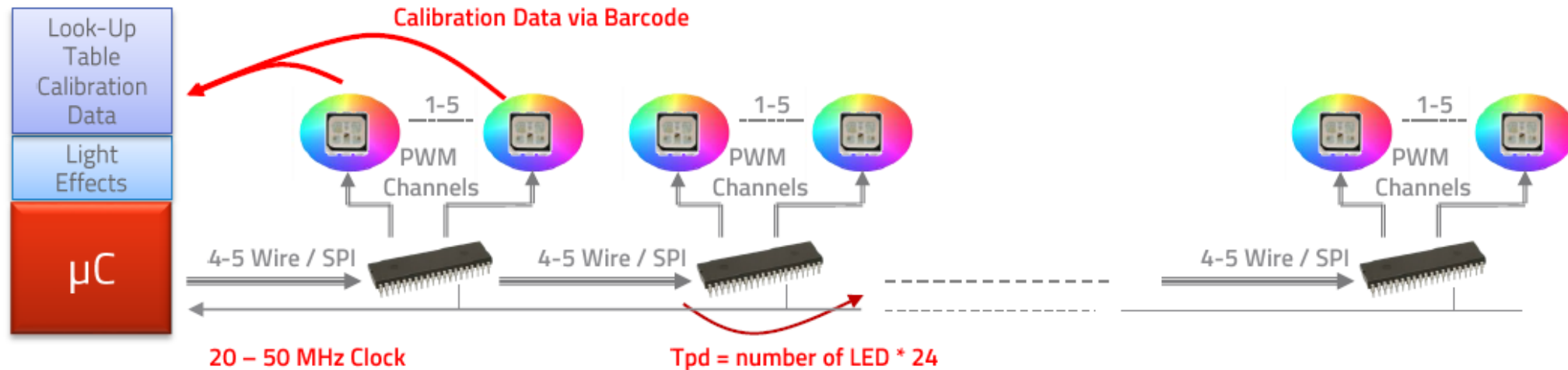


# ISELED – The Future of Automotive LED Lighting

- ISELED – Open Alliance to provide a complete system solution for smart, dynamic LED lighting initially targeting automotive interior lighting



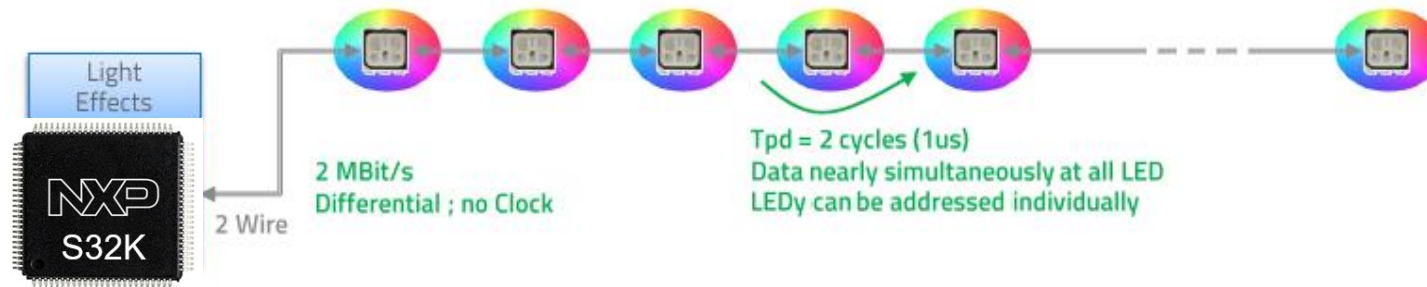
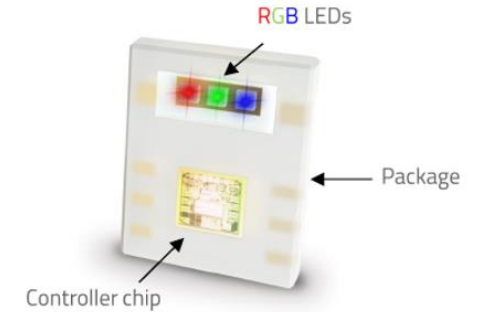
# Limitations of Existing LED Drive Methods



