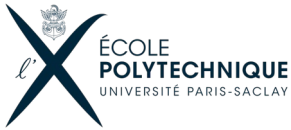# Real time big data healthcare platform
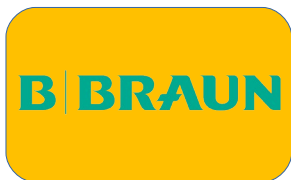## Architecture overview

Jona JOACHIM

U942 30 Mai 2023

Evolution of data acquisition

- 2013: DataCollect
  - 1 sample every 30 secondes
- 2014: ixTrend for Waveform recording
  - Manual waveform recording
- 2015: InfuPy
  - syringe pump recording
- 2016: GraPhysio
  - Data analytics
- 2019: DWC
  - Systematic high fidelity patient monitor recording
- 2021: ICCA
  - Perioperative charting

RADIOMETER

B|BRAUN

mindray
healthcare within reach

PHILIPS
Healthcare

EAI

APACHE
kafka

HL7® FHIR®

Assimilation of heterogenous data
Numerics and Waveform
Lab values, Drug infusion
Perioperative Events

Philips DWC

Prospective high fidelity biometric data recording.

- Numerics
  - 1 value per second
- Waveforms
  - 125 Hz
- Alerts
- Since March 1st 2019

Data from ICCA

TIMESTAMP timestamp without time zone	IPP text	NDA text	NOM text	PRENOM text	CLINICALUNIT text	BEDLABEL text	LABEL text	VALUE text	UNIT text
2023-03-02 07:21:00					MATERNITE	M_BO2	Temps	Incision	
2023-03-01 17:59:00					BLOC CENTRAL	BO 11	Temps	HEMOSTASE	
2023-03-01 15:36:00					MATERNITE	M_BO2	Temps	SURVEILLANCE SSSPI	
2023-03-01 15:01:00					MATERNITE	M_BO2	Temps	Exsufflation	
2023-03-01 14:34:00					MATERNITE	M_BO2	Temps	Insufflation	
2023-03-01 13:38:00					BLOC CENTRAL	BO 09	Taille	160	cm
2023-03-01 13:38:00					BLOC CENTRAL	BO 09	Poids	55.0	kg
2023-03-01 13:21:00					BLOC CENTRAL	BO 11	Temps	Craniectomie	
2023-03-01 12:49:00					BLOC CENTRAL	BO 12	Temps	Infiltration	
2023-03-01 11:05:00					BLOC CENTRAL	BO 12	Taille	155	cm
2023-03-01 11:05:00					BLOC CENTRAL	BO 12	Poids	74.0	kg

How much data

Currently 25 TB of data (Mar 2023)

Number of patients:

Digestif ambulatoire	1677		REA CHIR	4532
Ophtalmologie	1559		USC	349
Urgences	7848			
ORL	4171		SSPI Central	18061
Neurochirurgie	3058		Dechocage	1822
Maternité	1636			
Orthopédie	1308		Total	46021

What kind of data

ECG, SpO2, NBP	Tous (46021)
Halogénés	17433
Ventilation	20161
Cardiac output	2130
EEG	8611
KTA	5782
NMT	12442
Temperature	14812
Swan-Ganz	40
$ScvO_2$	1624
NIRS	547
pCO_2tc	1651

Babynoradrénaline

Spécialité	% interventions
Digestif ambulatoire	19
Gynéco-Obstétrique	26
Neurochirurgie	77
Neuroradiologie interventionelle	88
ENT / ORL	37
Orthopedics	43
Emergency surgery	37

Spécialité	Durée moyenne (h)	Dose cumulée moyenne (µg)
Digestif ambulatoire	1.14	180
Gynéco-Obstétrique	1.37	226
Neurochirurgie	3.99	774
Neuroradiologie interventionelle	2.21	523
ENT / ORL	1.79	308
Orthopedics	1.62	298
Emergency surgery	1.59	340

