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Energy- and Size-efficient Ultra-fast Plasmonic Circuits for Neuromorphic Computing Architectures

Deliverable D7.4
PlasmoniAC video presentation

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*) PU = Public ;PP = Restricted to other programme participants (including the Commission Services) ; RE = Restricted to a group specified by the consortium (including the Commission Services) ; CO = Confidential, only for members of the consortium (including the Commission Services)

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Abstract

This report gives an overview of the PlasmoniAC video presentation as a tool for project promotion and dissemination material within WP7.

Keywords

Communication, Dissemination, Video, website

Table of Contents

List of Abbreviations

BTO	Barium Titanate
DEMUX	Demultiplexer
InP	Indium Phosphide
KPI	Key Performance Indicator
MUX	Multiplexer
PhC	Photonic Crystal
ReLU	Rectified Linear Unit
SiOC	Silicon Oxycarbide
WDM	Wavelength Division Multiplexing
WP	Work Package

1 Executive Summary

This document presents information regarding the official PlasmoniAC project video presentation, it's content, purpose, visual appearance and targeted audience. It includes the screenshots of the relevant content, video description and narrated text.

2 Introduction

2.1 Purpose of this document

The objective of this deliverable is to present the official PlasmoniAC video presentation, as well as its targeted audience and reach, in a view of KPIs set out in the Grant Agreement, Annex 1, Part B.

2.2 Document structure

The present deliverable is split into following major chapters:

- PlasmoniAC video overview
- PlasmoniAC video narration
- Announcements

2.3 Audience

This document is public.

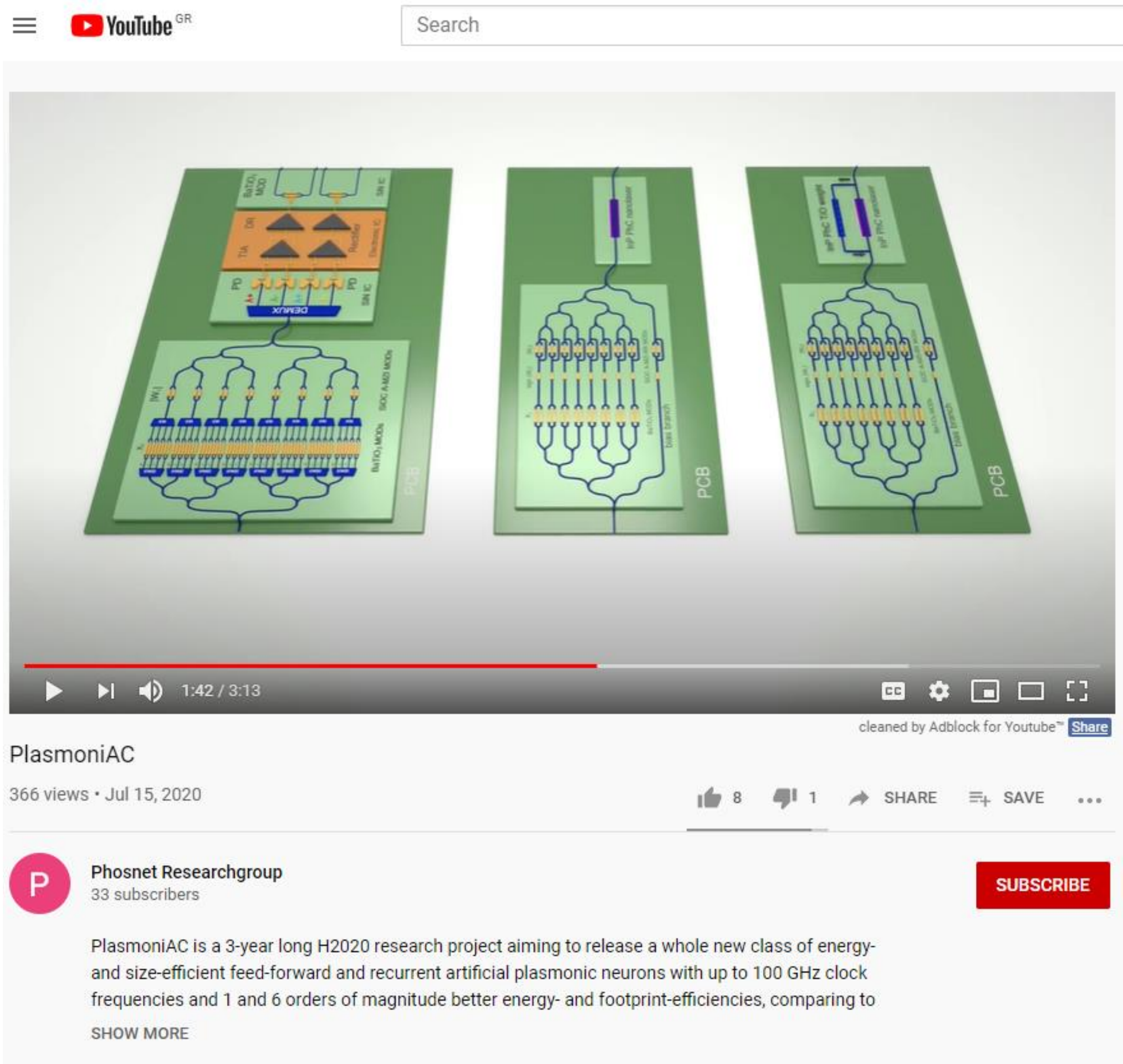
3 PlasmoniAC video overview

The official PlasmoniAC video presentation, which can be found at:

