

Empowering Innovation Through Leading-Edge Technology

[REDACTED] PhD

[REDACTED]
NEC Laboratories Europe
and

[REDACTED]
[REDACTED] NEC Global Relations.



\Orchestrating a brighter world

NEC brings together and integrates technology and expertise to create the ICT-enabled society of tomorrow.

We collaborate closely with partners and customers around the world, orchestrating each project to ensure all its parts are fine-tuned to local needs.

Every day, our innovative solutions for society contribute to greater safety, security, efficiency and equality, and enable people to live brighter lives.

NEC today

 OVER
\$26 BILLION
REVENUE



75 MILLION
GLOBAL USERS



125+
COUNTRIES

 **#1**

SMB & ENTERPRISE
COMMS **WORLDWIDE**

GLOBAL 100

MOST SUSTAINABLE
COMPANIES IN
THE WORLD
(CORPORATE KNIGHTS)



LEADER IN
BIOMETRICS



**RECOGNIZED
AS A LEADER**
BY FROST & SULLIVAN
IN ENTERPRISE
COMMUNICATIONS
TRANSFORMATION



TOP 100

GLOBAL INNOVATORS
(THOMSON REUTERS)

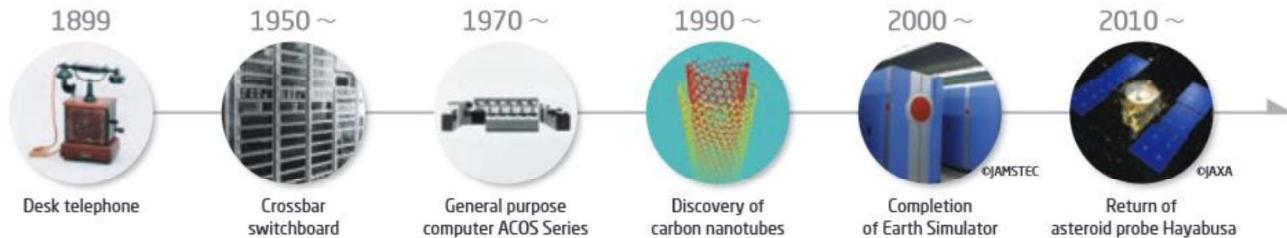


4,000+
CHANNEL
PARTNERS

107,000
**TEAM
MEMBERS**
WORLDWIDE



NEC: a long history of innovation



Global Research Laboratories

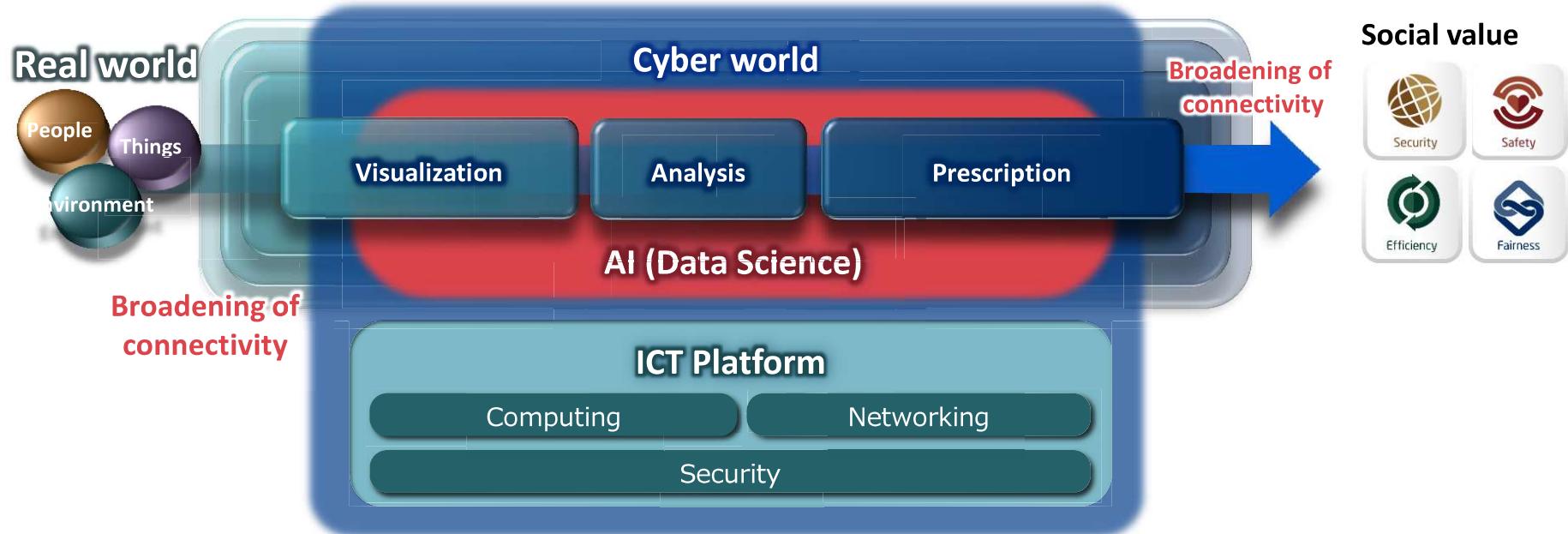
9 laboratories throughout the world employing nearly 1,000 researchers