Data quality

HL7 Seringue électrique

MSH|^~\&|||||20230302121534||ORU_R01^ORU_R01|35939031|P|2.6|||AL|NE||UNICODE UTF-8|||IHE_PCD_001^IHE PCD^1.3.6.1.4.1.19376.1.6.1.1.1^ISO
PID|||^^^Hospital^PI||^^^^^L||19540725|F
PV1|1||BLOCS BMT^BO 11^BO 11^LARIBOISIERE
OBR|1|||69986^MDC_DEV_PUMP_INFUS_VMD^MDC|||20230302121528
OBX|15||69986^MDC_DEV_PUMP_INFUS_VMD^MDC|1.2.0.0||||F|||F
OBX|16||69987^MDC_DEV_PUMP_INFUS_CHAN^MDC|1.2.1.0||||F|||F
OBX|17|NM|157836^MDC_PRESS_FLUID_MEAS^MDC|1.2.1.157836|0|266016^MDC_DIM_MMHG^MDC|||||R|||20230302121528||||
OBX|18|NM|157772^MDC_TIME_PD_FLUID_DELIV_SINCE_START^MDC|1.2.1.157772|173.50|264352^MDC_DIM_MIN^MDC|||||R|||20230302121528||||
OBX|19|NM|157888^MDC_VOL_FLUID_DELIV_TOTAL_SET^MDC|1.2.1.157888|308.842|263762^MDC_DIM_MILLI_L^MDC|||||R|||20230302121528||||
OBX|20|NM|157860^MDC_VOL_FLUID_BOLUS^MDC|1.2.1.157860|0.00|263762^MDC_DIM_MILLI_L^MDC|||||R|||20230302121528||||
OBX|21|NM|157864^MDC_VOL_FLUID_DELIV^MDC|1.2.1.157864|197.87|263762^MDC_DIM_MILLI_L^MDC|||||R|||20230302121528||||
OBX|22|NM|157924^MDC_RATE_DOSE^MDC|1.2.1.157924|0.00|265650^MDC_DIM_MILLI_G_PER_KG_PER_HR^MDC|||||R|||20230302121528||||
OBX|23|NM|157760^MDC_CONC_DRUG^MDC|1.2.1.157760|10.00|264306^MDC_DIM_MILLI_G_PER_ML^MDC|||||R|||20230302121528||||
OBX|24|ST|184508^MDC_PUMP_STAT^MDC|1.2.1.184508|Stopped|262656^MDC_DIM_DIMLESS^MDC|||||R|||20230302121528||||
OBX|25|ST|67293368^NOM_SETT_PUMP_MODE^MDC|1.2.1.184508|Off|||F|||F
OBX|26|NM|157776^MDC_TIME_PD_FLUID_STANDBY^MDC|1.2.1.157776|0|264320^MDC_DIM_SEC^MDC|||||R|||20230302121528||||
OBX|27|ST|184468^MDC_DRUG_NAME_POINTER^MDC|1.2.1.184468|Propofol|262656^MDC_DIM_DIMLESS^MDC|||||R|||20230302121528||||

JSON Kafka

{
    "ward": "BLOCS BMT",
    "bed": "BO 11",
    "pump_station": "08131023162171X",
    "mstimestamp": 1677759192000,
    "syringes": {
        "2": {
            "volume": "308.842",
            "volume_unit": "MDC_DIM_MILLI_L",
            "rate": "56",
            "rate_unit": "MDC_DIM_MILLI_L_PER_HR",
            "drug": "Propofol"
        }
    }
}

HL7 Orbis / ICCA

MSH|^~\&|Philips.CIS.CDS.MMS^LRB-SRVICCA-P02.wprod.ds.aphp.fr^DNS||||20230302121645||ADT^A01|1201136574|P|2.4
EVN|A01|20230302121645
PID|||8014666679^^^Philips.CIS.ADT^MR~472701483^^^Philips.CIS.ADT^VN||DUPONT^JEAN||19770509000000|F||^^HL70005|||||^^HL70296|^^HL70002|^^HL70006|||||^^HL70189
PV1||II|BLOC CENTRAL^^BO 11||||||||||||||||472701483||||||||||||||||||^^HL70114

JSON Kafka

{
    "timestamp": "20230302103451",
    "event_type": "A01",
    "mci": "1122880539",
    "ipp": "8006013664",
    "ddn": "19860506000000",
    "source": "Philips.CIS.ADT",
    "nom": "DUPONT",
    "prenom": "JEAN",
    "sexe": "M",
    "nda": "318974215",
    "clinicalunit": "BLOC CENTRAL",
    "bedlabel": "BO 11"
}