https://www.youtube.com/watch?v=8pM-TJ_977Y

and in the homepage of the PlasmoniAC official webpage, http://plasmoniac.eu/,

aims at summarizing the project's vision and objectives in an easy-to-understand manner, placing them into the context of the modern information age needs, but also focusing on the key technical details of the project.



The diversity of the targeted audience, including policy makers, MPW service providers, research & education community, private sector, related projects & initiatives, and, finally, general public, shaped the video such that it offers all relevant information in a restricted timeframe of 3:13, increasing the chances for the audience to stay engaged from the beginning until the end of the video.

As of August 26th, the number of views stands at **368**, which is **73.6% of the KPI** (>500) set out in GA, Annex 1, part B.

3.1 Video description

The following *description* has been added to the video:

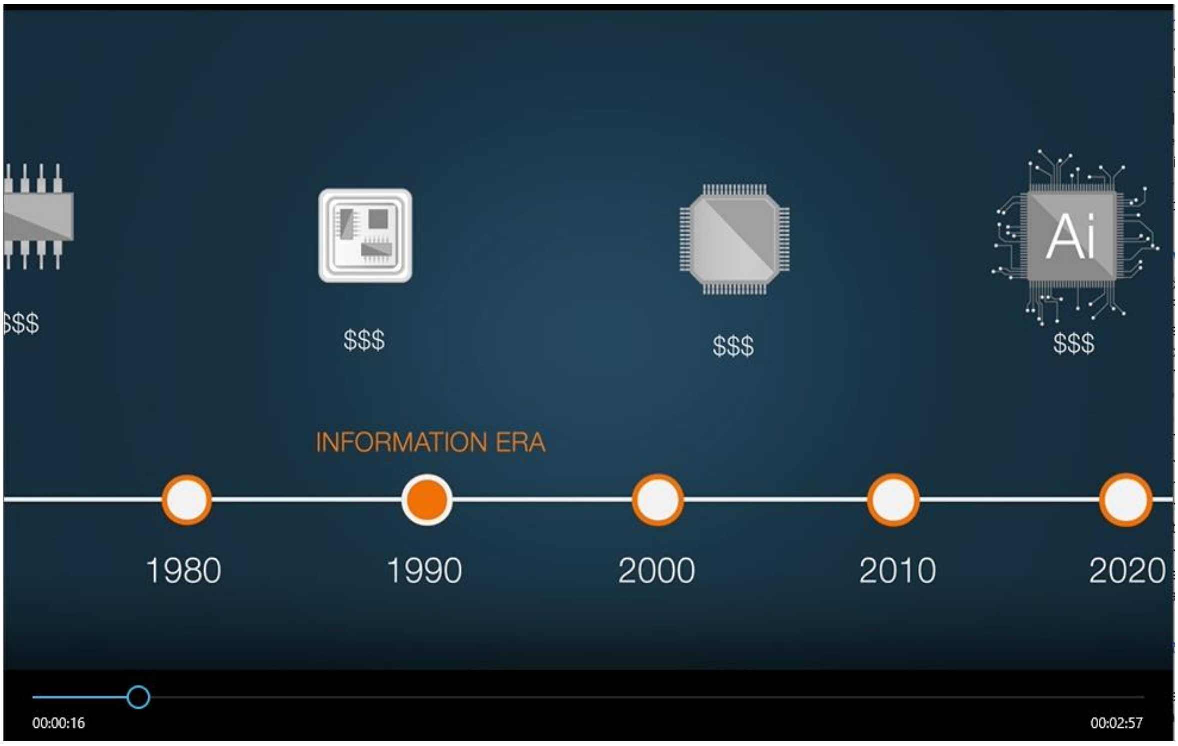
"PlasmoniAC is a 3-year long H2020 research project aiming to release a whole new class of energy- and size-efficient feed-forward and recurrent artificial plasmonic neurons with up to 100 GHz clock frequencies and 1 and 6 orders of magnitude better energy- and footprint-efficiencies, comparing to the current electronics-based state-of-the art. It adopts the best-in-class material and technology platforms for optimizing computational power, size and energy at every of its constituent functions, harnessing the proven high-bandwidth and low-loss credentials of photonic interconnects together with the nm-size memory function of memristor nanoelectronics, bridging them by introducing plasmonics as the ideal technology for offering photonic-level bandwidths and electronic-level footprint computations within ultra-low energy consumption envelopes. In a holistic hardware/software co-design approach, PlasmoniAC will follow the path from technology development to addressing real application needs by developing a new set of DL training models and algorithms and embedding its new technology into ready-to-use software libraries.

