

# Federated Sharing of Disparate Database Resources

Joshua Roberts

# System Goal

*Sharing data between different organizations*

Motivation: To improve collaboration among alliances.

Examples:

- Share medical information related to patient care in collaboration with multiple providers;
- Share data among law enforcement agencies to aid investigations;
- Share clinical trial data among multiple research organizations to discover new therapeutics;
- Share data from IoT systems among different organizations to amass data to find optimizations and to build innovations.

# System Goal

## ***Problem:***

- Multiple types of DBMS with different schema makes sharing data between different organizations a challenge.
- Solution had to be non-intrusive while maintaining the security, privacy, and integrity of the data.

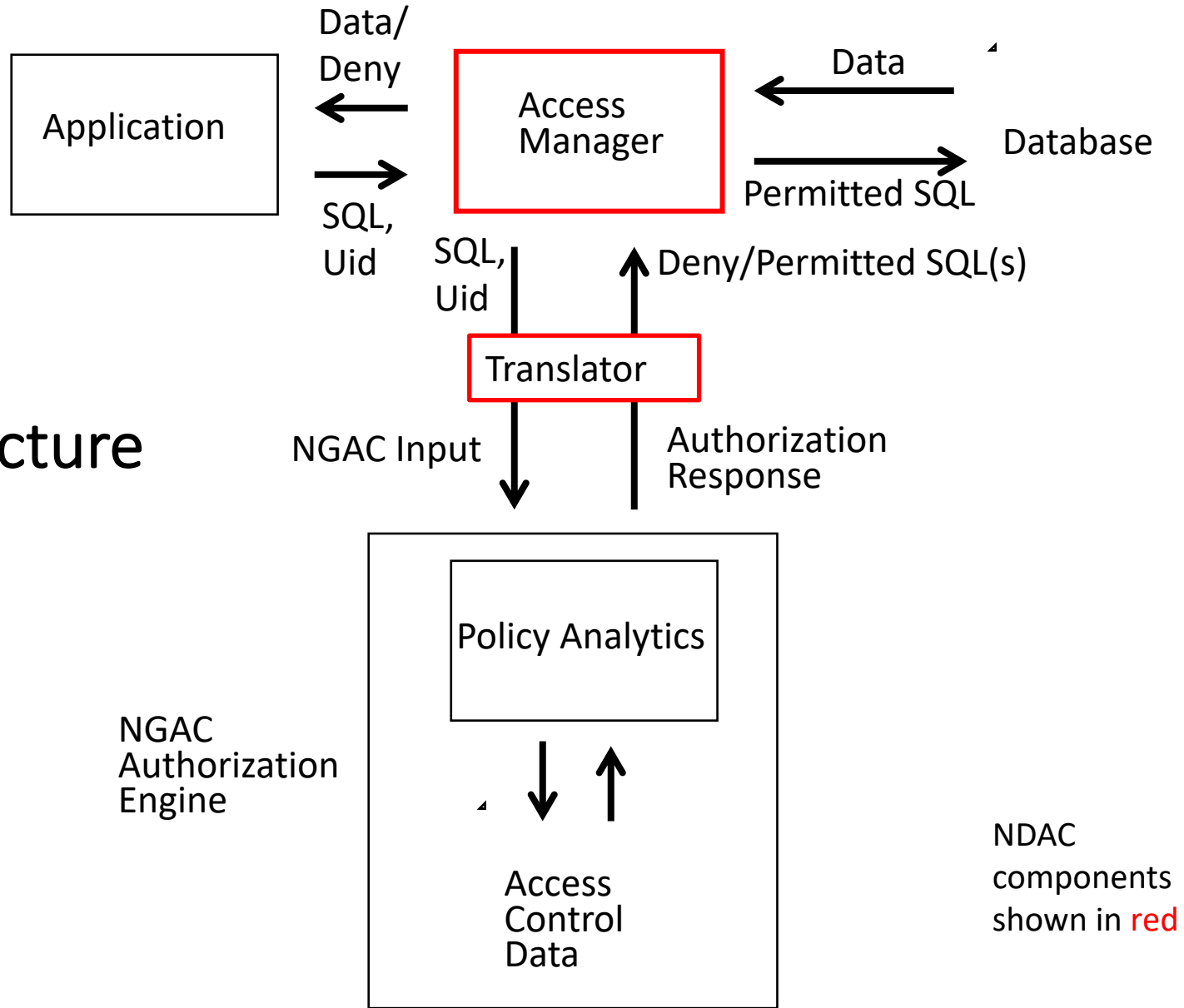
## ***Approach:***

- Leverage two proven NIST technologies: Next Generation Database Access Control (**NDAC**), and **data block matrix** to have controlled shared access.
- Exchange **attributes** not **data**