The Process of Creating Social Value through ICT

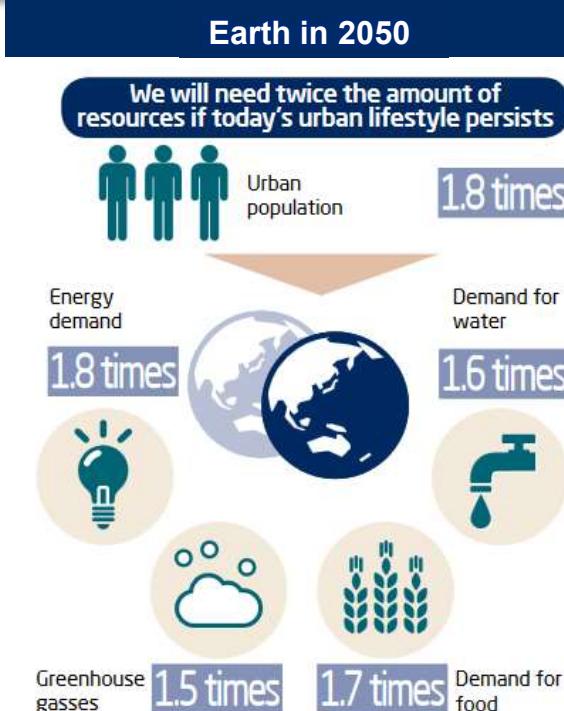
Enable enhancement of social value by refining NEC's No.1/Only 1 core technologies that support social value creation.

Social value generated by ICT and the source of value enhancement



NEC's future direction

Megatrends indicates the way towards social solutions



Social Value Creation: Seven Themes

- Sustainable Earth
- Safer Cities & Public Services
- Lifeline Infrastructure
- Communication
- Industry Eco-System
- Work Style
- Quality of Life

History of NEC's Initiatives in AI

NEC has a technology portfolio and business track record that extends over half a century, including AI technologies that rank top around the world.

1960

Visualization

OCR



Fingerprint
Recognition



Ranked 1st
eight times
2003～2016

Police

Face
Recognition



Ranked 1st
four consecutive times
2009,2010,2013,2017

Immigration
control

Iris
Recognition



Ranked 1st
2018

National
ID

* U.S. National Institute of Standards and Technology (NIST)

2000

Analysis

SVM*

Deep Learning

Applied in human resource matching,
image analysis
(RAPID Machine Learning)

Heterogeneous
mixture
learning
Applied in demand
forecasting, etc.

