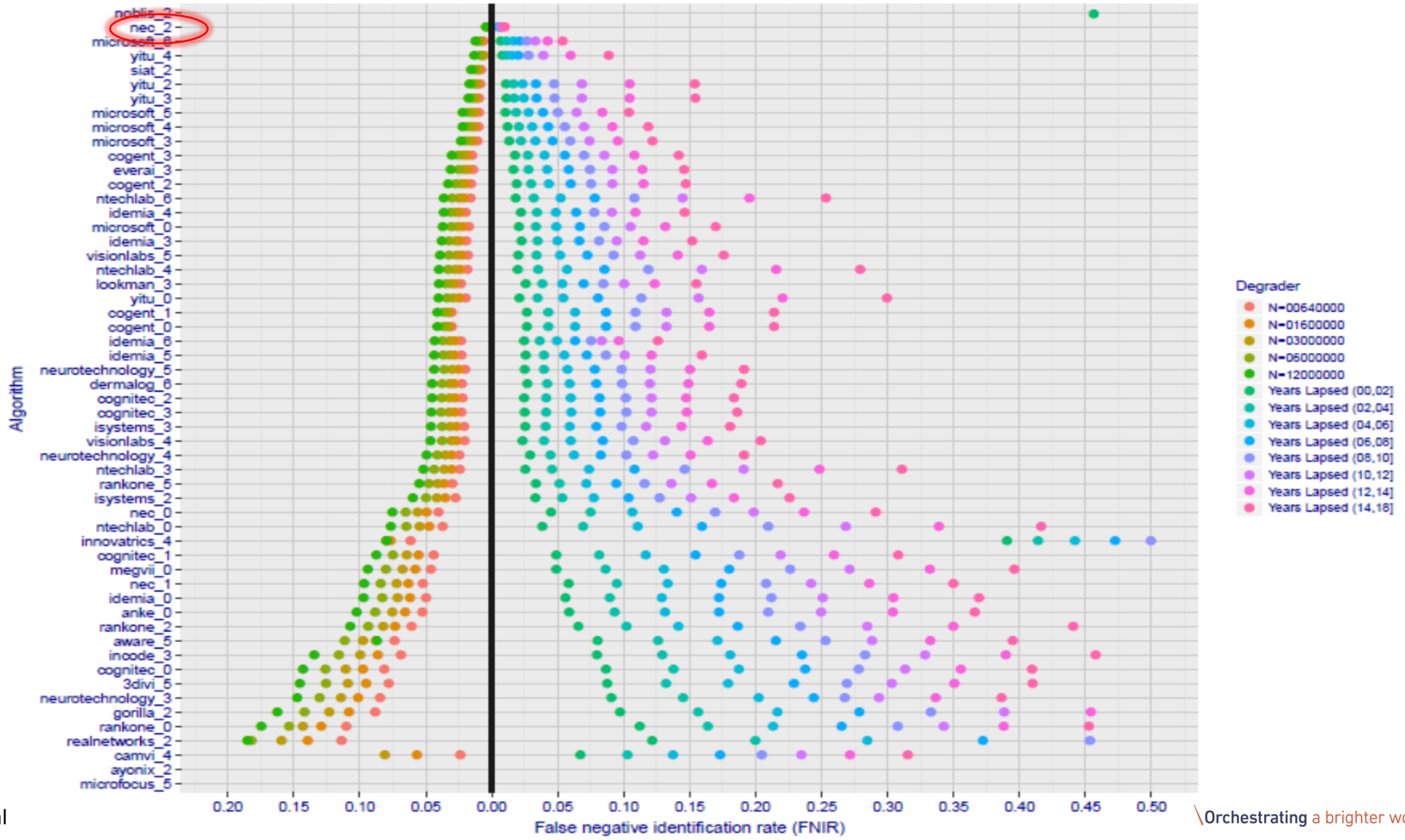
NEC Error Rates *Extracted from NIST Testing Charts	
White Male	0.49%
Black Male	0.35%
White Female	0.57%
Black Female	0.42%



*Results are sorted by maximum error rate among 4 categories

※ Each vendor's accuracy are cited from Figure 33, Figure 31, Figure 51 and Figure 24 in Annex 16
https://pages.nist.gov/frvt/reports/demographics/annexes/annex_16.pdf

NEC FRVT2018 Algorithm Age/Gallery Size Performance



Future Ahead

- NEC has retained the highest rank in NIST tests over the past 10 years due to a powerful combination of R&D, rigorous testing, and modern algorithm training techniques with large, efficient, well distributed data sets.

- According to NIST, NEC's algorithms perform the best across demographic population sets in the category of identification (1:N).

- The market will continue to demand facial recognition algorithms that are strong in performance (fast, speed) but also highly accurate in both false non-match/false match rates and demonstrate to the lowest extent possible, a minimization of errors across demographic groups.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