

# St. Petersburg R&D Center Introduction



A composite image of Earth and the Moon in space. The Earth is shown as a large, curved horizon with a bright blue atmosphere, set against a dark, star-filled background. The Moon is visible in the upper left quadrant, appearing as a smaller, dark sphere. The text "IT Storage Compression" is overlaid in the center in a white, sans-serif font.

# IT Storage Compression



# Who we are: Team, organization & business

## The team

- Aleksei Romanovskii, PhD (2+ years in Huawei) : expert in enterprise storage, compression, embedded SW for mobile, 3D real-time graphics, compilers
- Vladimir Sosnin, PhD (12+ months in Huawei) : experienced researcher in areas of networks and virtualization
- Ilya Papiev, MS (15+ months in Huawei) : highly qualified professional in storage architecture, algorithms analysis and performance engineering
- Nikita Yatskovets (6+ months in Huawei): new team member, expected to deliver high impact results, student of the Peter the Great St. Petersburg Polytechnic University

## Organization

- IT Algorithm Research Dept, Hangzhou

## Business

- Huawei Enterprise storage products
  - Huawei OceanStor Dorado AFA storage
- Huawei virtualization SW stack
  - FusionCompute





# What we have been doing (some examples)

- **Lossless data reduction algorithms for block storage**
  - LZX compression algorithm – 47% improved decompression speed, up to 17.9% better CR vs previous achievements (improvements are dataset dependent), integrated in product
  - Network QoS for server virtualization software - has only a 5% inaccuracy of achieving target throughput as compared to 22% inaccuracy , research
  - Other algorithms
- **Plans, innovations and ideas**
  - Storage tiering algorithms for AFA, cloud to improve data reduction, IO balancing, durability, and to decrease TCO
  - Optimization of link flow control for inter-controller communication in distributed system Huawei Hyper Metro
  - Other ideas