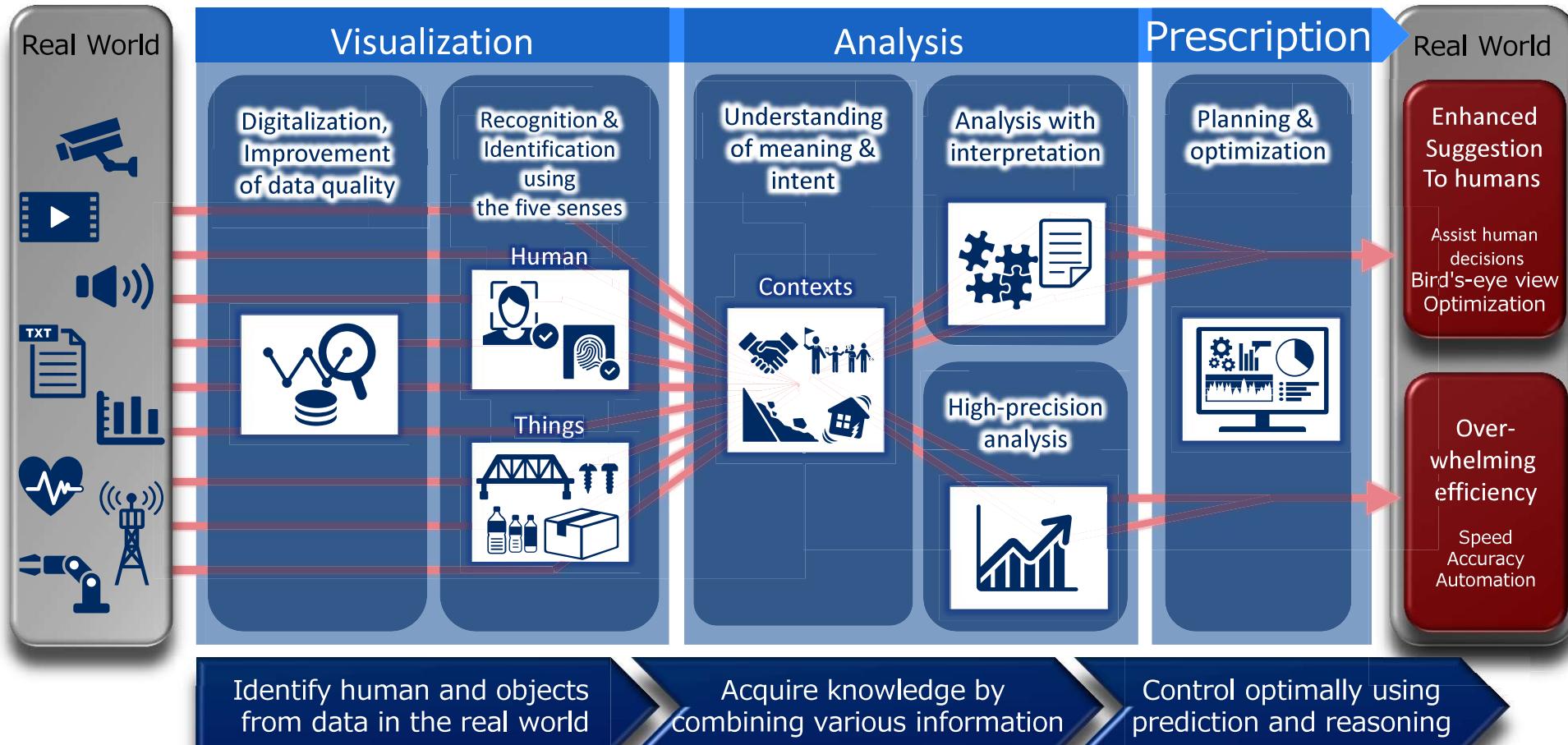
2010

Prescription

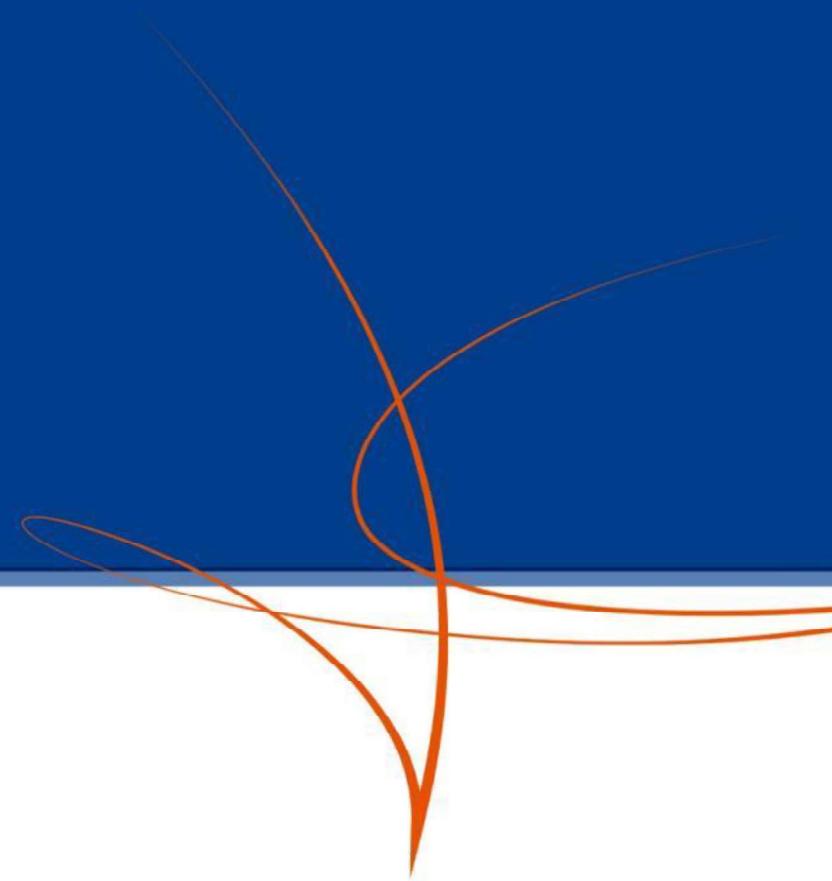
Autonomous
and Adaptive
Control

Predictive Robust
Optimization Framework

Value Creation by Combining Various data and AI Technologies

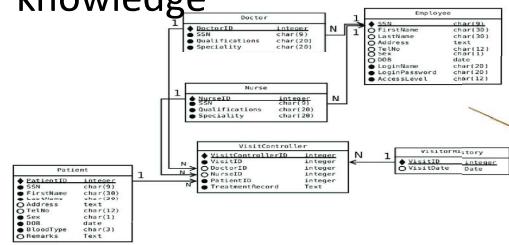


Technology foresight: TRL 4-5



Graph-based relational learning (multi-relational, multi-modal, interpretable)

Customer database & domain knowledge



Graph-based relational learning

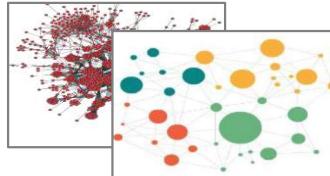
Integrate and induce a relational and multi-modal representation

Learn neural-relational models for the representation

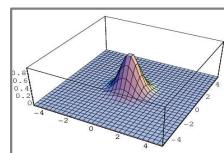
Easier to debug and evaluate before deployment

Selected by top conferences*

External KGs



Numerical



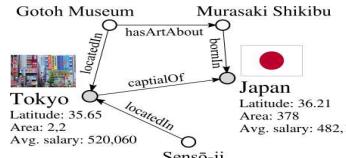
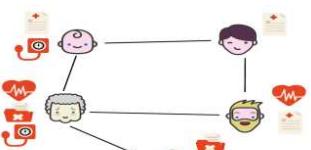
Text