- Multiple, independent RGB LED drivers connected over LIN bus/proprietary buses – low speed and high cost/complexity
- Calibration of each driver and LED necessary to ensure stable colour and brightness over temperature and lifetime
  - LED binning and bar coding
  - Extensive and complex s/w management – look-up table required in main MCU memory
- 1-way communication to LED and sub-controllers with latencies
  - High speed single-ended communication impacting robustness
  - To change a parameter in one LED, all LEDs have to be addressed/updated (shift register approach)
  - No diagnostics

# ISELED LED Drive Concept

- ✓ Packaged LED module with RGB LEDs and ISELED \*Controller IC (Inova Semiconductor)
  - Brightness and colour calibration performed during manufacture and data stored in LED controller IC non-volatile memory – no LED binning classes, bar coding or look-up table in main control MCU
  - Integrated temperature sensor for automatic compensation
- ✓ Proprietary protocol
  - Serial, differential communication
    - EMI robust design with up to 2Mbps data rate and no dedicated clock
    - Simple RGB based colour control for addressing up to 4096 LEDs
    - Fast update rate – 100 LEDs in 5.25ms
    - Efficient bandwidth utilisation – address LEDs individually, by group or in broadcast mode to check status
  - LED control exclusively over communication interface – no additional peripherals required (high resolution timers, PWM, ADC for measuring LED's forward voltage)
  - Bus initialisation on start-up, auto detection of new or replaced LEDs



# NXP ISELED Solution

## Hardware

- S32K1 ISELED MCU part numbers include software license
- Application Dev. Kit (ADK): S32K144 EVB + ISELED Power Adaptor Board, + 16-LED Bar (with Dominant Opto or \*OSRAM LEDs)



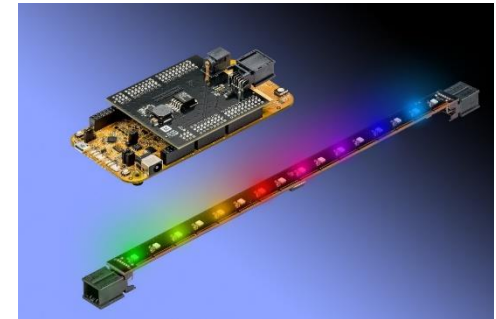
## Software

- ISELED s/w driver
  - NXP Production SDK
  - NXP Autosar 4.0/4.2 (ASIL)
  - 90-day free evaluation version
  - Production: included in S32K ISELED MCU part number
  - Size ~6.5KB
  - Based on S32K1 MCU FlexIO / LPSPI
- Autosar: NXP MCAL + 3rd party BSW (Vector, Elektrobit..)



## Mass Market Launch July 2019

- Evaluation
  - Order ADK
  - Download s/w driver
  - Start development!
- Production
  - Order ISELED S32K part numbers