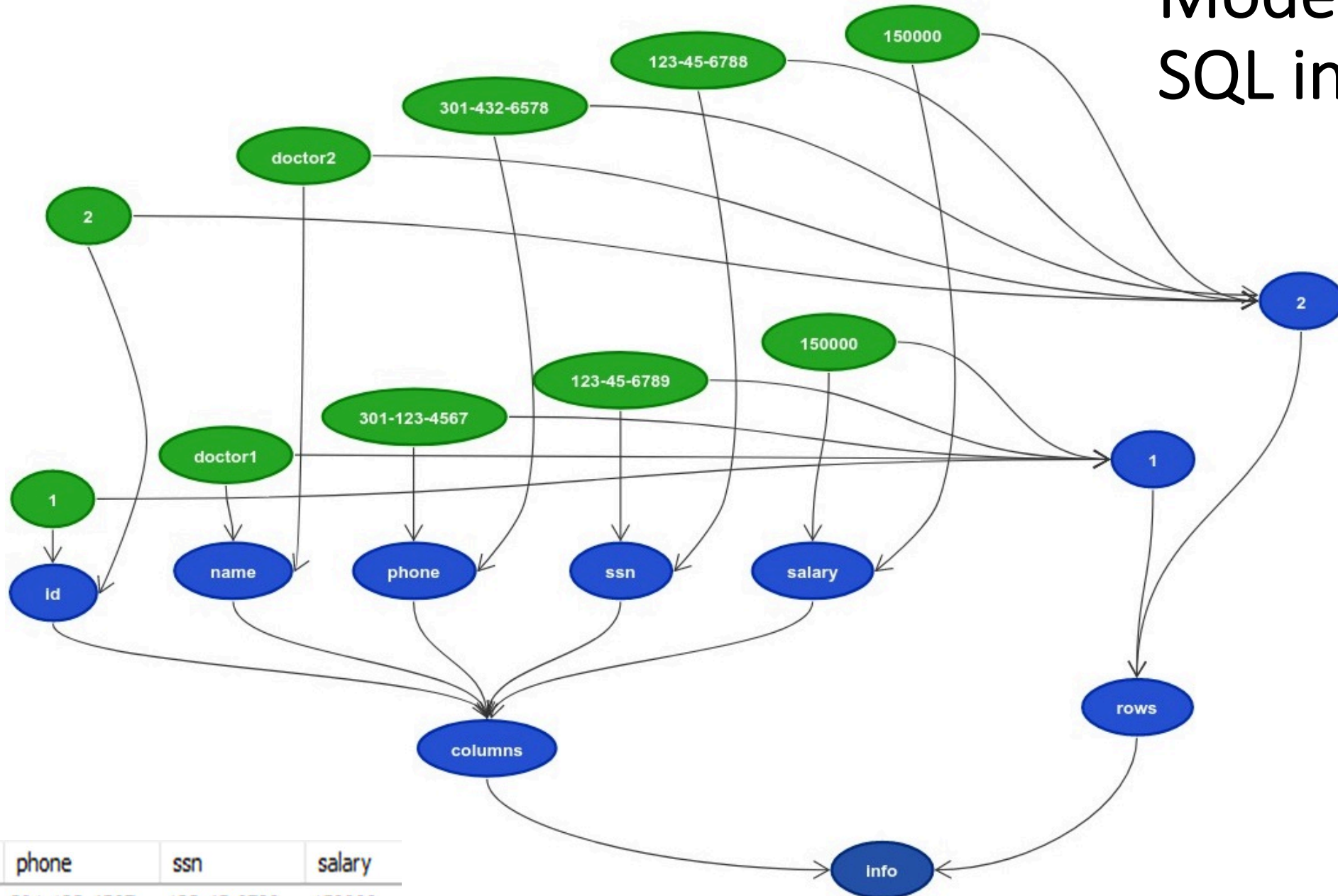
# Approach - NDAC

- Middleware that leverages NGAC and policy review for imposing access control over database queries
- Eliminates the need to implement and manage access control in the application or DBMS
- Translates a user's query to a **permitted** query for Select, and Grant/Deny for Update, Delete, and Insert
