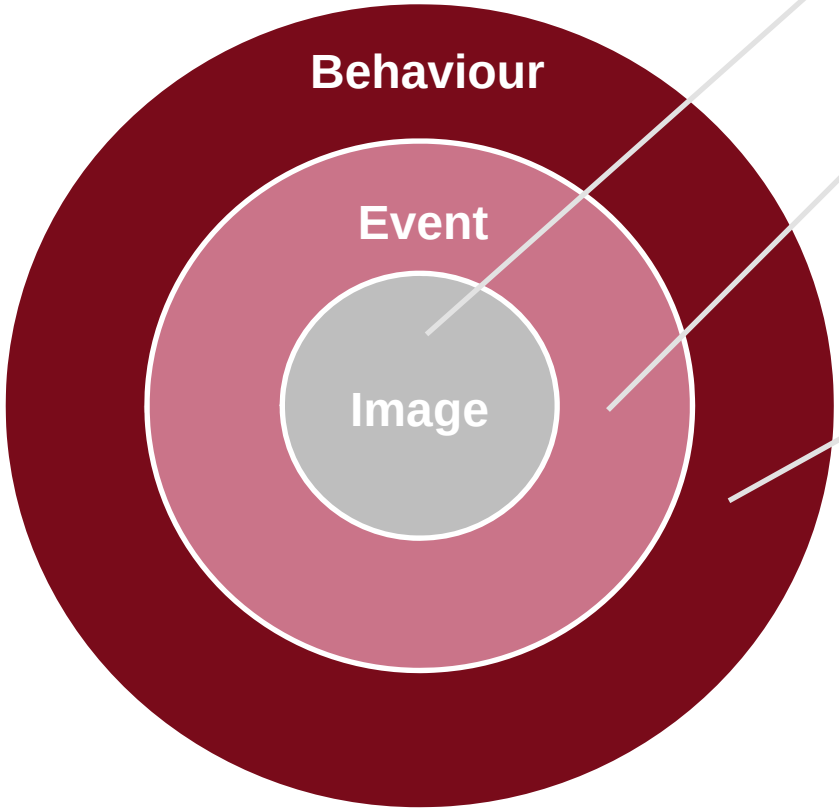
AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

Next Generation Video Surveillance

Innovations and solutions

Reasons for video surveillance…

…pose different requirements on technical level



Image

- Person identification
- Vehicle Identification
- ….

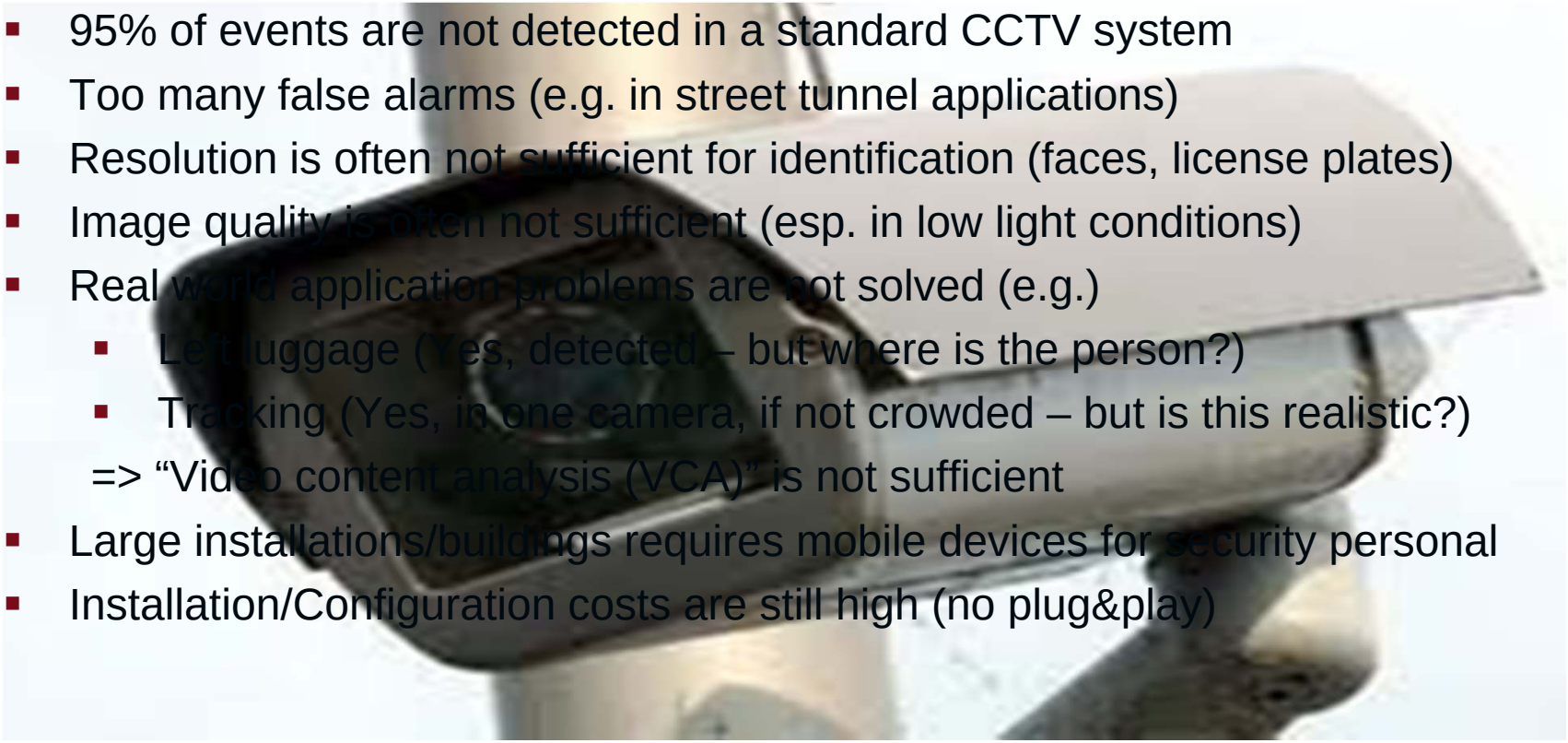
Events

- Intrusion
- Fire
- Panic
- Vandalism
- …

Behaviour

- Left luggage
- Tracking
- Counting/Traffic Analysis
- …

Motivation - Why today‘s surveillance systems may fail ?