To learn more, visit:

www.plasmoniac.eu"

3.2 Video presentation

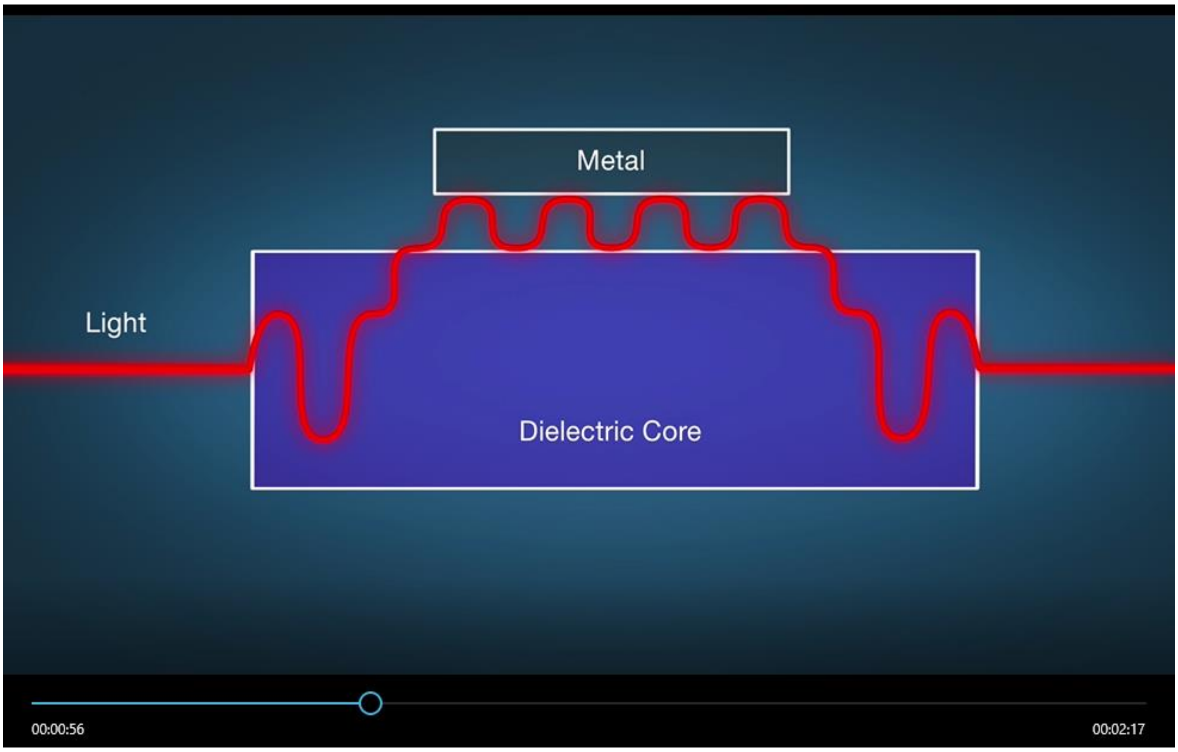
PlasmoniAC video starts with a timeline, symbolically covering the development of integrated circuits, highlighting the beginning of the information era and graphically representing the important implications of Moore's law.



The story continues with the focus on the information overflow and the urgent need for efficient data processing approaches. The scene shows some of the modern-day data sources, as well as the approximate amount of data generated within a minute, focusing on the number of number of emails and messages sent (270 million), the number of video-hours watched (6.7 million), the number of log-ins/views/swipes/scrolls on social media (6.3 million), the amount of money spent on online shopping (1.1 million dollars) and the number of search requests (4.1 million).