Web Engine



# Web everywhere

In Vehicle Infotainment systems



Modems and routers UI



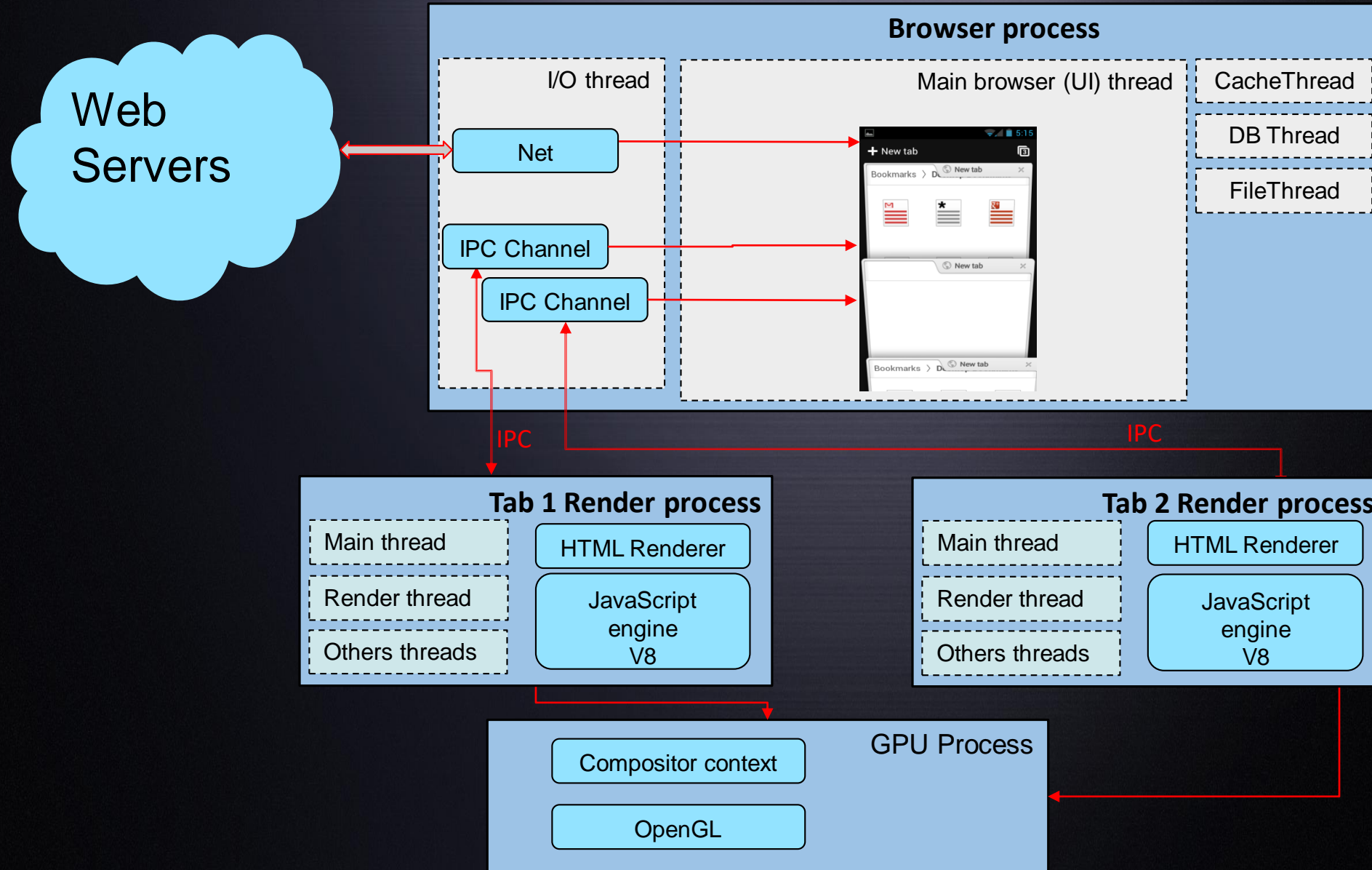
HTML5-based Cloud Office



Progressive WebApps



# Web Browser high level architecture





# Optimizations for modern Huawei phones

Modern Huawei phone specification:

Chipset: Kirin 970 with NPU

4xCortex A73 2.36 GHz + 4xCortex A53 1.8 GHz

RAM: 6 GB

ROM: 128 GB

Even for this mobile phone, optimizations of WebEngine are still required to get better performance and lower power consumption





A composite image of Earth and the Moon in space. The Earth is shown in the foreground, with a bright blue atmosphere and a dark, cratered surface. The Moon is visible in the background, appearing as a smaller, dark sphere. The text "Machine-oriented Video Processing" is overlaid in white, sans-serif font across the center of the image.