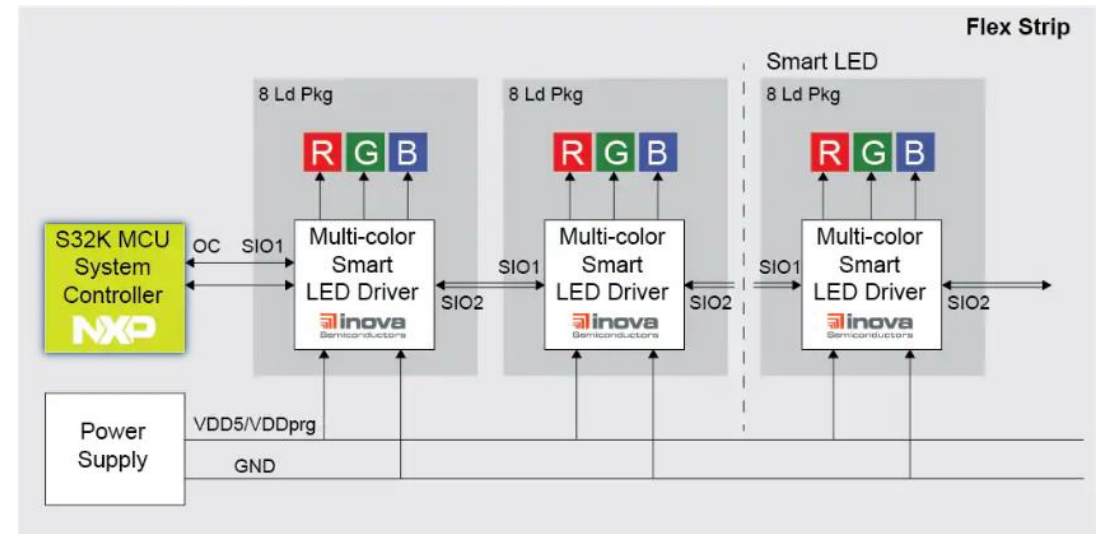


\*Available end 2019

# S32K ISELED Solution - Hardware

## S32K Control MCU

- Choice of 6 scalable MCU families:
  - S32K116/118: CM0+, 128/256KB
  - S32K142/144/146/148: CM4F, 256kB-2MB
- Bi-directional communication between S32K1 MCU and LED over LPSPI or FlexIO interface – fast, flexible and with low CPU overhead



MCU Family	ISELED Part Number	Core	Flash	RAM	Package	Key Features	Ambient Temperature		
S32K116	FS32K116LIT0VFMFMT	Arm CM0+	128KB	17KB	32QFN	48MHz + DMA + FlexIO + ISELED	-40 to 105°C		
	FS32K116LIT0VLFT				48LQFP	48MHz + DMA + FlexIO + ISELED			
S32K118	FS32K118LIT0VLFT		256KB	25KB	48LQFP	48MHz + DMA + FlexIO + ISELED			
S32K142	FS32K142UIT0VLHT	Arm CM4F	256KB	32KB	64LQFP	112MHz + DMA + FlexIO + ISELED			
S32K144	FS32K144UIT0VLHT				512KB	64KB		64LQFP	112MHz + DMA + FlexIO + ISELED
	FS32K144ULT0VLHT							100LQFP	112MHz + DMA + FlexIO + ISELED + CAN FD + CSEc
S32K146	FS32K144ULT0VLLT		1MB	128KB	100LQFP	112MHz + DMA + FlexIO + ISELED			
	FS32K146UIT0VLLT					112MHz + DMA + FlexIO + ISELED + CAN FD + CSEc			
S32K148	FS32K148UIT0VLQT	2MB	256KB	144LQFP	112MHz + DMA + FlexIO + ISELED				
	FS32K148UGT0VLQT				112MHz + DMA + FlexIO + ISELED + CAN-FD + CSEc + ENET				

NOTE: ISELED feature only available with above S32K1 part numbers, both Tray and Reel (16<sup>th</sup> PN character = T or R)

Visit [www.nxp.com/S32K-ISELED](http://www.nxp.com/S32K-ISELED) for sample ordering

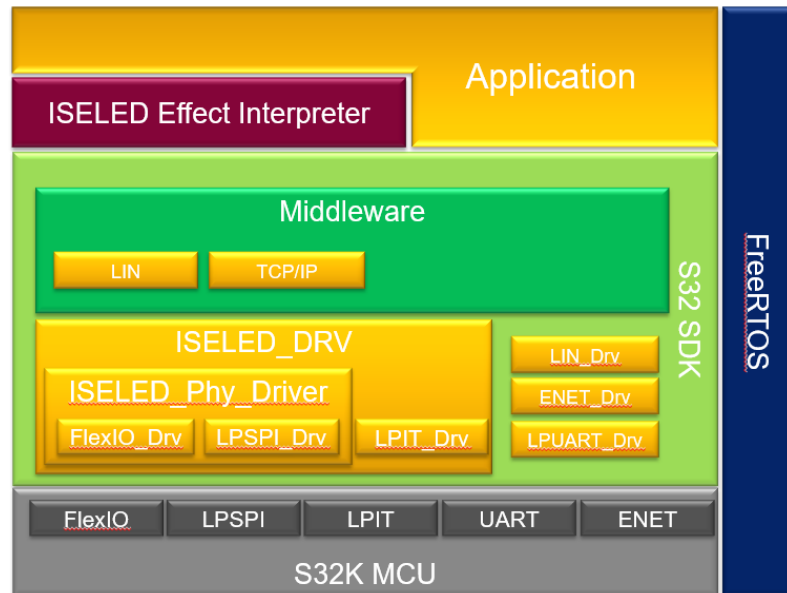


# S32K ISELED Solution - Software

The ADK can be controlled by NXP ISELED Driver with the S32 SDK, or using the 'Lucie Creator' tool from company Lucie Labs which also allows the creation of complex lighting effects.