  - User's query may fetch entire data sets and NDAC restricts access to the set of data permissible for the user.
- Enforcement of policy combinations over DBMS data down to the field level

# NDAC Architecture



# Modeling SQL in NGAC



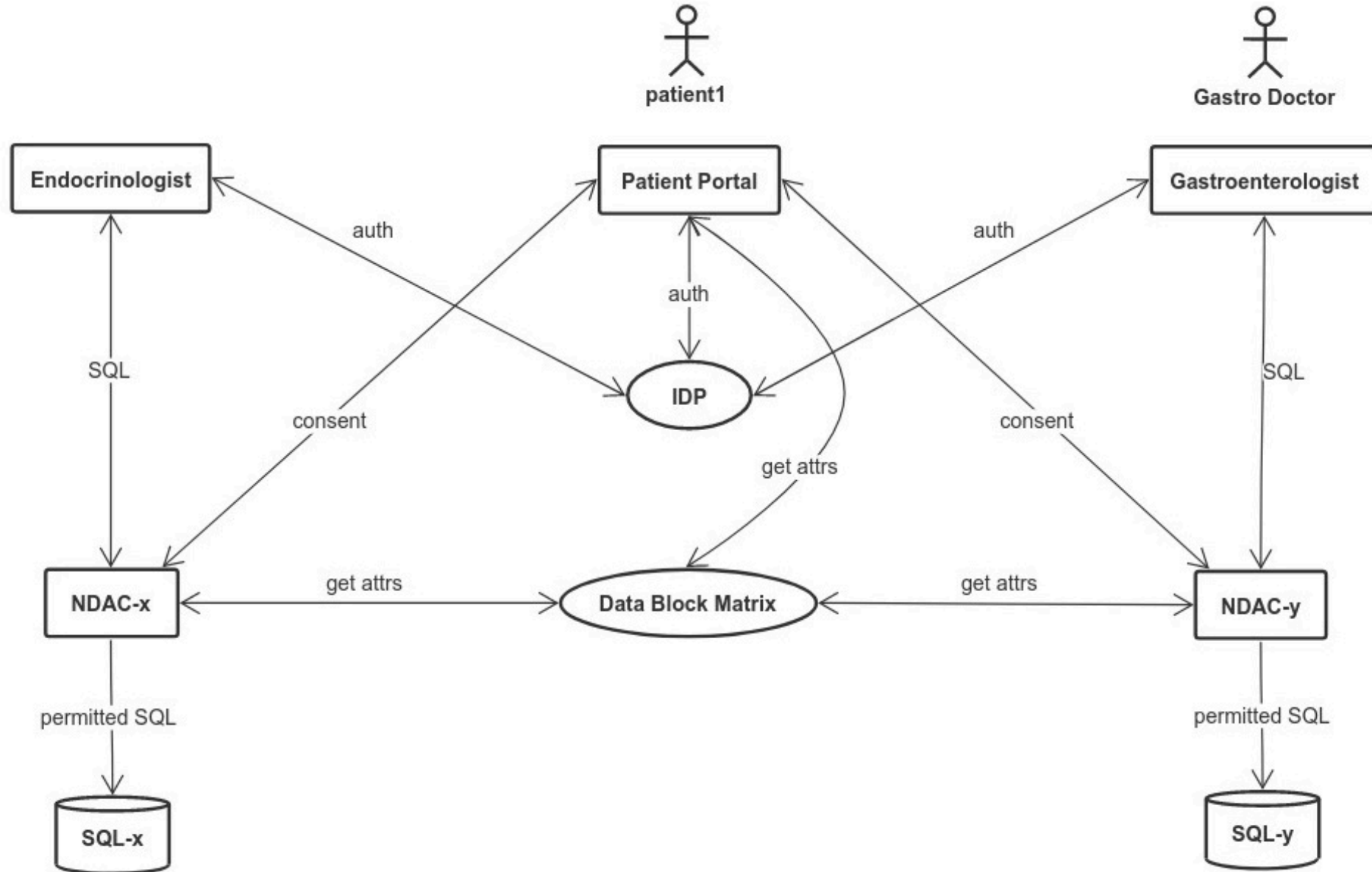
	id	name	phone	ssn	salary
▶	1	doctor1	301-123-4567	123-45-6789	150000
	2	doctor2	301-432-6578	123-45-6788	150000