Visual



1. Induce and Integrate Graphs



2. Learn (complete) representations



- Graph classification
- Node classification
- Link prediction

3. Reason and Explain

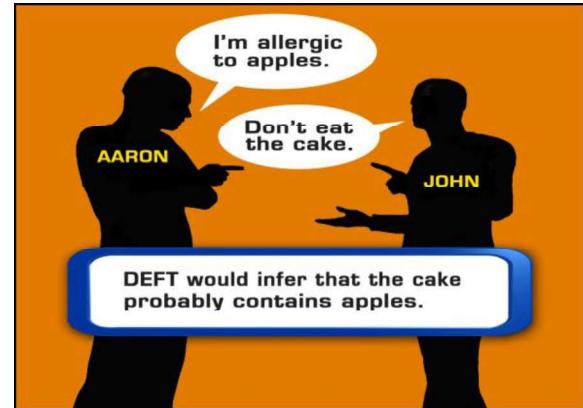
Diagnosis of patient A?

Financial fraud?

Graph-based relational learning for Multi-Intelligence

Growing importance of KGs for Intelligence

- NLE's member M. Niepert worked on the DARPA DEFT = from raw text to query answering in a KG
- As visualization tools linking databases

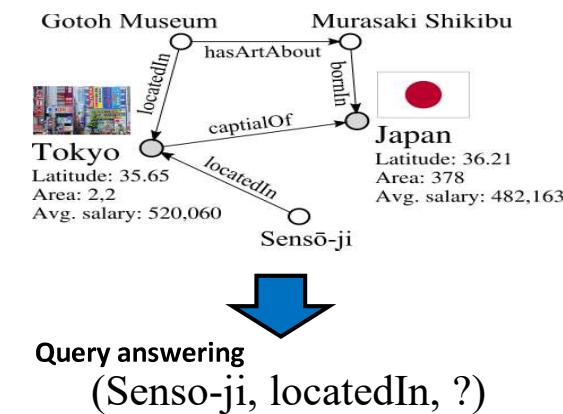


Today's systems

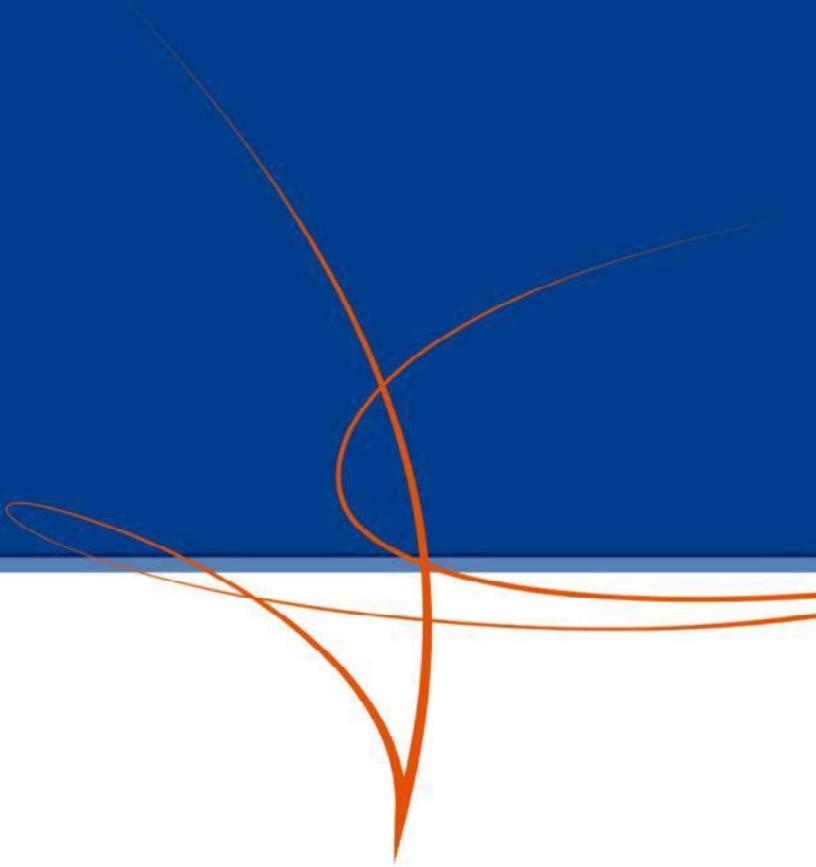
- Many solutions for individual xINT systems
- A few solutions for Multi-INT: data integration for **relational** databases built with **single-modality** metadata, able to match entities across databases (IBM i2 iBase, Palantir, MarkLogic). No KB completion