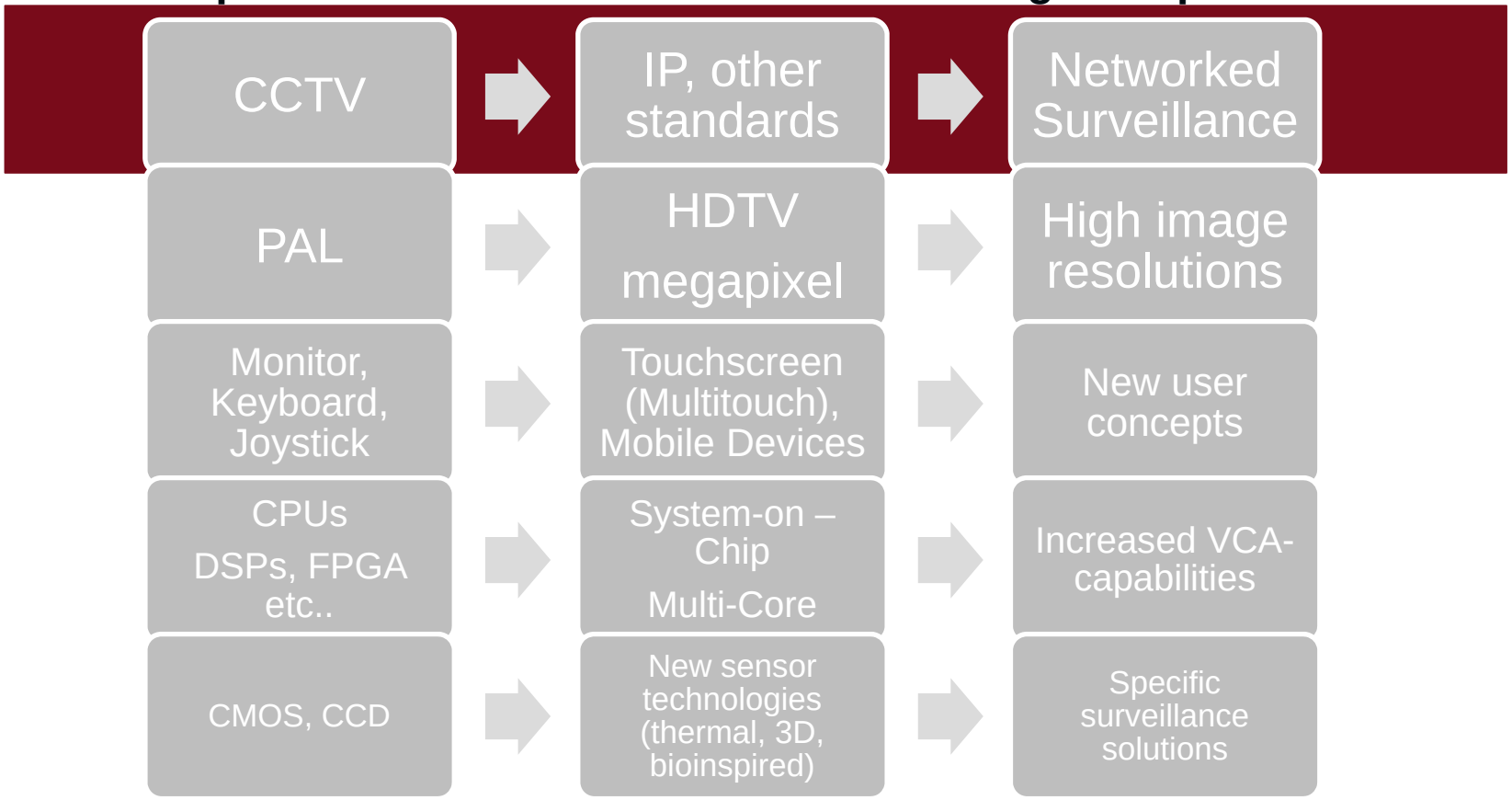


- 95% of events are not detected in a standard CCTV system
- Too many false alarms (e.g. in street tunnel applications)
- Resolution is often not sufficient for identification (faces, license plates)
- Image quality is often not sufficient (esp. in low light conditions)
- Real world application problems are not solved (e.g.)
  - Left luggage (Yes, detected – but where is the person?)
  - Tracking (Yes, in one camera, if not crowded – but is this realistic?)

  => “Video content analysis (VCA)” is not sufficient
- Large installations/buildings requires mobile devices for security personal
- Installation/Configuration costs are still high (no plug&play)

Main Statements

Disruptive Innovations lead to new technologies/capabilities



Transmission - Systembalancing

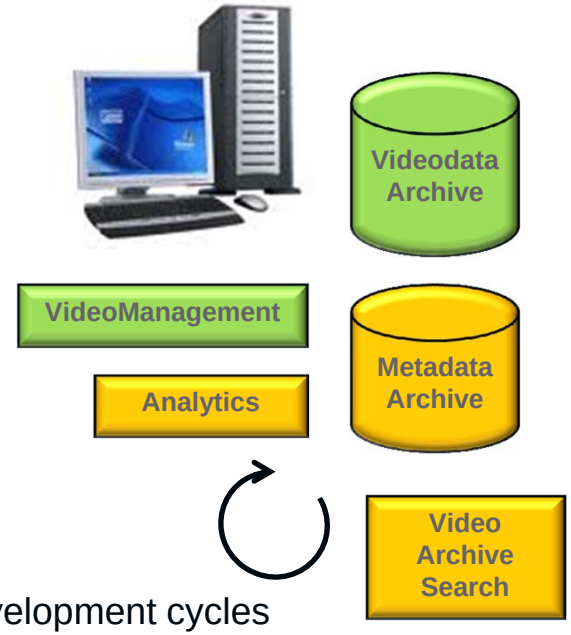
Where to do the storage/analytics ?