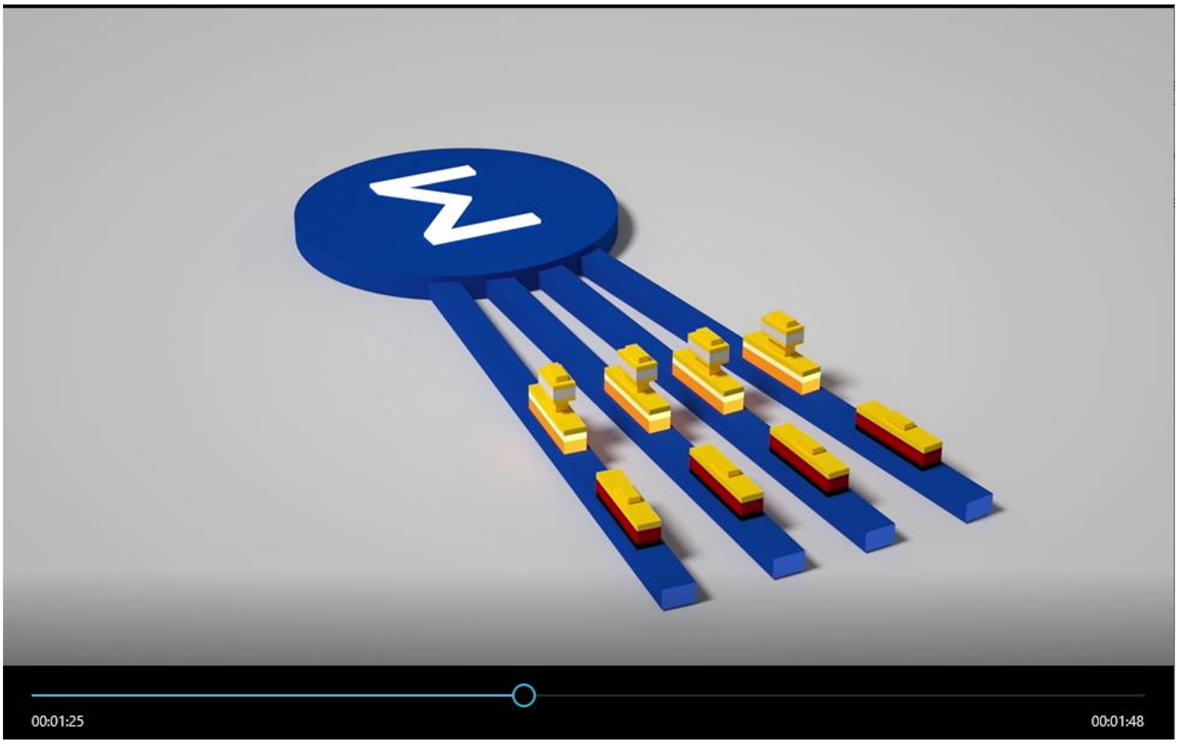
Brain is introduced as the most efficient machine known to the human kind and the viewer is exposed to the underlying concept of artificial intelligence, focusing on a custom neuromorphic hardware, inspired by biological neural cells.

The final introductory scene reveals the potential that plasmonic carries in blending photonic bandwidths with nano-sizes of electronics for boosting the energy and footprint efficiency.

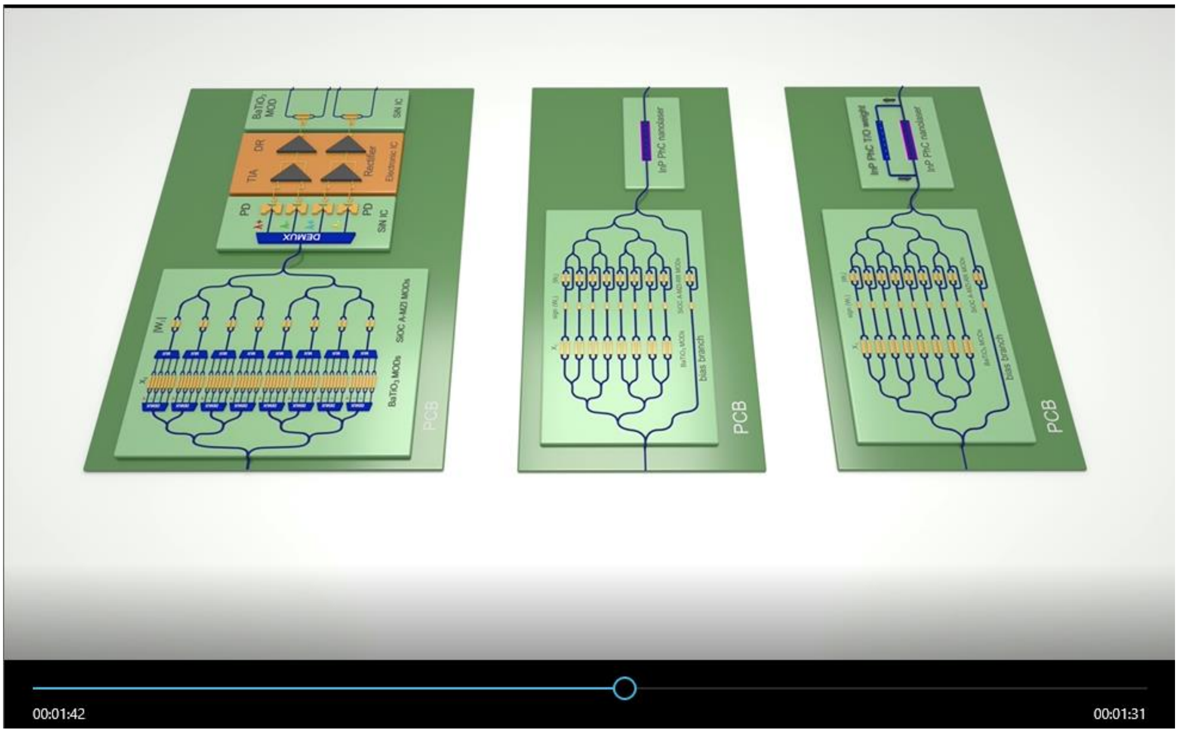


Members of PlasmoniAC consortium are introduced.