Why Graph-based relational learning

- Builds and integrates knowledge graphs across **different modalities** of the data, i.e. images, numbers, text
- Enables answering of **queries across the knowledge graphs**
- Queries over a knowledge graph provide answers **even if not explicitly** in knowledge graph (inferred relation with a confidence level)

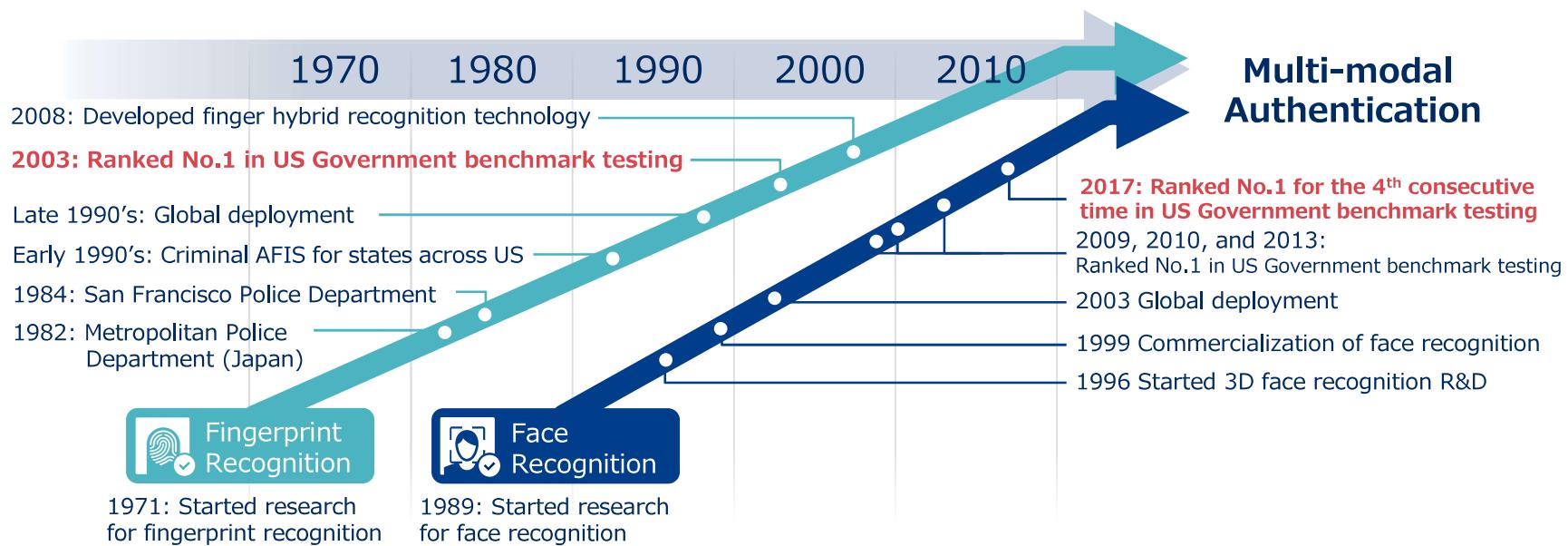


Operational components

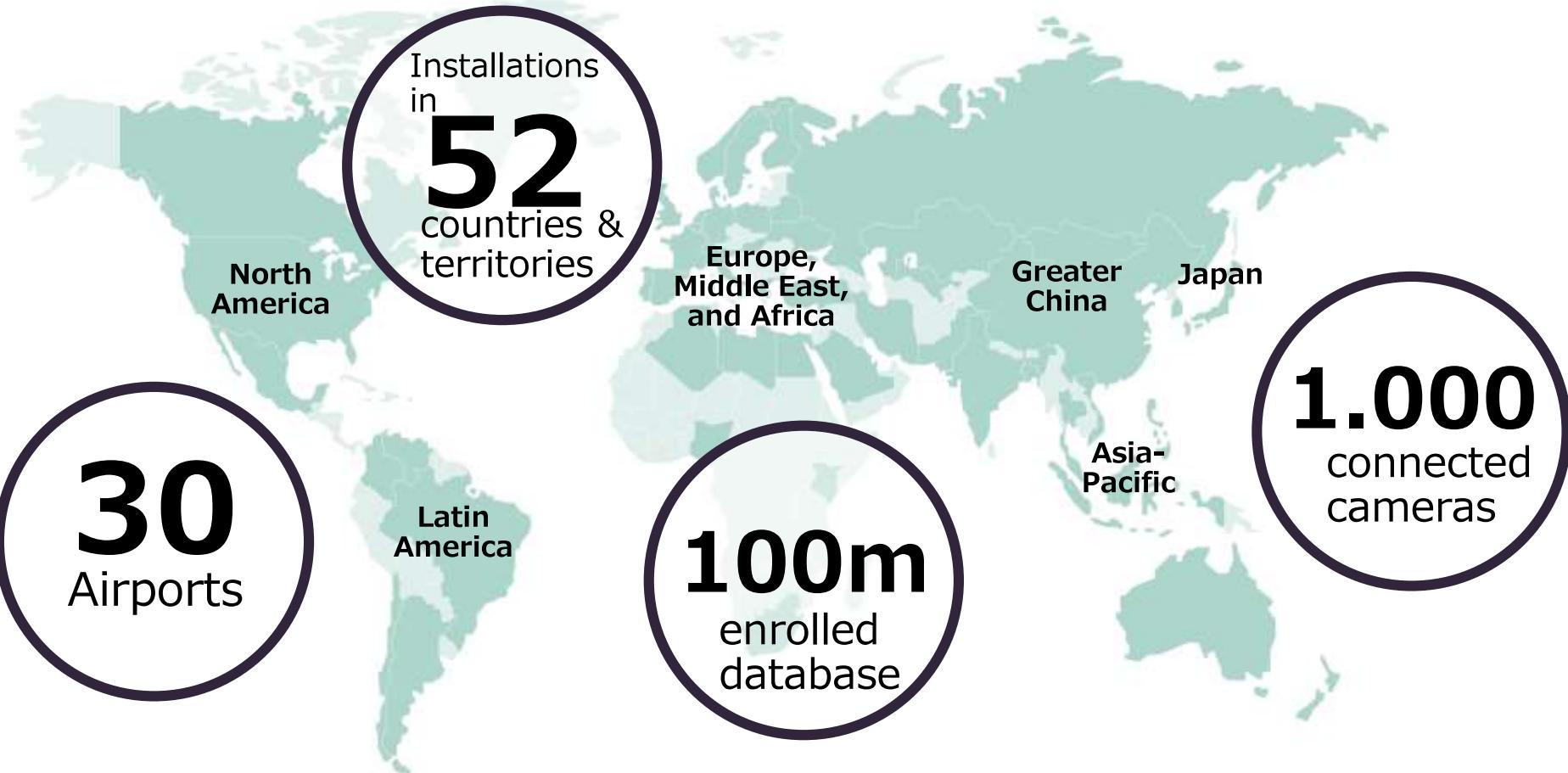


History of NEC Overall Biometric Technology

NEC - Market Leadership over 40 years of Biometrics Experience -



NeoFace Watch | NEC's Global Face Recognition Platform



NEC's Biometrics Recognition Technologies



**4 Consecutive wins
in NIST*¹ Evaluation**
(2009,2010,2013,2017)

Face

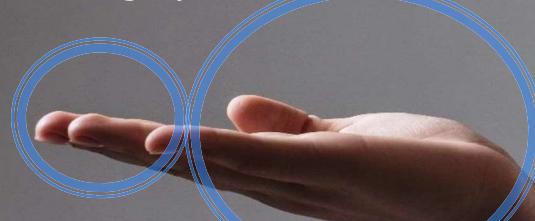


**5 Consecutive wins
in NIST*¹ Evaluation**
(2004,2007,2009,2012,2013)



Fingerprint

Palm • Vein



**Rank No.1 in
NIST*¹ Evaluation
(2018)**

Iris



Voiceprint



Ear Acoustic



NIST: National Institute of Standards and Technology