Camera/Encoder | **Transmission** | **Client/Server**

Analytics

- proprietary
- standard
- only events
- metadata

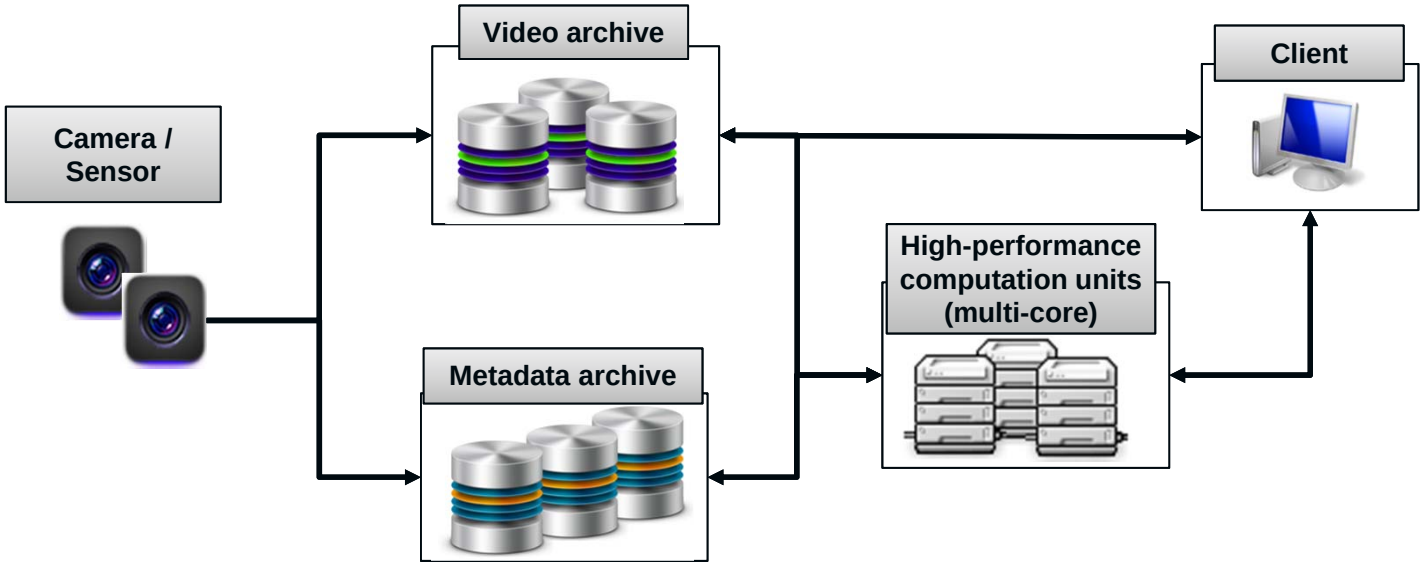
PSIA, ONVIF



- difficult, slow (=> expensive) development
- limited performance
+ intelligent device: works standalone
+ cheap
+ embedded = reliable

+ faster development cycles
+ fast update cycles
- VCA on compressed data (no raw data available)
- single point of failure

Future M2M (Machine-2-Machine) Architecture



Future M2M Architecture – Ways2Go

- Standards !
  - IP – telephony, TV, distributed business solutions – Plug & Play
  - PSIA – ONVIF --- Only first step!
    - ONVIF has 800 conformant products (May, 11th; 2011)
- Open Networks - Cloud-Computing – Hosted Video - Hosted Services
  - IT-Security
  - IT-Reliability
  - Privacy
    - Legal and Social Issues

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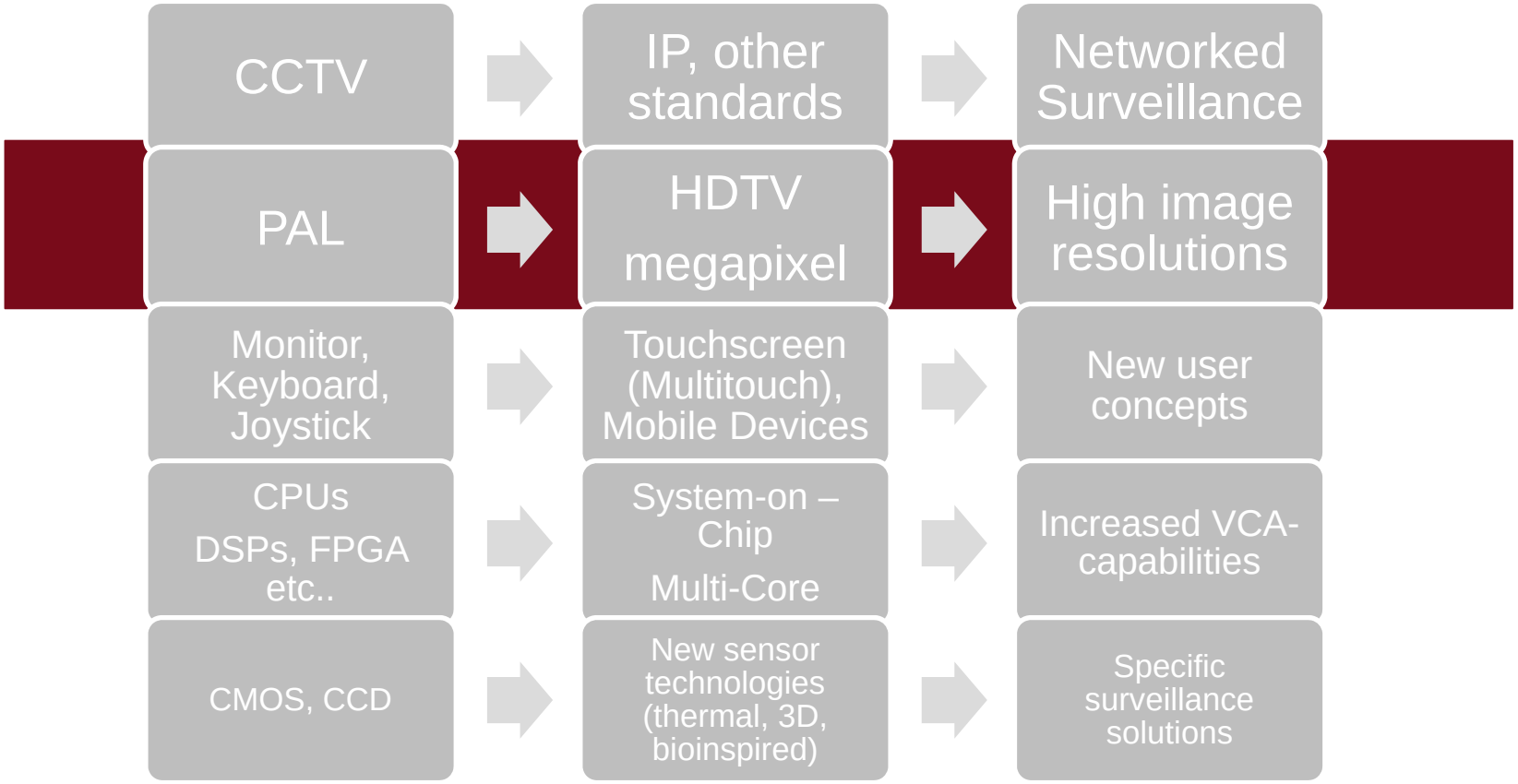
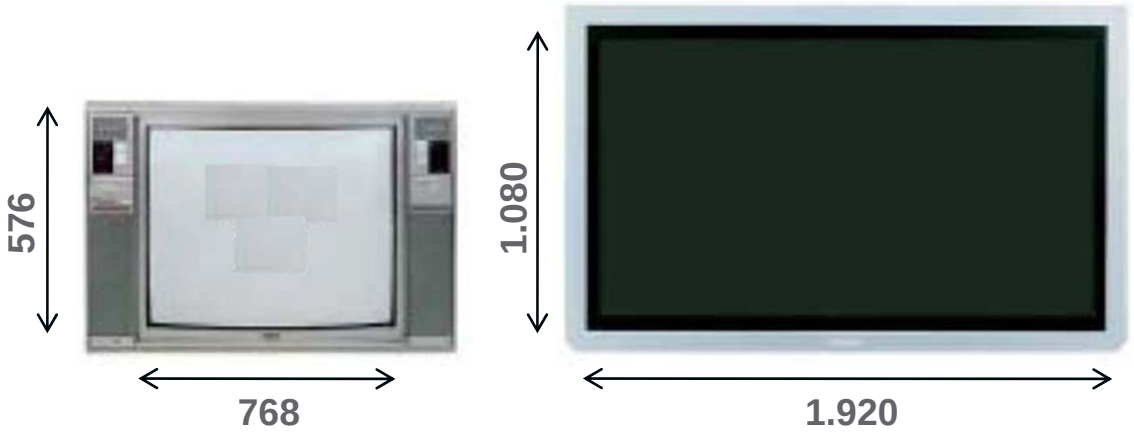