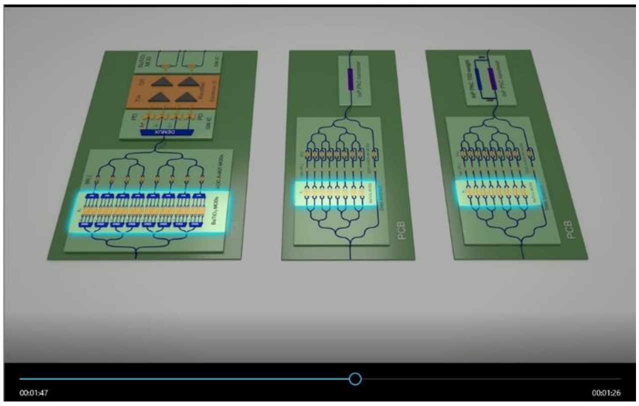
The technical part of the video starts with revealing the idea of 3D cointegration technology, which is harnessing the best of three worlds: photonics for interconnection, plasmonics for computation and memristor nanoelectronics for weight control. The viewer is acquainted with the schematic representation of a linear perceptron and the concept of inputs, weights and summation stage.

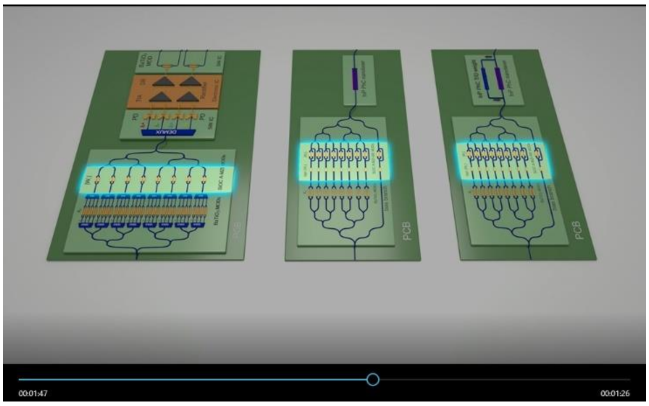


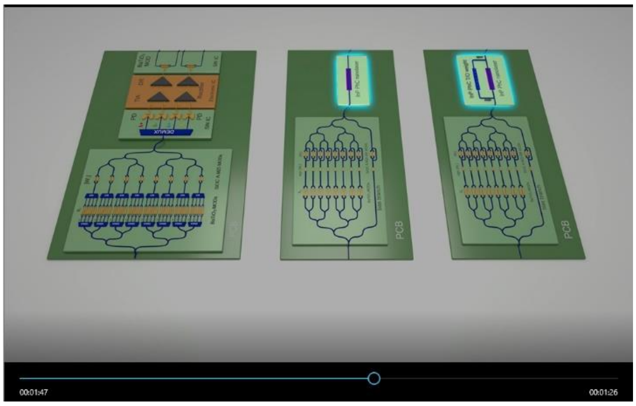
The video proceeds with introducing the three neuromorphic layouts targeted in PlasmoniAC: *(left)* 16-fan-in WDM-accelerated plasmo-electronic neuron with balanced photodetector $sin^2(x)$ and ReLU activation; *(centre)* 8-fan-in phase-encoded feed-forward neuron with sigmoid and tanh InP photonic crystal laser activation; and *(right)* 8-fan-in phase-encoded recurrent plasmo-photonic neuron with InP photonic crystal laser and weight in a loop.

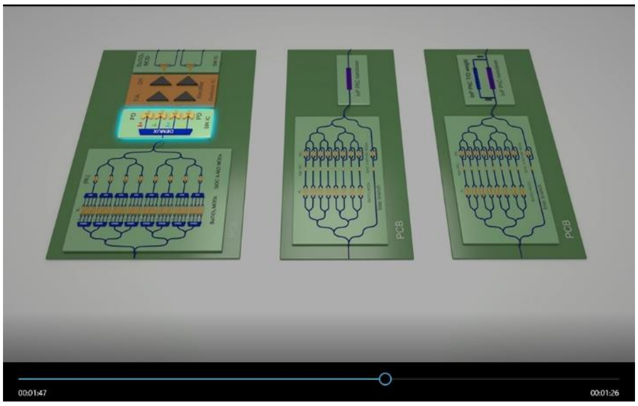


All crucial technologies (BTO input modulators, SiOC weights, InP PhC nanolaser activation and plasmonically-enhanced graphene PDs) that PlasmoniAC brings to its architectures are highlighted during the following scenes.