# Approach - Data Block Matrix

- A NIST developed distributed ledger
  - integrity protection of a blockchain but with the ability to edit or delete data.
- Provides an API for storing, managing and sharing attributes
  - Stores a catalog of common attributes using standard nomenclature (e.g., SNOMED-CT) in the federation (e.g., Dr, Nurse, Patient, Clerk, HR, Supervisor)
  - Enables user access to the resources of other Relying Party's (RPs), not for accessing resources in their own organization.
- Establishing trust in the federation (e.g., who under what authority can create/delete in the DBM.)

	0	1	2	3	4	
0	X <sub>0,0</sub>	X <sub>0,1</sub>	X <sub>0,2</sub>	X <sub>0,3</sub>	X <sub>0,4</sub>	H <sub>0,-</sub>
1	X <sub>1,0</sub>	X <sub>1,1</sub>	X <sub>1,2</sub>	X <sub>1,3</sub>	X <sub>1,4</sub>	H <sub>1,-</sub>
2	X <sub>2,0</sub>	X <sub>2,1</sub>	X <sub>2,2</sub>	X <sub>2,3</sub>	X <sub>2,4</sub>	H <sub>2,-</sub>
3	X <sub>3,0</sub>	X <sub>3,1</sub>	X <sub>3,2</sub>	X <sub>3,3</sub>	X <sub>3,4</sub>	H <sub>3,-</sub>
4	X <sub>4,0</sub>	X <sub>4,1</sub>	X <sub>4,2</sub>	X <sub>4,3</sub>	X <sub>4,4</sub>	H <sub>4,-</sub>
	H <sub>-,0</sub>	H <sub>-,1</sub>	H <sub>-,2</sub>	H <sub>-,3</sub>	H <sub>-,4</sub>	