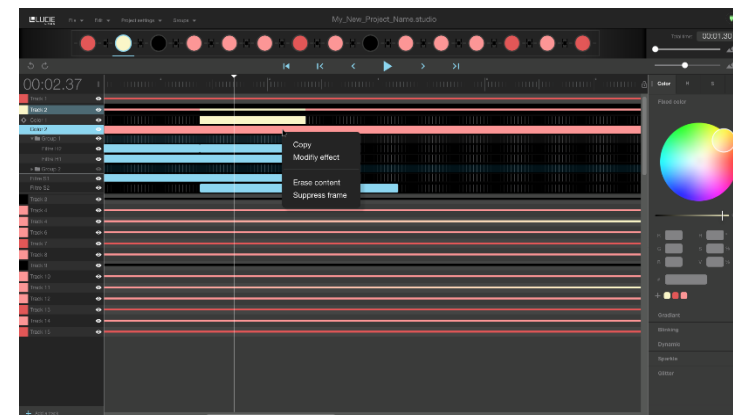
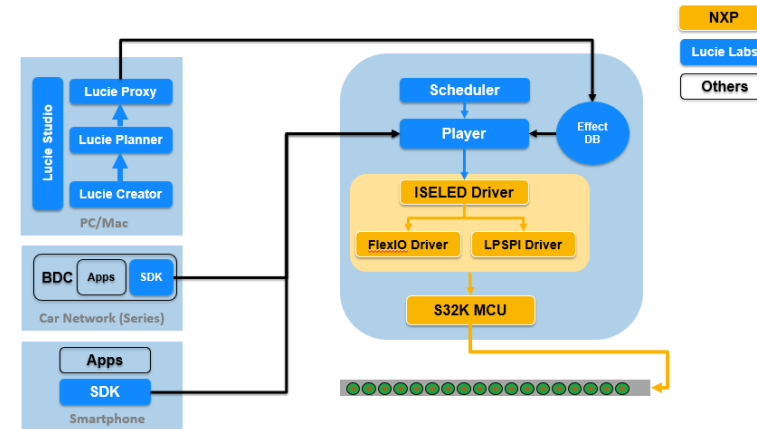
## ISELED Driver integration in S32 SDK

- ISELED driver stacked on two types of peripherals:
  - Comm. interface: FlexIO, Low Power SPI (LPSPI)
  - Timing: Low Power Interrupt Timer (LPIT)
- Download S32DS IDE & SDK, ISELED driver & FreeMASTER tool (see instructions in 'S32K SDK ISELED Driver Installation Guide')
- ISELED SDK demo example included



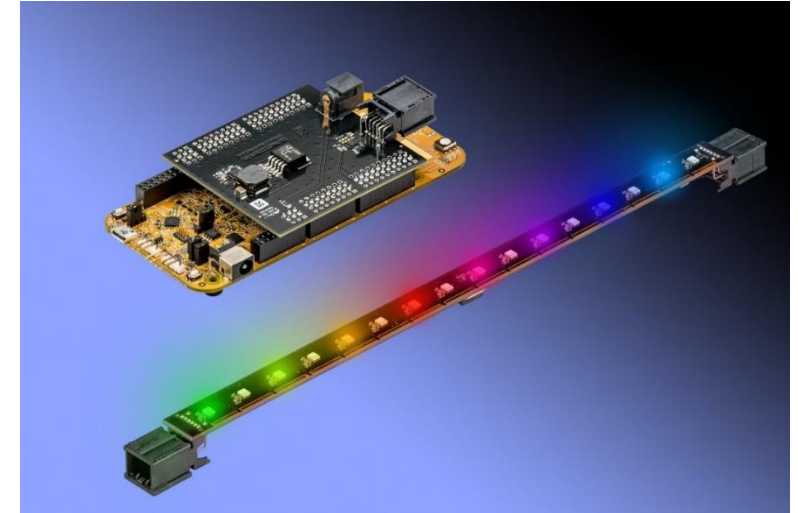
## 'Lucie Creator' LED Effects Tool (from Lucie Labs)

- ISELED 'Effect Interpreter' lighting s/w stack and 'Lucie Creator' Tool available from Lucie Labs – free 90-day evaluation version
- See download instructions in 'ADK User Manual'