PAL => HDTV, Megapixel

	PAL	720p	1080p
Resolution	576 x 768	720 x 1.280	1.080 x 1.920
Pixels per image	442.368	921.600	2.073.600
Pixels per s	11.059.200	46.080.000	62.208.000
Frequency	50 Hz (interl.)	50 Hz (progr.)	60 Hz (progr.)
Format	4:3	16:9	16:9



Multiplication of data volume:

Capturing
Encoding
Transmission
Storage
Visualization

High video resolution leads to data explosion

Dataexplosion Videodata

1 Zetabyte (10^{21}) in 2010

1000 and more videos (live - and hours in the archive)

Large installation (1000 – 10.000) cameras

Operator miss 95% of the events after 20 min. due to information overflow

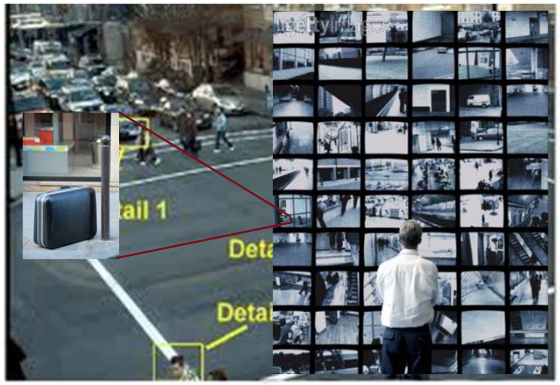
intelligent interactive Video Content Analysis

Intelligent interpretation of pattern

From „data“ to „information“ using economical systems

Who, What, Where, When, Why ?

Interactive Situation



Q&A:

„Where is the person that left the luggage now?
Which person was close to the yellow car?“

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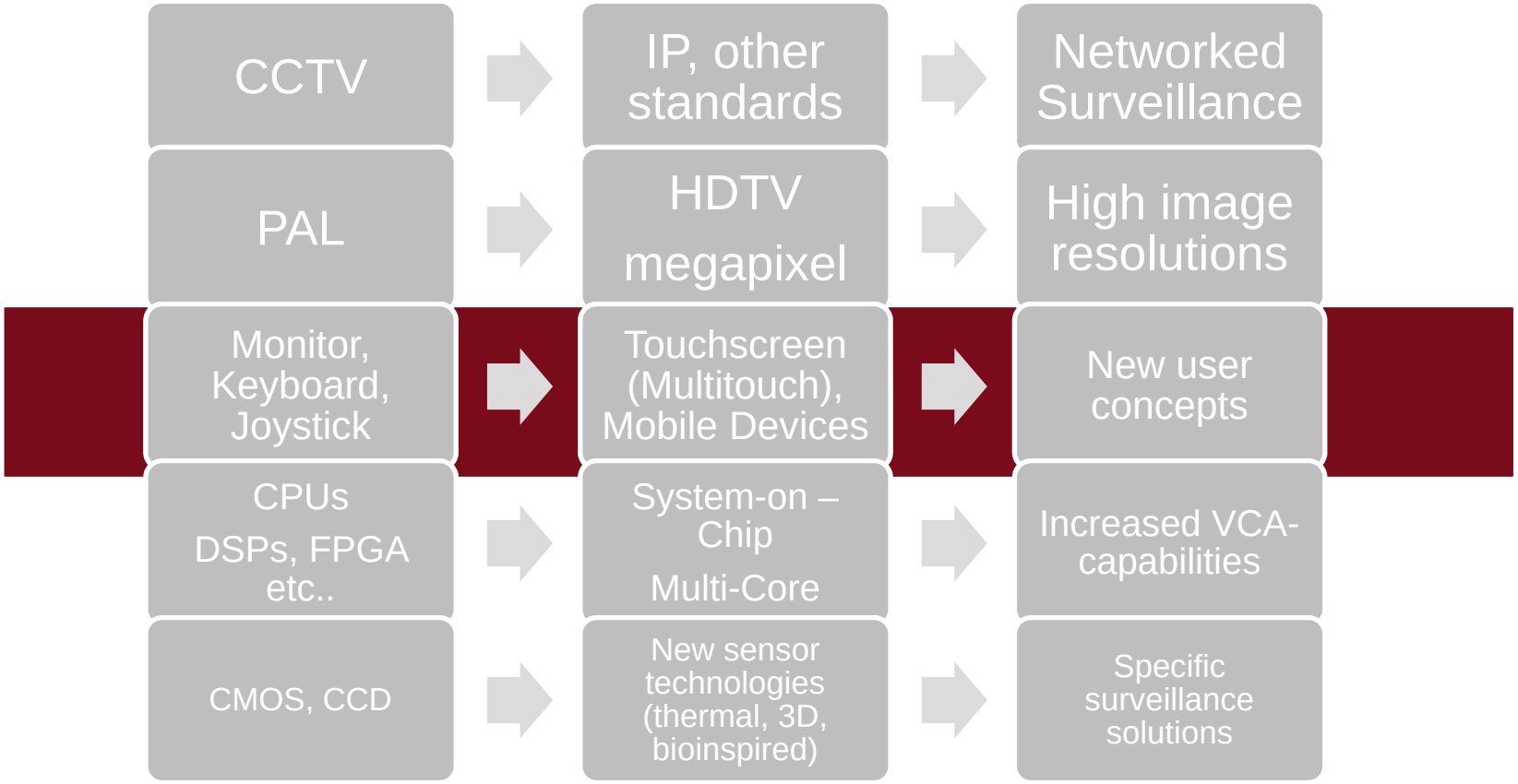
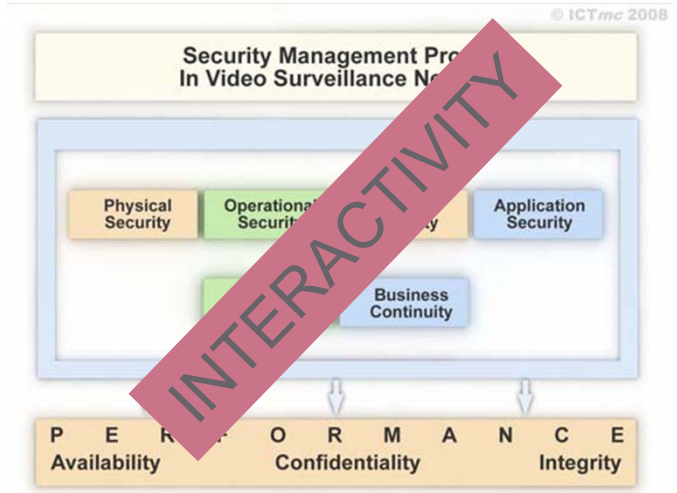