# Machine-oriented Video Processing

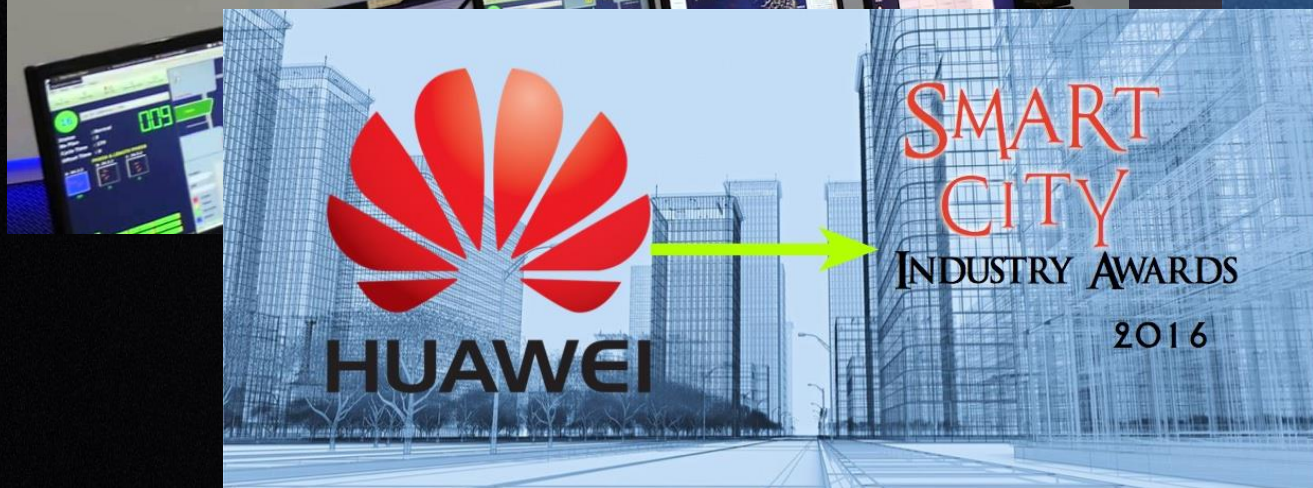


# Applications

*Smart video surveillance systems*

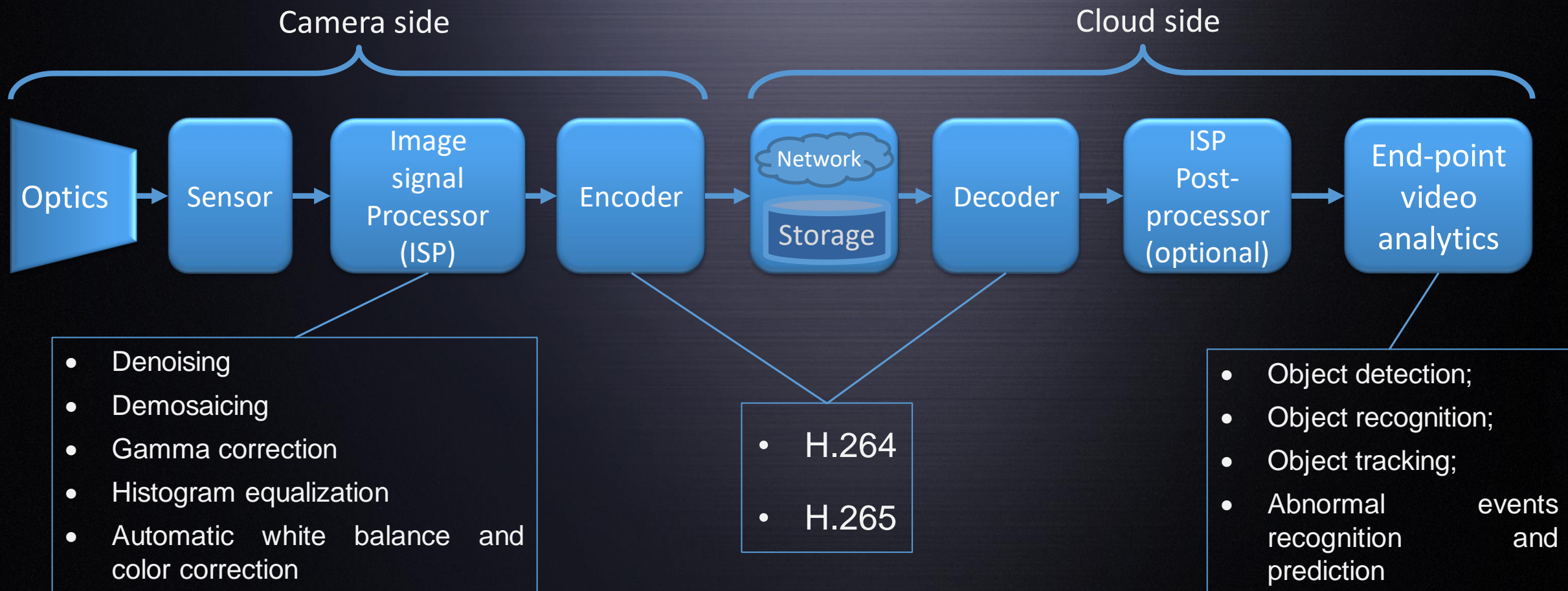


*Computer vision in ADAS*





# Typical Video Processing Pipeline





# Challenges

*Super high resolution (4K/8K)*

The machine can recognize images that far exceed the human eye's ability (small face recognition requires 20x20 pixels / face)