Non-Regulatory agency of the US Department of Commerce

USA: CBP US Exit Control face recognition



Immigration Control

Challenges

Reduce processing time, enhance customer service and safety of airport operations.

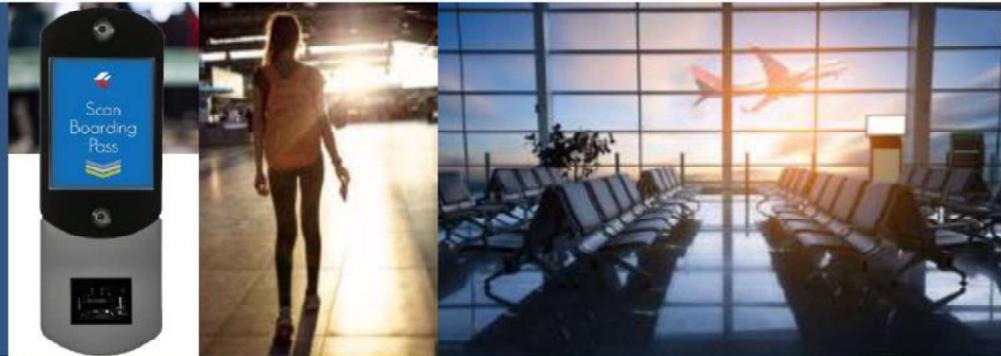
Solution

Walkthrough face recognition system NeoFace Express

Results

Enhanced security for exit control using face recognition.
Enable frictionless exit process.

- Exit control trial in several US airports including Dulles International Airport.
- Checking against passport DB (US citizens) and entry data (visitors) to confirm the identities of those leaving the country.
- Enhance security and enable detection of illegal overstays of foreign visitors.



Frictionless exit control system using face recognition.

Brazil: Face recognition for 14 international airports

Enhanced Citizen Services

Challenges

Increase efficiency and rigor of customs control at airports.

Solution

NeoFace Watch real-time face recognition system

Results

Detection of pre-registered individuals who have been registered for suspicious activities.

- Used to enhance efficiency and effectiveness of customs operations in 14 international airports in Brazil.
- Screening of passengers as they walk past the customs control area based on a database of pre-registered suspects.



Preventing illegal activities at airport customs control.

Summary

- NEC has a large footprint worldwide and wide view of use cases / segments
- History of NEC's innovation shows that successful projects can be better delivered with an integrated approach
 - human-centered → need dialogue with end users to understand real customer value
 - data availability → partner with “data providers”
- Face recognition now operational
- Graph-based relational learning: TRL 4-5 (technology validated in a lab or in a relevant environment) → how to get to the next step?
 - E.g., collaborating with Frontex?
 - Design Thinking? (involvement of users...)
 - Data ... data ... data ... (how to have confidential data available?)

\Orchestrating a brighter world

NEC