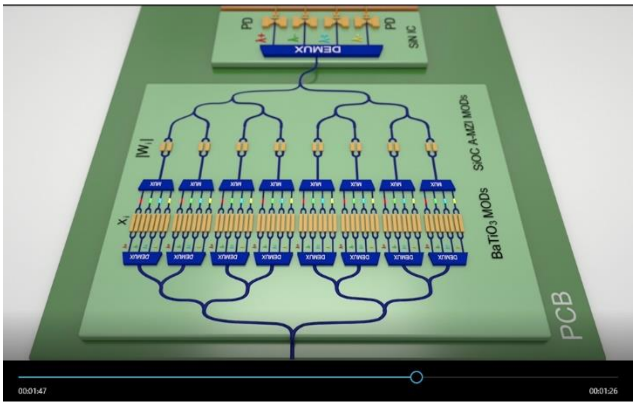


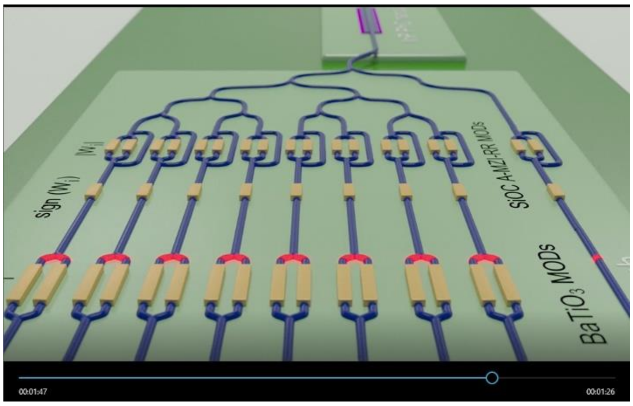






During the description of the operating principles of WDM-enhanced and phase-encoded neuron types, an animation is showing signal propagation from input through the whole linear neuron, followed by activation unit. Where appropriate (in WDM enhanced case), signal is split into its color-coded wavelength components in DEMUXes and recombined in MUXes.





The video ends with crediting EU Horizon2020 framework and European Technology Platform Photonics21. It features the PlasmoniAC logo, as well as the QR codes for easy accessing to the PlasmoniAC social network accounts. The bottom of the screen has a summary of important project information: Grant Agreement number, the name of the call and the project start and end dates.


HORIZON 2020
PHOTONICS21
plasmoniAC
@PLASMONIAC
WWW.PLASMONIAC.EU
Grant agreement: 871391
Horizon 2020 - ICT - Unconventional Nanoelectronics
01/01/2020 - 31/12/2022
00:01:47
00:01:26

4 PlasmoniAC video narration

The video presentation *script* is as follows:

INTRODUCTION (00:00 – 01:01)

Nearly half a century ago, Gordon Moore made a bold statement that the number of devices per chip will double approximately every year and a half without affecting the chip's price. This trend changed the world as we knew it and brought us to the "information era". But, can it continue forever?

The data today is being generated faster that it can be consumed. To tackle the data overflow, the time has come to learn from the most efficient machine known to the humankind – the brain. Last decade brought significant advances in artificial neurons – man-made electronic devices striving to mimic the biological neural cells. However, the question remains– is electronics truly the best platform for AI? Should we employ photonics? Could plasmonics be the answer, by combining the speed of light and nano sizes of electronics?

PLASMONIAC – CONSORTIUM AND THECHNOLOGY (01:02 – 02:45)

Faced with these questions, 10 partners from 7 countries gathered under the EU umbrella to launch 3-year long PlasmoniAC project.

By blending photonics for interconnections, CMOS-compatible plasmonics for computation and memristor-based weights, PlasmoniAC aims to develop a powerful 3D co-integration platform. Using its platform, PlasmoniAC will fabricate 100 Gb/s all-optical neurons with up to 6 orders of magnitude better energy- and footprint-efficiencies than the electronic state-of-the-art, exploiting the best-in-class materials, like the prominent Barium Titanate and Silicon Oxycarbide and technologies, such as Photonic Crystal lasers and plasmonically-enhanced Graphene Photodiodes.

Plasmo-electronic architectures will harness the power of wavelength division multiplexing for sign encoding, a technique that allows several optical signals of different colours to use the same photonic hardware simultaneously. Signal detection will be wavelength-selective using balanced photodetector which, together with the next layers' modulator, forms a nonlinear activation function.