New devices (mobile devices, tablets), New interfaces

Touch, gesture; language

G-speak/Der Standard

…lead to new concepts/processes etc...



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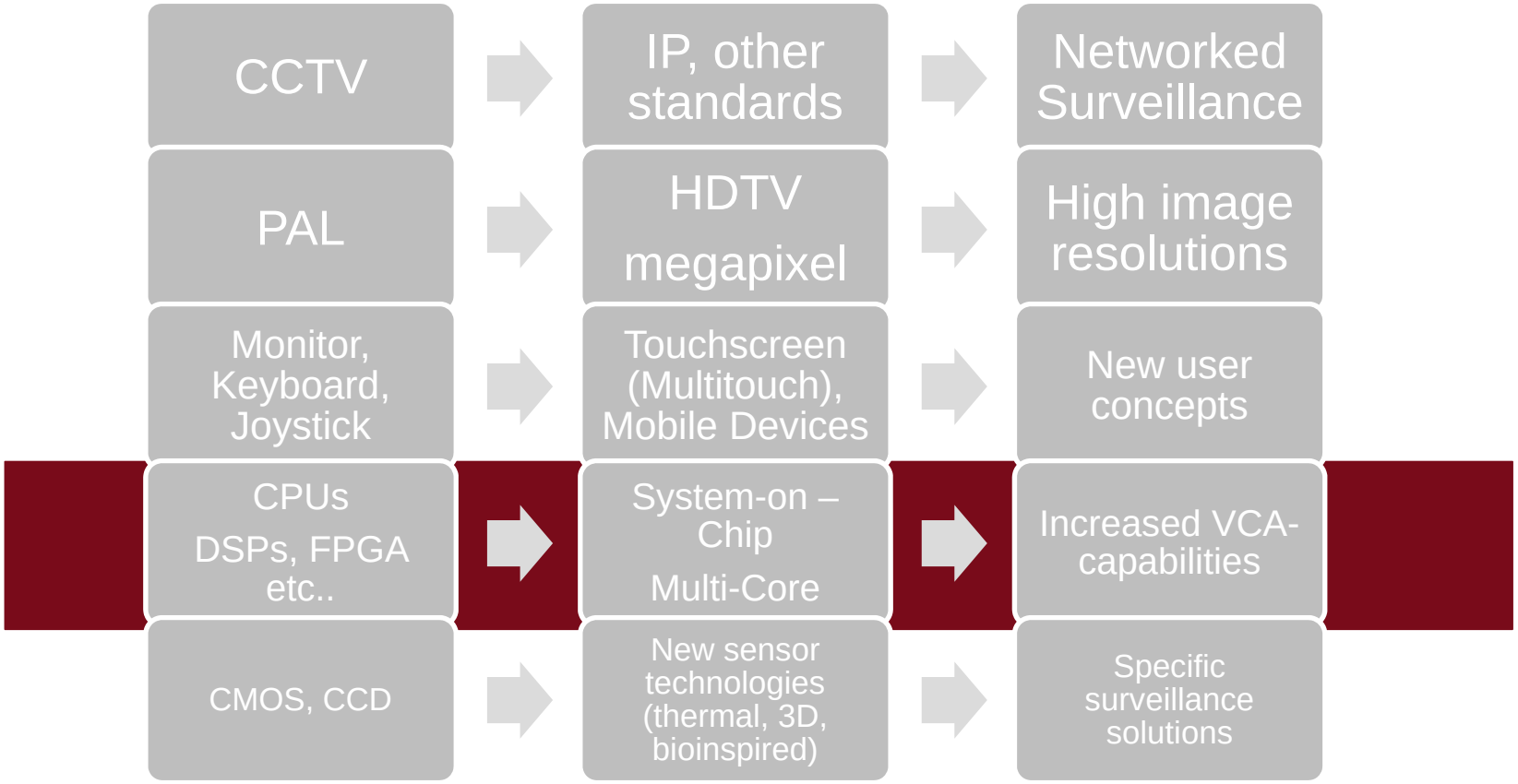
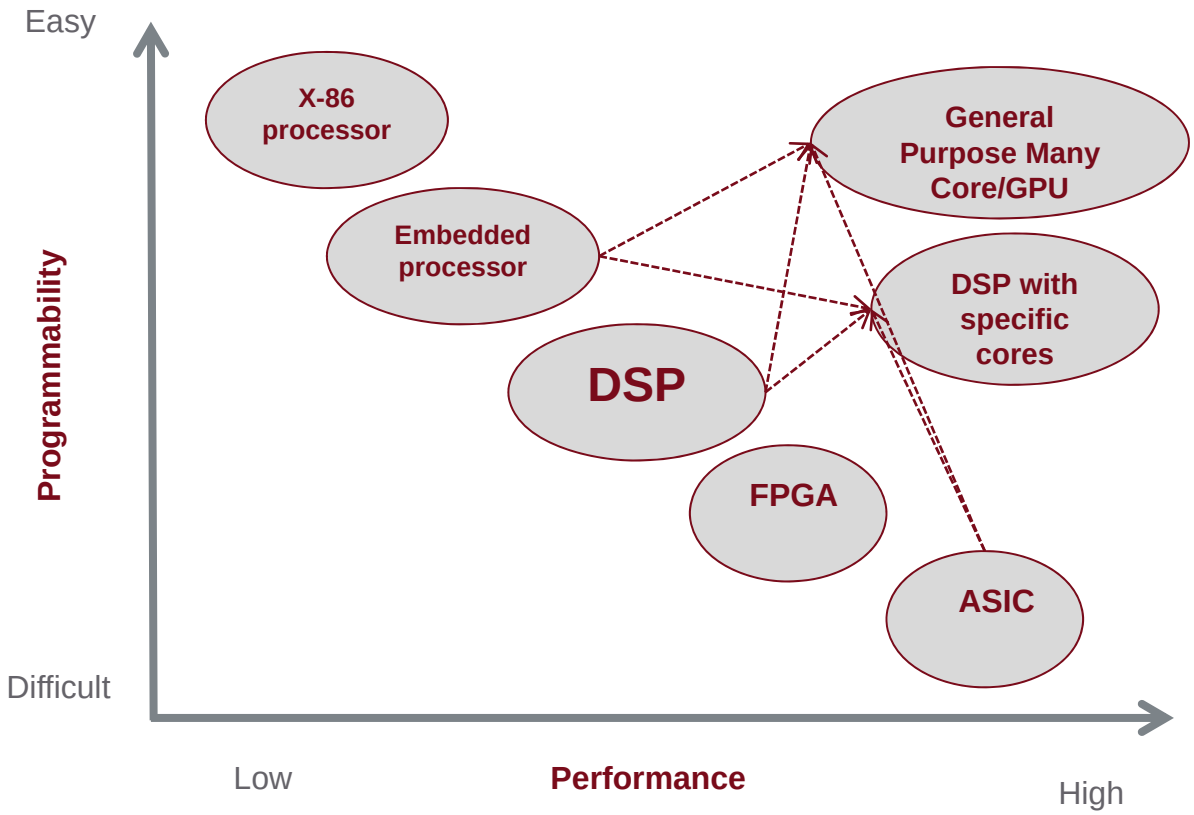
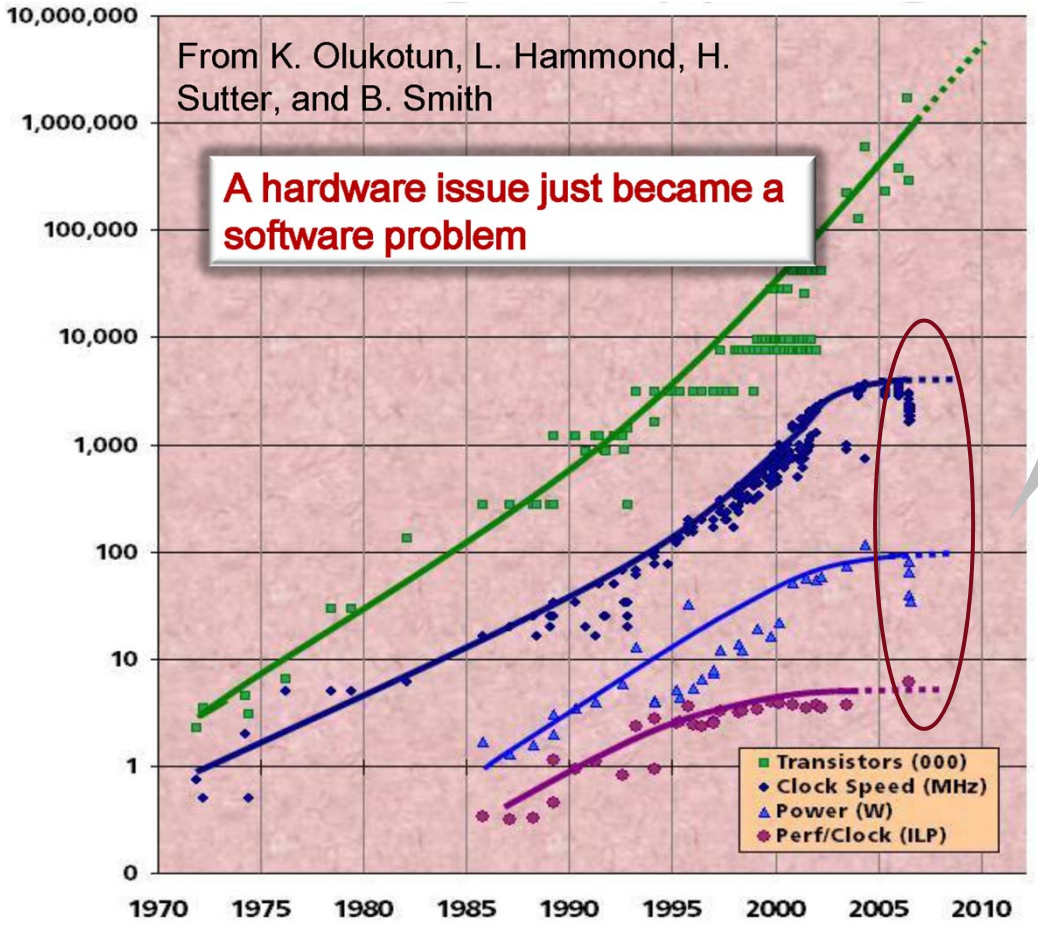


Processor Landscape



Processors - MultiCore Driving Forces - Technology



- **Power Wall**
  - Power = C x V^2 x f
  - f prop. V → P prop. V^3
  - Reduce frequency and Voltage
- **ILP (Instruction Level Parallelism) Wall**
- **Memory Wall**

The only known way to overcome this dilemma is parallelism!