*Extreme weather (rain, fog, snow)*



*Low light conditions*

*Low illumination*



*Strong backlight striking*

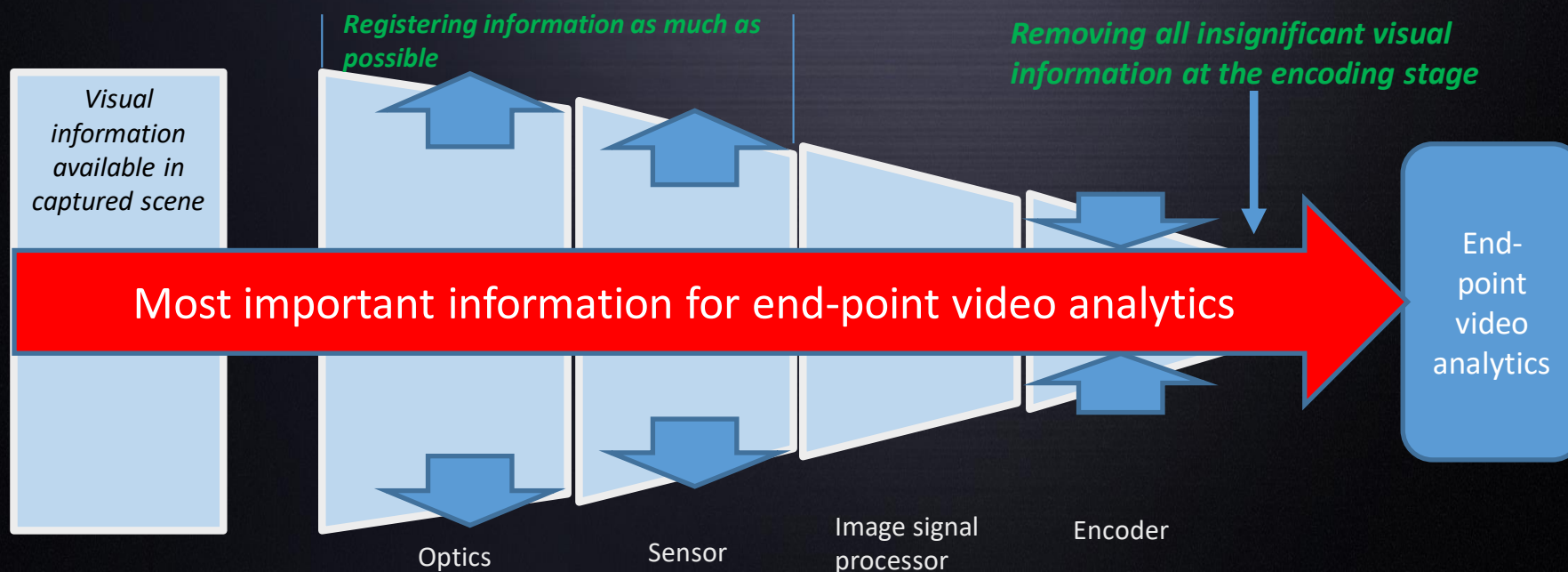
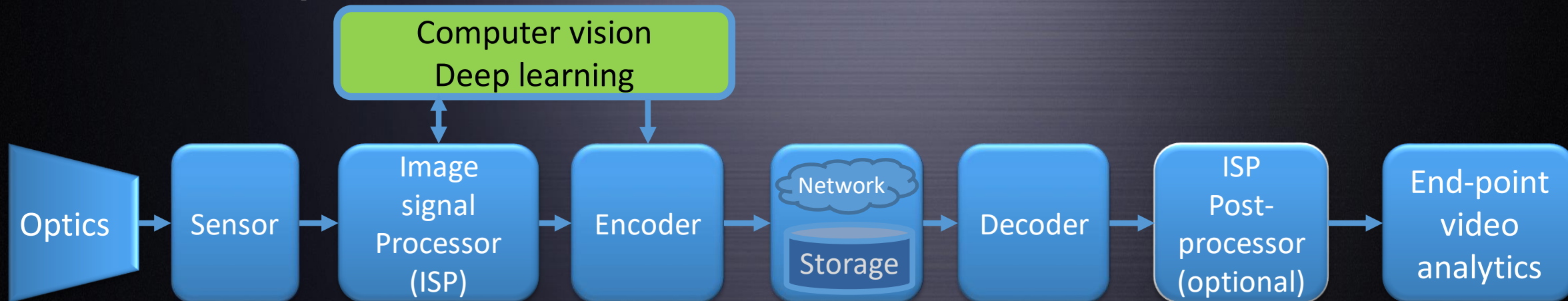