# Operational Sharing of Data Resources

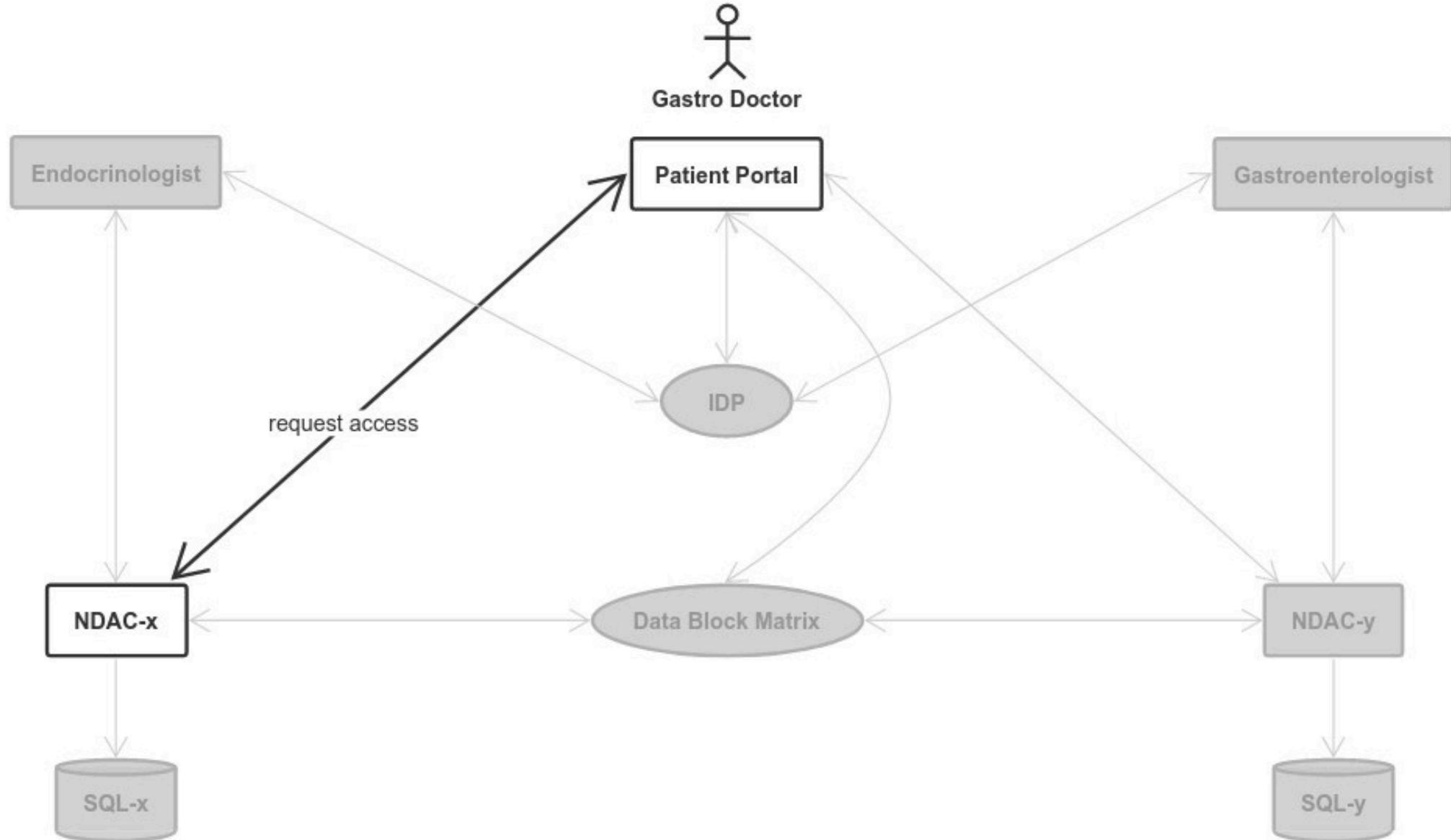




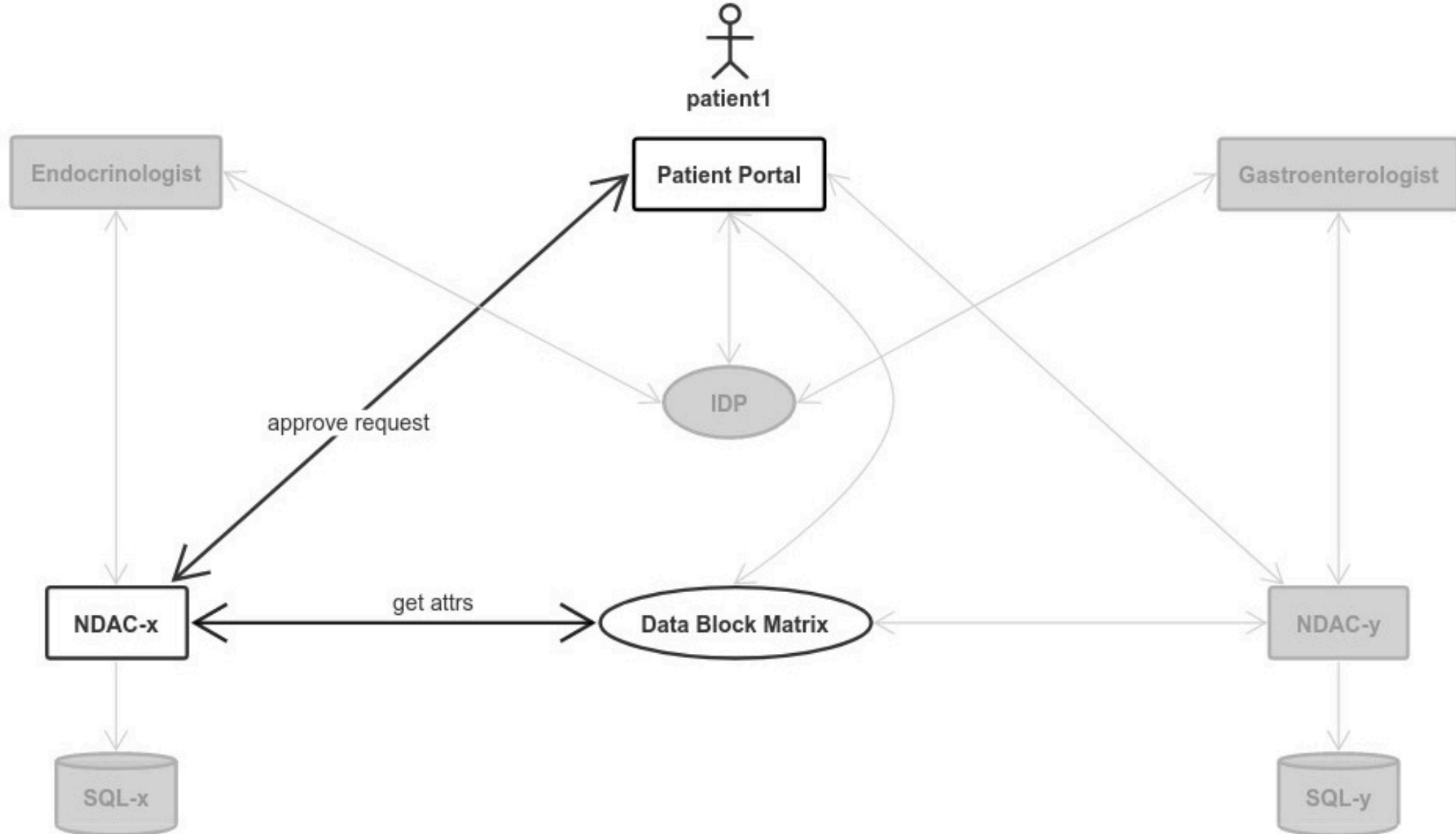
## Federated Consent Scenario

- Gastroenterologist doctor requests access to patient1's endocrinologist record
- Patient1 accepts request
- Doctor is onboarded into endocrinologist with attributes from the data block matrix
- Doctor accesses patient1's record at the endocrinologist

# Gastroenterologist requests access to patient1's endocrinologist record



# Patient1 accepts request and Gastro Doctor is onboarded





# Demo User Story

- Patient1 is 15 years old
- Diagnosed with T1D at the age of 10
- Patient1\_mom has control of patient1's record
- Sees a primary care physician and an endocrinologist to maintain T1D
- Recently visited the primary care physician with symptoms of celiac disease, so the doctor referred patient1 to a gastroenterologist
- Patient1 and patient1\_mom are about to visit the gastroenterologist

# Links

- Data Block Matrix Whitepaper
  - <https://csrc.nist.gov/publications/detail/white-paper/2018/05/31/data-structure-for-integrity-protection-with-erasure-capability/draft>
- Data Block Matrix GitHub
  - <https://github.com/usnistgov/blockmatrix>
- NIST Policy Machine GitHub
  - <https://github.com/PM-Master/policy-machine-core>
- NDAC Whitepaper
  - <https://csrc.nist.gov/publications/detail/conference-paper/2017/03/24/imposing-fine-grain-ngac-over-database-queries>