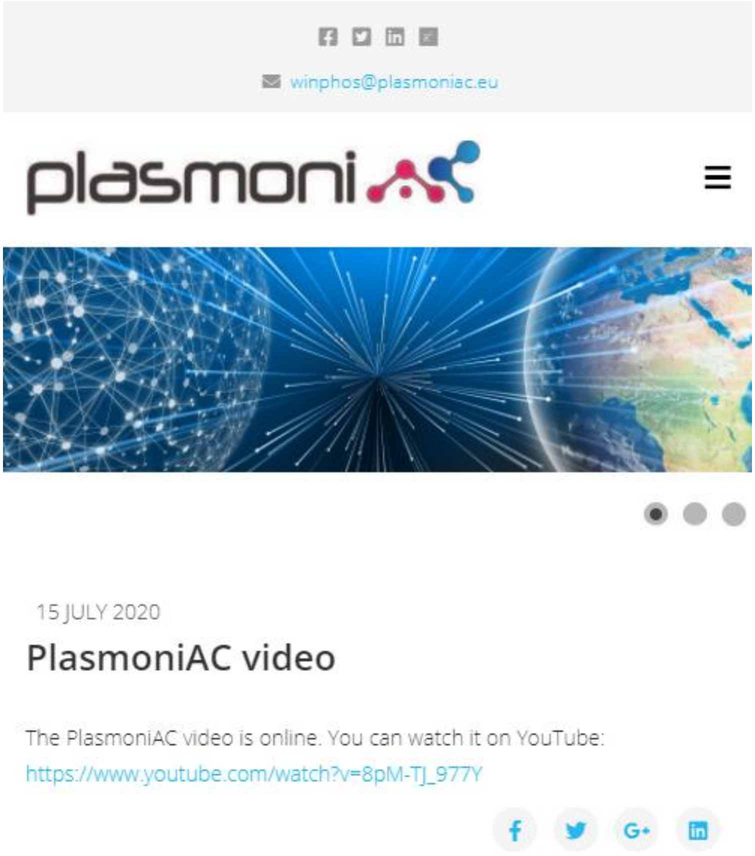
Plasmo-photonic neurons will follow the coherent roadmap, where sign of the weight is encoded in signal's phase, harnessing interference as its summation mechanism, yielding a neuron compatible with all-optical activation, implemented by photonic crystal nanolaser.

OUTRO (02:46 – 03:13)

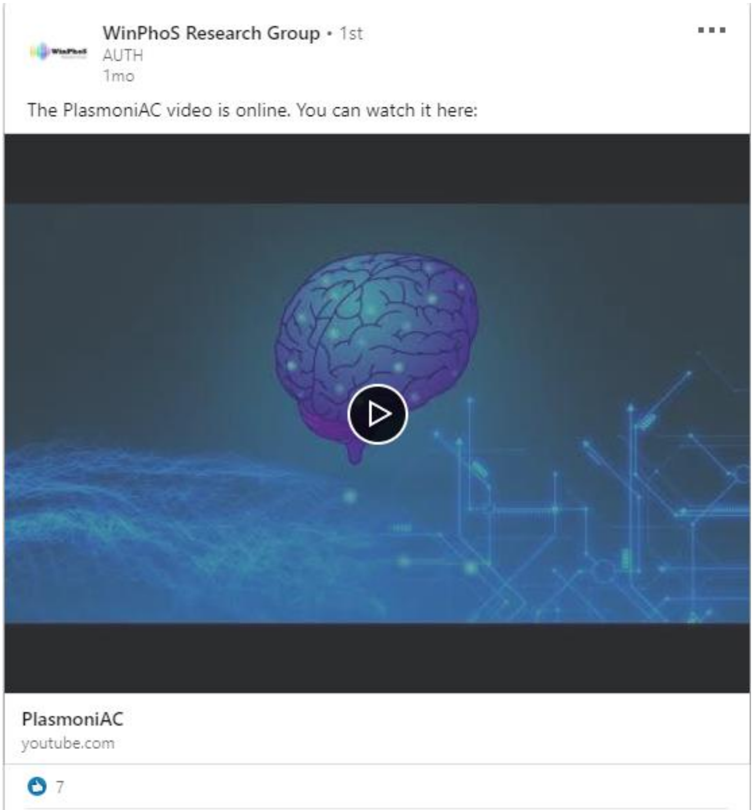
With its hardware-software codesign approach, PlasmoniAC is inaugurating a new era of secure, fast and efficient neuromorphic computing. Follow us and stay informed about the developments in the exciting field of plasmonic neuromorphics!