MultiCore Scaling Trends

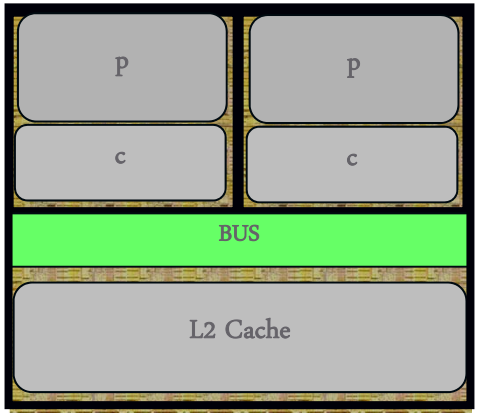
Today

A few large cores on each chip

Diminishing returns prevent cores from getting more complex

Only option for future scaling is to add more cores

Still some shared global structures: bus, L2 caches

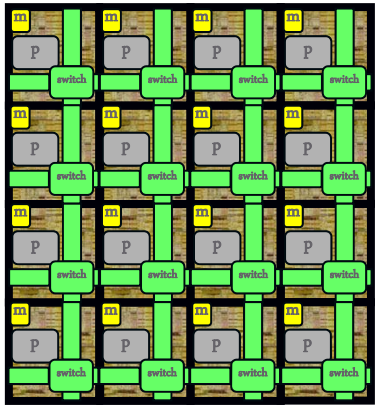


Tomorrow

100's to 1000's of simpler cores
[S. Borkar, Intel, 2007]

Simple cores are more power and area efficient

Global structures do not scale; all resources must be distributed

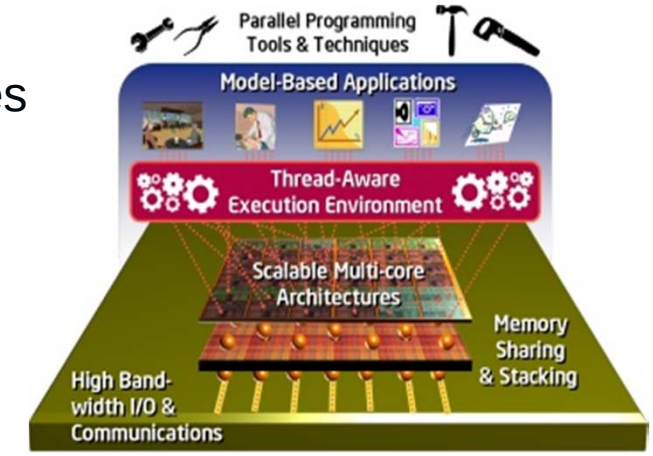


	2003	2005	2007	2009	2011	2013	2015	2017
Technology Node (nm)	90	65	45	32	22	16	11	8
Integration Capacity	2	4	8	16	32	64	128	256

MultiCore Challenges

MultiCore can close the “Moore’s Gap” - parallelism is the key for growing performance → a new business modell, but …

- Scalability
  - Architectures that grow easily with each new technology generation
  - How do we turn additional cores into additional performance?
- Programming
  - Traditional parallel programming techniques are hard
  - Parallel machines were rare and used only by rocket scientists
  - Multicores are ubiquitous and must be programmable by anyone

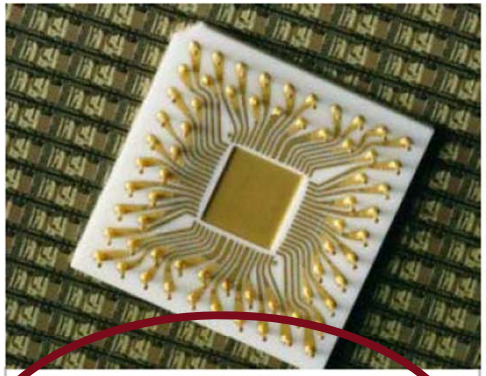


VCA - Factors that influence VCA

3 Key Variables that Influence Success

Environmental Factors

- Indoor/Outdoor
- Camera Angle
- Distance
- Lighting/WDR/etc
- Activity Level



Computational Factors

- Processing Power
- Real-time vs post-processing

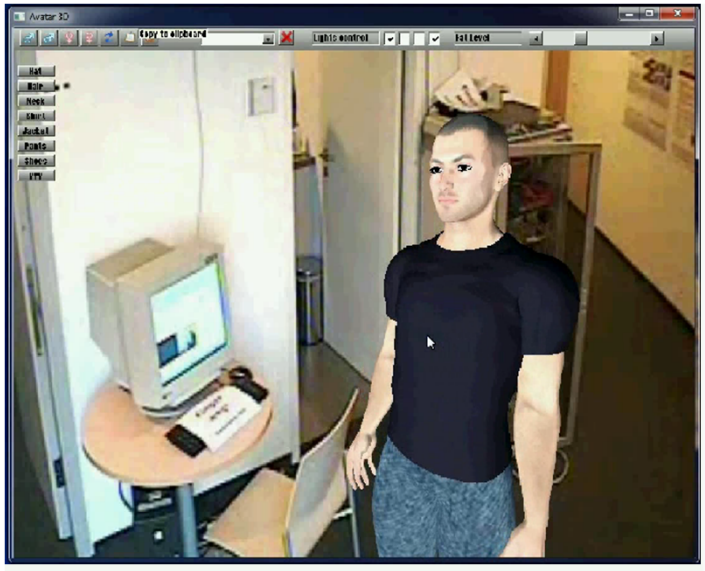
VMS Integration

- GUI
- Reporting
- Alerting

Ref.: Aimetis, J.Schorn (CEO)

Advanced Video Content Analysis

- Appearance-based algorithms need processing power – Parallelism is possible
- Search and retrieval processes are naturally interactive
- Multi-camera approaches for full coverage