# S32K ISELED Solution - Application Development Kit (ADK)

- Orderable only from Etailer [Element14/Farnell](#) (as per ISELED Alliance Distribution policy)
- ADK Contents:
  - S32K144EVB-Q100 (NXP)
  - ISELED Power Adaptor board (Inova Semiconductor)
  - 1 x 16-LED 'Bar' (Dominant Opto or \*OSRAM LEDs)
- Part numbers & Availability:
  - Dominant Opto LED version
    - **ISELED\_ADK\_D** //available now
    - **ISELED\_ADK\_EXT\_D** //includes 1x 16-LED bar
    - **ISELED\_ADK\_EXT\_D** //1 x 16-LED bar for daisy-chain
  - OSRAM LED version //in development
    - **ISELED\_ADK\_O** //includes 1x 16-LED bar
    - **ISELED\_ADK\_EXT\_O** //1 x 16-LED bar for daisy-chain
- S32K1xx EVB Compatibility with ISELED Power Adaptor Board:
  - S32K142/144/146 EVBs: 100% compatible
  - S32K116/118/148 EVBs: minor h/w changes needed (see back-up slide)



# How to start with NXP ISELED solution?

- **STEP 1:** Purchase ISELED Application Development Kit
  - Orderable via Element14/Farnell website (<https://de.farnell.com/b/element14>)
- **STEP 2:** Download ISELED s/w Driver
  - Visit [www.nxp.com/S32K-ISELED](http://www.nxp.com/S32K-ISELED) for installation guide and download link
- **STEP 3:** Evaluation Phase
  - When using ISELED development kit or non-ISELED K1 standard part number device:
    - *License for evaluation only. Limited functionality: Mandatory driver re-initialization after 150,000 (SDK version) or 10,000 (AUTOSAR version) ISELED commands.*
- **STEP 4:** Production Phase
  - Purchase S32K1 custom ISELED MCU part number ([www.nxp.com/S32K-ISELED](http://www.nxp.com/S32K-ISELED))
  - License for evaluation and production included
  - Full functionality available



# Summary

- ISELED provides a simple, robust and cost-effective solution for creating dynamic lighting effects in Automotive, Industrial & Consumer applications – no LED binning/bar-coding, constant colour & brightness maintained over temp., fault diagnostics, up to 4096 LEDs at video speed...
- NXP & Inova Semiconductor provide the complete ISELED ecosystem:
  - Scalable S32K1 Arm Cortex MCU family with low power, connectivity, security, ASIL-B & AEC-Q100 Auto qual.
  - S32 Design Studio IDE + Production grade SDK + ISELED S/w Driver (unlimited use)
  - S32K ISELED ADK available for immediate evaluation & development
- More info @
  - [www.nxp.com/S32K-ISELED](http://www.nxp.com/S32K-ISELED)
  - <https://inova-semiconductors.de/iseled.html>
  - <https://iseled.com/>



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# ISELED ADK – S32K1 EVB Compatibility

Device	Evaluation Board (EVB) Part Number	Compatibility to ISELED ADK	Modifications needed
S32K116	S32K116EVB-Q048	Modifications needed	<ul style="list-style-type: none"> <li>ISELED Adapter needs two wires (clock and data) routed from J5 to J4: J5-19 routed to J4-13 ; J5-17 routed to J4-09</li> <li>ISELED Adapter must be connected to MCU EVB so that all the pins from ISELED Adapter header J3 are connected to header J4 from MCU EVB</li> <li>In case ISELED Adapter pins hit GND2 test point and don't allow the Adapter to be inserted completely in headers, GND2 must be bent (if Adapter pins are touching GND2 it's not a problem)</li> </ul>
S32K118	S32K118EVB-Q064	Modifications needed	
S32K142	S32K142EVB-Q100	100% compatible	No
S32K144	S32K144EVB-Q100	100% compatible	No
S32K146	S32K146EVB-Q144	100% compatible	No
S32K148	S32K148EVB-Q176	Modifications needed	<ul style="list-style-type: none"> <li>ISELED Adapter needs two wires (clock and data) routed from ISELED Adapter header J5 to MCU EVB header J2: J5-19 routed to J2-25 ; J5-17 routed to J2-28</li> <li>ISELED Adapter must be connected to MCU EVB so that all the pins from ISELED Adapter header J5 are connected to header J5 from MCU EVB</li> </ul>