*Object-of-interest light striking*





# New concept: Machine-oriented video





# Methods used in solution

## Image signal processing

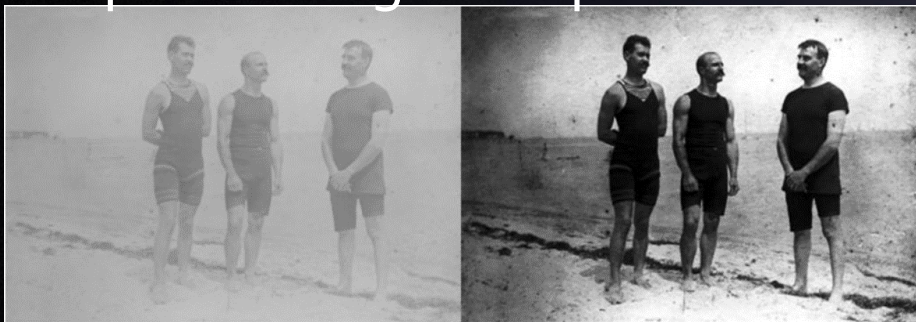
Dehazing



HDR data processing



Adaptive histogram equalization



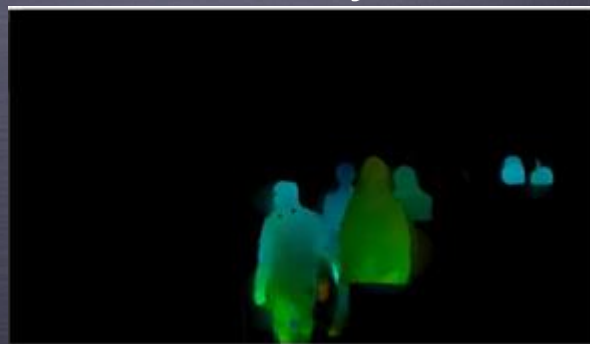
Machine-oriented demosaicing



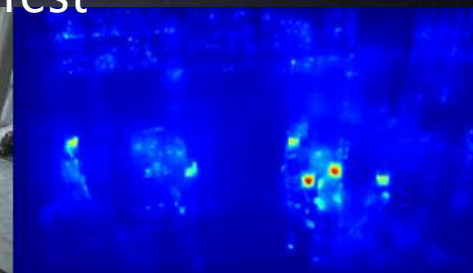
# Computer vision methods

## at the camera side

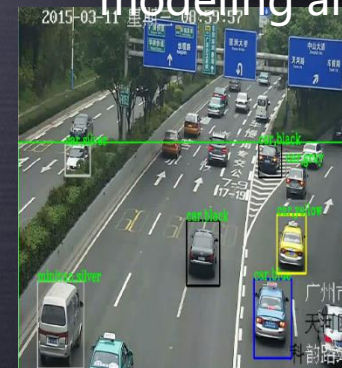
Motion analysis



Automatic detection of regions-of-interest



Intelligent background modeling and compression

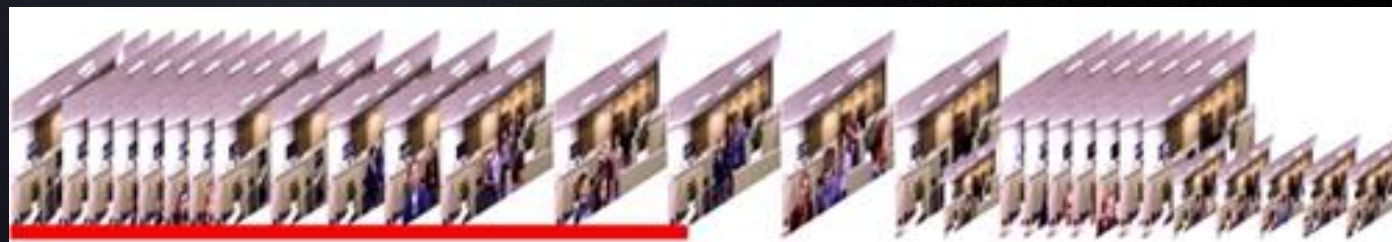


Only process valuable video data

- ❑ No coding and transmission for static background
- ❑ Save bandwidth and storage space