5 Announcements

Official website:



LinkedIn:



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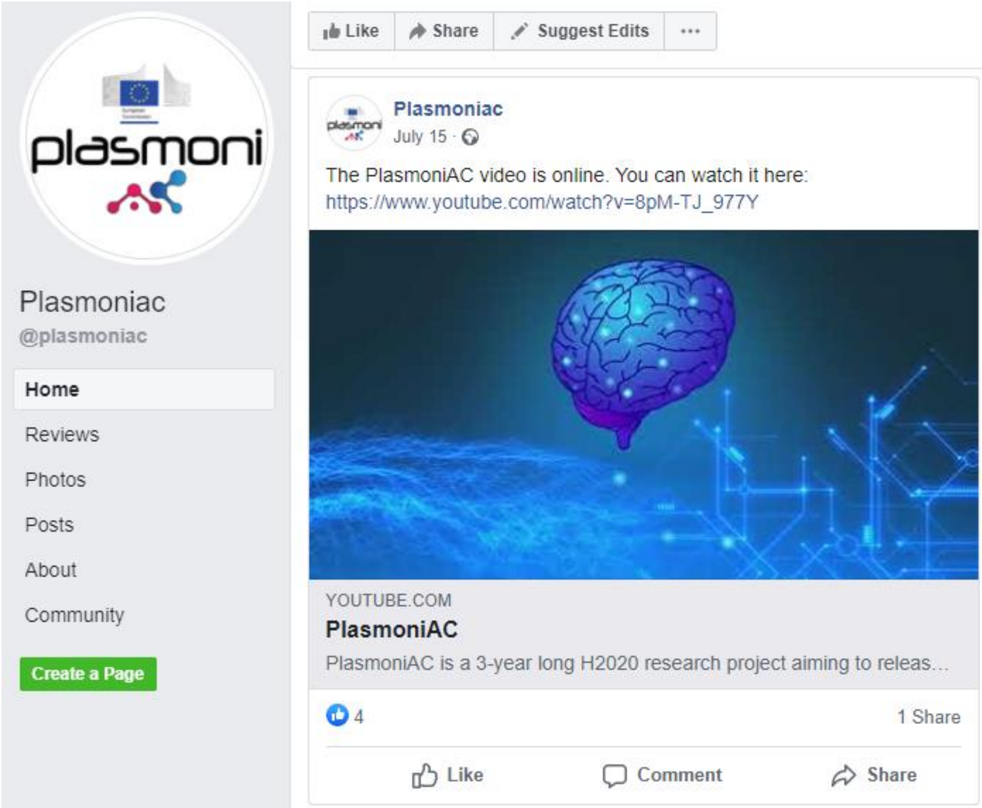

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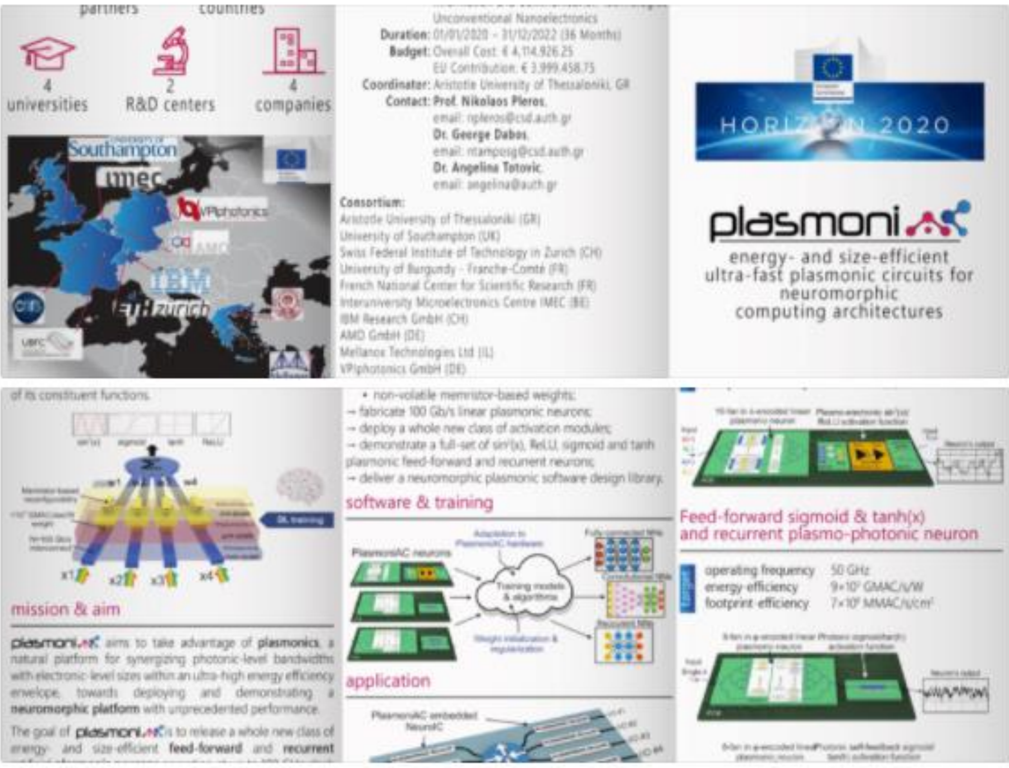

PlasmoniAC promo

Have a look at our official project video to learn more about PlasmoniAC's vision!

https://www.youtube.com/watch?v=8pM-TJ_977Y

Prefer to read instead of watching? Check out our brochure in the attachment!

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