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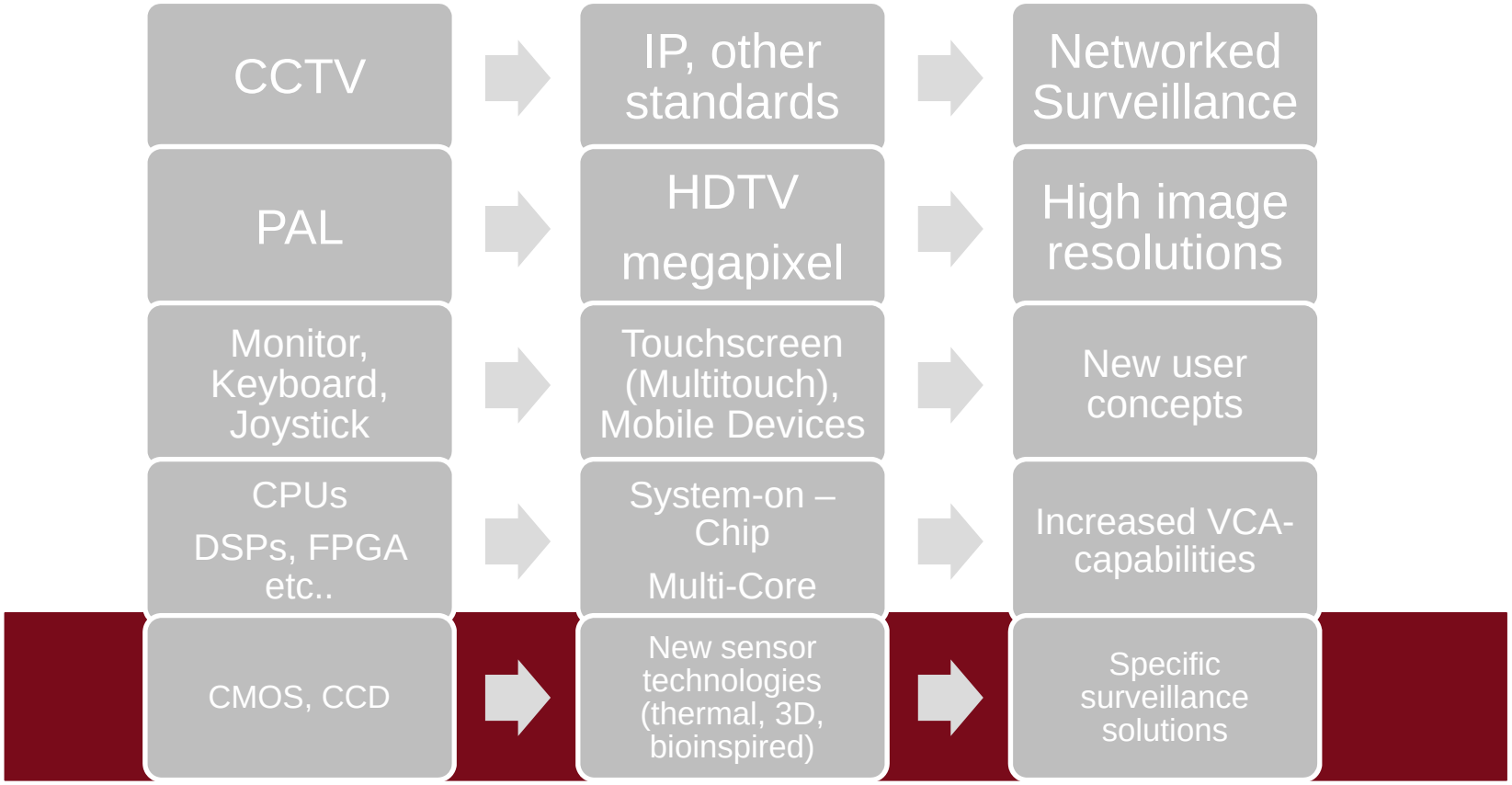


New (camera) sensor technologies

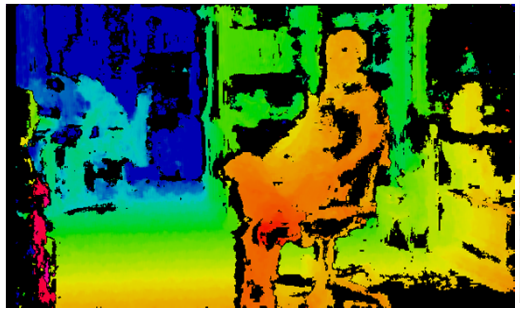
- CCD and CMOS show incremental improvements
- Radical changes can be seen for other sensors - examples
  - Thermal: uncooled sensors with **price drop** from sizes of 250k€ to 5k€
  - Stereo and Time-of-flight technology: **3D-vision**
  - Event-based sensors: **combination of low-light, high-speed and privacy**

Thermal sensors

- Uncooled sensors dropped prices into reasonable level for broad application
- Main benefit: Increased „visability“ especially in low-light conditions

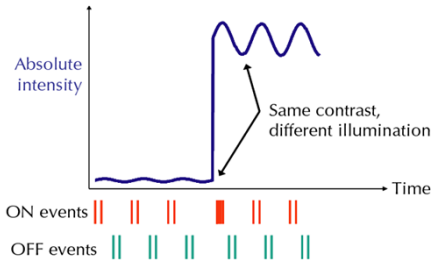
3D Vision – Stereo/Time-of-Flight

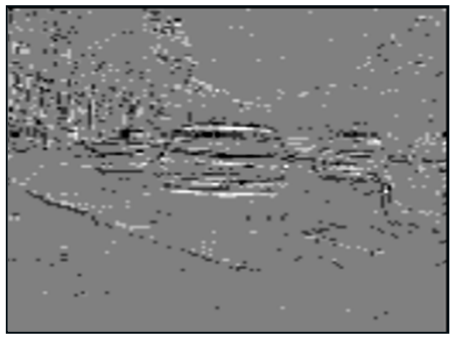
- Depth information – technically described as 2½ D
  - Two cameras with certain distance (base-line)
  - One Time-of-Flight camera using active illumination (PMD)
- Visual information is more reliable
  - Foreground/background segmentation
  - Shadows/Motion

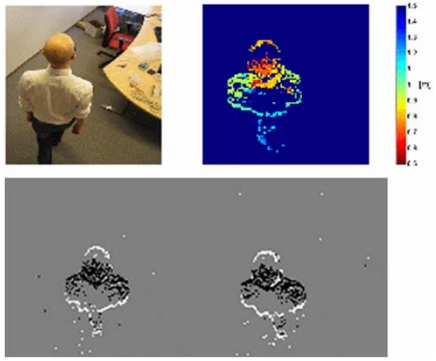



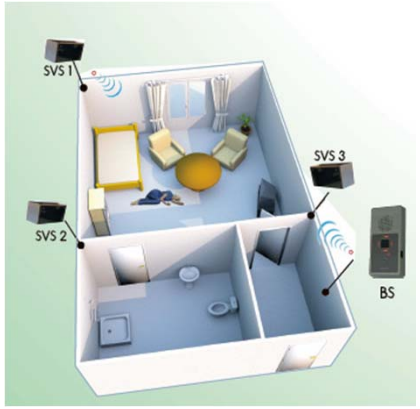

Event-based sensors

- Event = change of light in a pixel is signalled
- Instantan (few µs) not frame-based
- In every pixel (locally independent – high sensitivity)
- No image details => Privacy-by-design









Main Statements

Disruptive Innovations lead to new technologies/capabilities

Summary – The Outlook

Disruptive Innovations lead to new technologies/capabilities
New technologies/capabilities lead to Next Generation Surveillance Systems

Intelligent Vision Systems
Video Content Analysis for
SITUATION ASSESSMENT

From	**Videotransmission**	to	**Situation Awareness**
From	watching	to	interaction
From	alarming	to	decision support
From	data overflow	to	information access
From	inflexible architecture	to	distributed services

AIT Austrian Institute of Technology

your ingenious partner

DI. Dr. Markus Clabian

Business Development

Safety & Security Department

AIT Austrian Institute of Technology GmbH

Donau-City-Straße 1 | 1220 Vienna | Austria

T +43(0) 50550-4294 | M +43(0) 664 8157890 | F +43(0) 50550-4150

markus.clabian@ait.ac.at | http://www.ait.ac.at