## Intelligent video compression

Frame-rate adaptation Resolution adaptation





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AI Algorithm for mobile

# We develop new technologies



**Artificial Intelligence**



**Algorithm**



**Operation System**



**5G link**



**Voice Engine  
(ASR/NLP)**



**UX**



**AR/VR**



**Bigdata**



# We invent 1<sup>st</sup> NPU embedded AI platform

## HUAWEI Kirin 970

The World's First Smartphone AI Computing Platform with a Dedicated **NPU**



### Leading Process Technology

10nm Process Technology



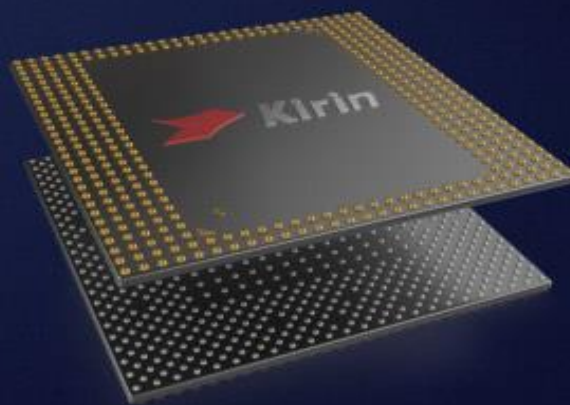
### Mobile AI Computing NPU

Up to 25x performance  
Up to 50x power efficiency



### High Performance 8-Core CPU

4xA73 @2.4GHz  
4xA53 @1.8GHz



### High Efficiency 12-Core GPU

First-to-Market  
Mali G72MP12



### Advanced Dual ISP

4-Hybrid Focus  
Low-light & Motion Shooting

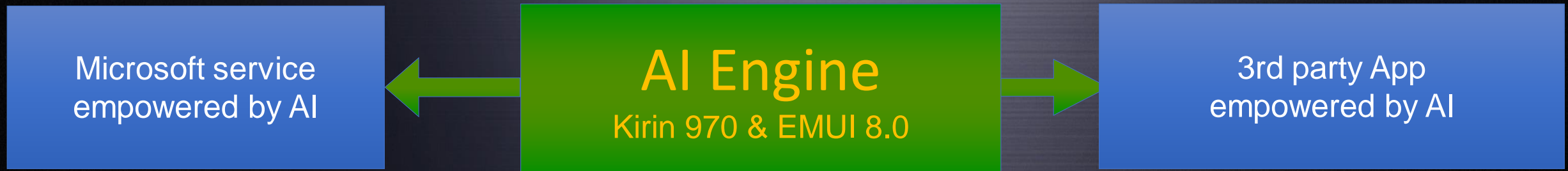


### Ultra-Fast 4.5G LTE Modem

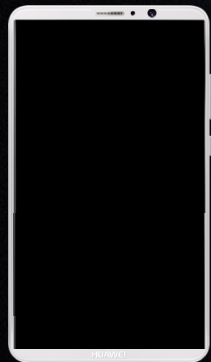
4.5G LTE Cat.18 up to  
1.2Gbps Download speeds