Transformation Example

Patient identification for Syringe Pumps

JSON Kafka

```
{
        "WARD": "BLOCS BMT",
        "PUMP_STATION": "08131023162171X",
        "TIMESTAMP": 1677749137000,
        "SYRINGES": {
                "2": {
                        "volume": "308.842",
                        "rate_unit": "MDC_DIM_MILLI_L_PER_HR",
                        "volume_unit": "MDC_DIM_MILLI_L",
                        "rate": "56",
                        "drug": "Propofol"
                }
        },
        "IPP": "8016793253",
        "NDA": "",
        "NOM": "DUPONT",
        "PRENOM": "JEAN",
        "DDN": 19860506000000,
        "SEXE": "M"
}
```
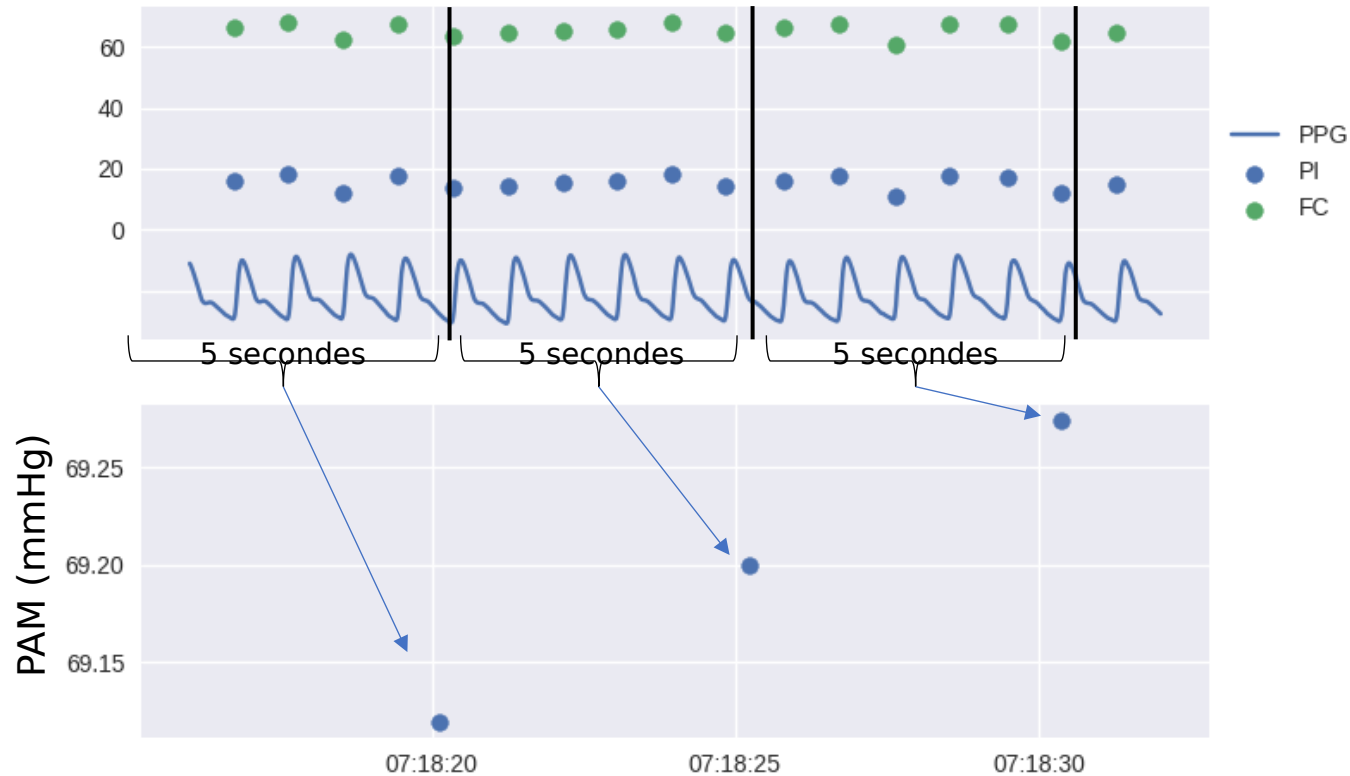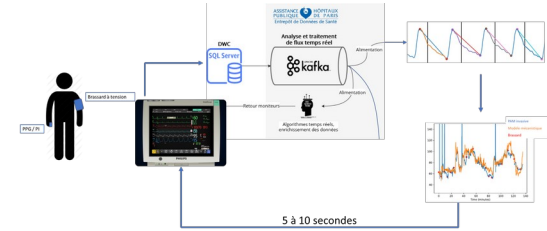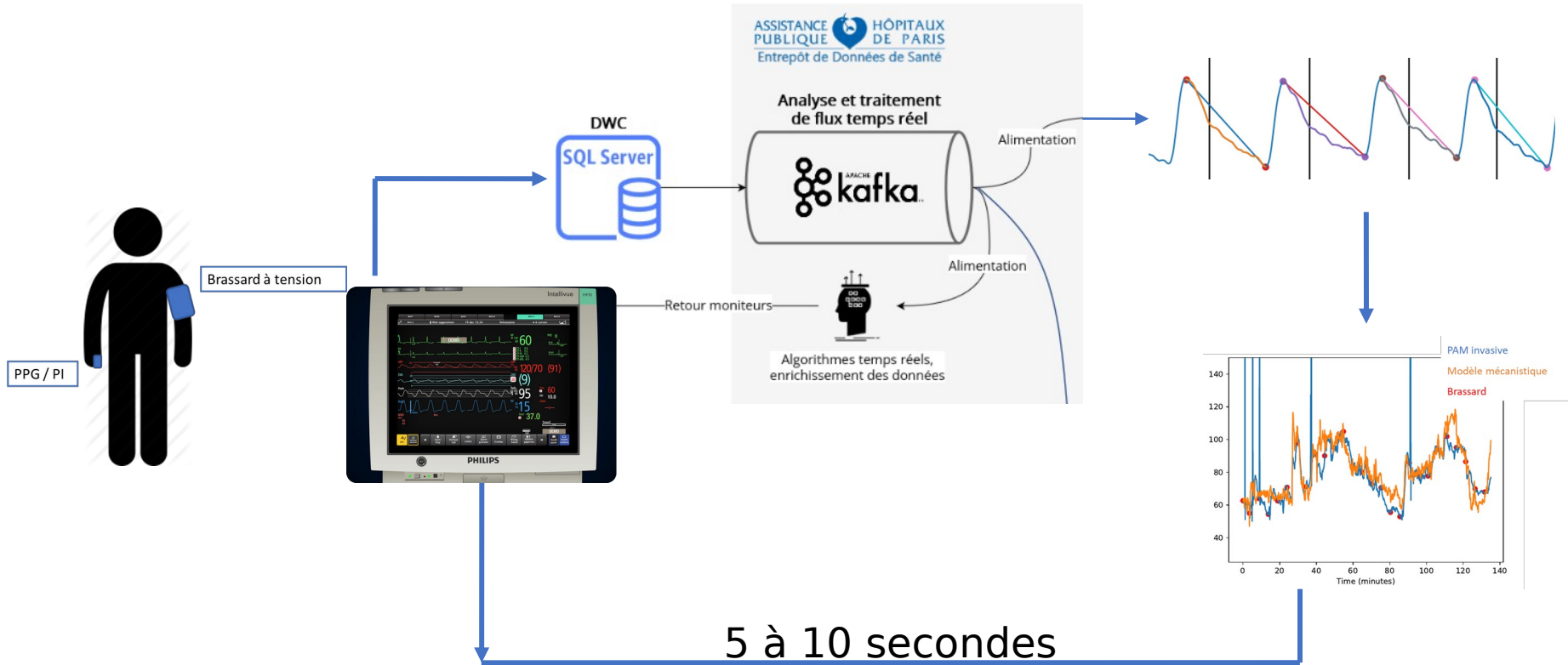
Database

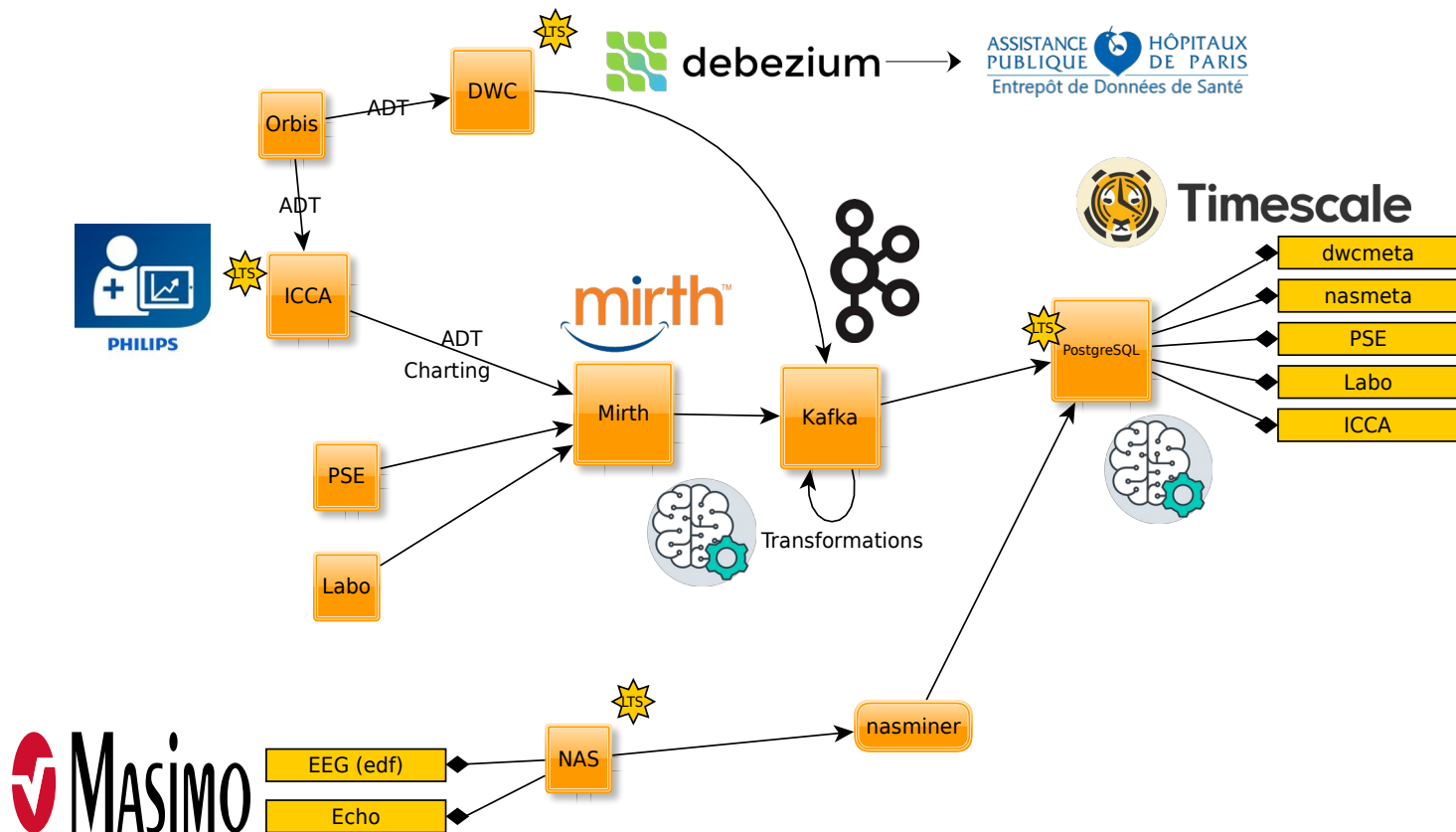| TIMESTAMP timestamp without time zone	CLINICALUNIT text	BEDLABEL text	PUMP_STATION text	SYRINGEID text	DRUG text	RATE real	VOLUME real	IPP text
2023-02-28 10:14:22	BLOCS BMT	BO 11	08131023162171X	1	seringue1	16	26.462	8016793253
2023-02-28 10:14:22	BLOCS BMT	BO 12	08131019146069X	4	seringue4	64	99.123	8005701706
2023-02-28 10:14:22	BLOCS BMT	BO 11	08131023162171X	2	Propofol	59	139.598	8016793253

Real time predictions

Real time data flow

Data Platform @Lariboisière

100% based on open source technology