# Ultimate Performance Powered by AI



In-house



AI + Speed

Ultimate Speed

AI + Power

Ultimate Power

AI + Leica

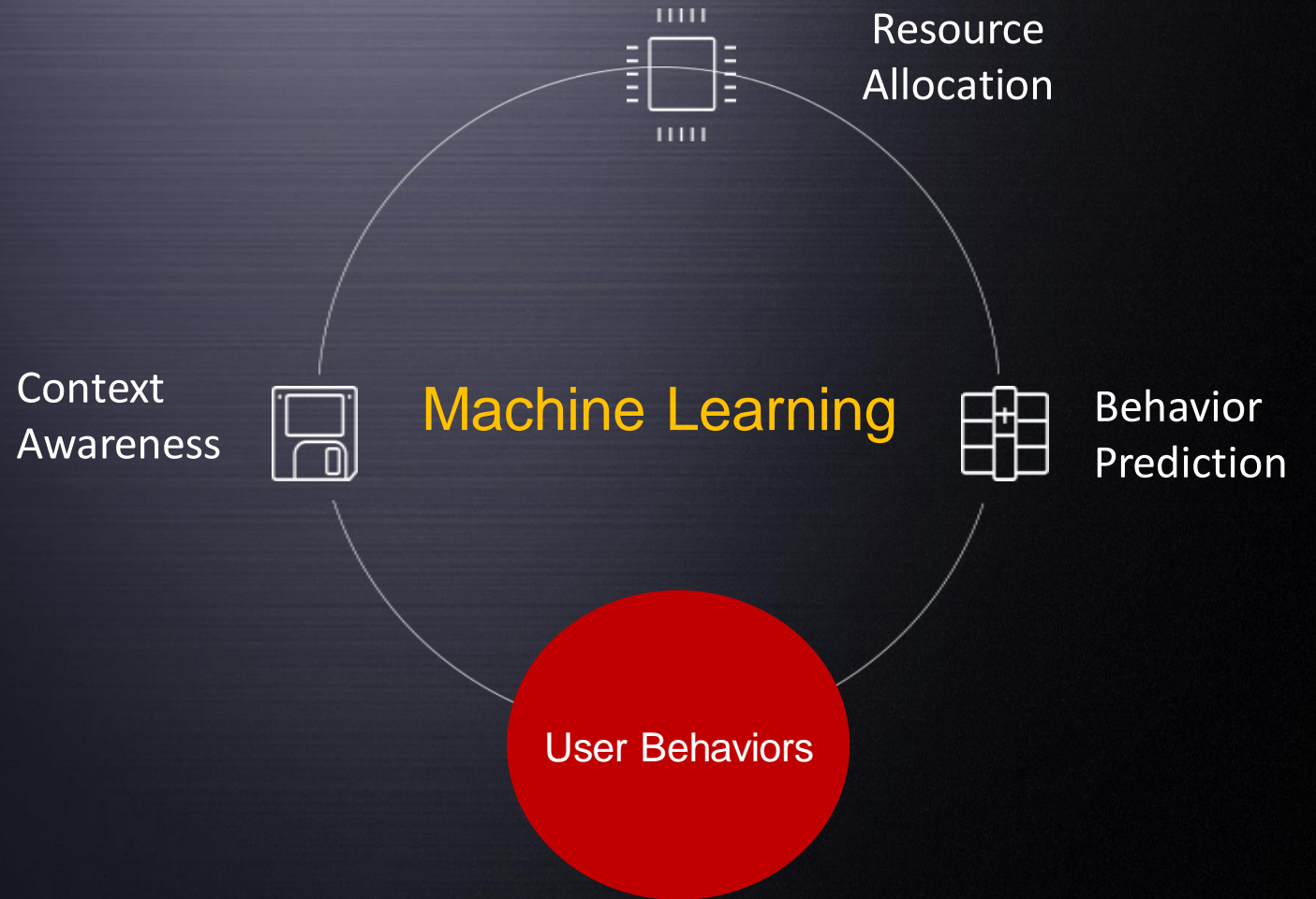
Intelligent Camera





# The Next Level of AI Optimization

Behavior-driven AI technology



# Big Data Training

More than 100 millions photos are learned  
Recognize the character of different scenes  
and objects





# 13 types of scenes and objects recognition



Blue Sky



Flower



Plant



Beach



Sunset/Sunrise



Performance



Food



Text



Nightscape



Snow



Cat



Dog



Portrait

On device object recognition &  
image enhancement





# Snapshot with AI Motion Detection





Shooting  
Sample



Mate 10



S8



# On device AI: Accurate, real-time, safe but big challenge because of resource limitation

## 智能感知



### Camera

See wider, more clear, faster



### Microphone

Hear more clear, more detail

## 精准认知



### Where are you

Recognize user's scenarios: Home? Driving?  
Conference? Restaurant?



### Who are you

Recognize user's interest, hobby, occupation,  
or some other information



### What are you going to do

Recognize user's intention: movie? order ticket?  
Table reservation? Listen music?

## data protection



Private information



configuration

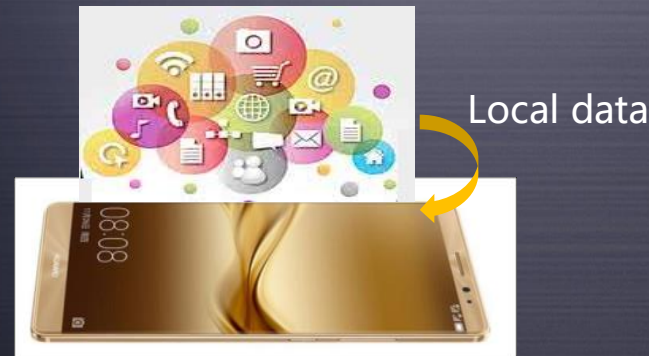


Real-time



Low power consumption

## On device learning



Accurate Portrail real-time

safe



## ■ On device learning:

Create and train the module on mobile rather than AI on cloud to protect user data security and to provide real time reaction

## ■ Challenge:

Limited data: small amount samples, hard to get characteristics of user

Limited storage: only small model can be used in mobile phone

Limited computing resource: need low complexity algorithm to save computing resource and power

# Computer vision for mobile

- Face recognition;
- Image semantic segmentation;
- Video understanding;
- OCR;
- Image quality enhancement;

# NLU for mobile



# Why Huawei?

Top 1 ICT provider & top 3 smartphone vendor

Leading technologies research

Interesting topics and huge influence

Top experts and professional team

Open environment for research

Contact:

[zengjiancheng@huawei.com](mailto:zengjiancheng@huawei.com)

+79214312250