



Sensor Open Systems Architecture™ (SOSA)

Technical Overview and Product Guide



The Sensor Open Systems Architecture™, more commonly referred to as the SOSA™ Technical Reference Architecture, leverages and brings together multiple open standards to define and apply a common modular and interoperable approach to systems used in both defense and rugged commercial applications. At the core of SOSA's hardware specifications is VITA 65 - or OpenVPX - a widely adopted architecture and form factor for rugged, high-performance computing. The OpenVPX family of open standards defines system-level interoperability for modular multi-vendor integrated platforms. The OpenVPX standard defines clear interoperability points necessary for integration from module to module, module to backplane and backplane to chassis.

The SOSA standard is called out in a 2019 memo issued by the U.S. Department of Defense (DoD) and signed by the secretaries of the Army, Air Force and Navy. It calls for the adoption of open standards in development activities for future weapon system modifications and new start development programs. MOSA is now codified into U.S. law (U.S.Code-2021, Title 10. 2446a, Part IV, Chapter 144B, Sec 2446a); after January 1, 2019, major defense acquisition programs “shall be designed and developed with a modular open system approach to enable incremental development and enhance competition, innovation, and interoperability.”

- 1. Establish an Enabling Environment
- 2. Employ Modular Design
- 3. Designate Key Interfaces
- 4. Use Open Standards
- 5. Certify Conformance

Elma is a participant and key contributor to open standards such as VITA, SOSA, PICMG and others. We have a long history of building proven products based on these standards, and have proven expertise in rugged solutions for both development and deployment on air, ground and shipborne platforms.

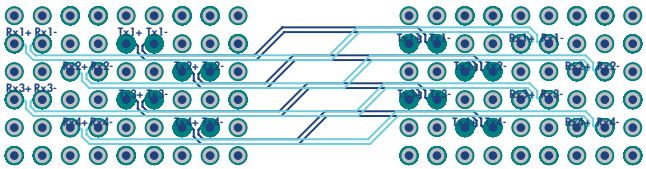


The VITA trade association provides members with the ability to develop and design products based on open standards. The VITA Standards Organization (VSO) is an ANSI-accredited group that provides members with a means to work together to define and develop key computer specifications such as the family of VPX standards, which include those listed below. Elma is a key contributor to several of the Working Groups within VITA.

17.3	Serial Front Panel Data Port (sFPDP) Gen 3.0
42	XMC mezzanine cards
46.0	VPX
46.30 & .31	Higher Data Rate VPX
46.4	PCI Express on VPX
46.6	Gigabit Ethernet Control Plane on VPX
46.7	10 Gigabit Ethernet on VPX
46.9	XMC Mapped Rear IO on VPX
46.10	VPX RTM
46.11	System Management on VPX
47.0-3	Environmental
48.2	VPX REDI: Mechanical Cooling
48.4	VPX REDI: Liquid Flow Through Cooling
48.8	VPX REDI: Air Flow Through Cooling
49.0	Radio Transport & RF Signals
62.0	VPX power supplies

65.0	OpenVPX
65.1	New Slot and Module Profiles
66.0	Optical Overview
66.1	Optical Full size Dual MT variant
66.2	Optical ARINC 801 Termini variant
66.3	Optical Mini Expanded Beam
66.4	Optical Half size MT variant
66.5	Optical Interconnect on VPX - Hybrid Variants
67.0	RF and Mixed Signal overview
67.1	3U RF
67.2	6U RF
67.3	Flexible multi-level RF on VPX
68	SpaceVPX
68.0	VDSTU VPX SI
68.1	VDSTU VPX SI backplane
68.2	VPX SI Mezzanine (under development)
90.0-7	VNX+

PIPES: FAT, THIN, ULTRA THIN



Fat Pipe: A channel that is comprised of four links (4 Tx pairs + 4 Rx pairs) is now being referred to as a Fat Pipe or by use of the x4 nomenclature. 100GBASE-KR4 and 40GBASE-KR4, PCIe-x4.



Thin Pipe: A channel that is comprised of two links (2 Tx pairs + 2 Rx pairs) is now being referred to as a Thin Pipe or by use of the x2 nomenclature. 10/100/1000BASE-T, PCIe-x2.



Ultra-thin Pipe: A channel that is comprised of one link (1 Tx pair + 1 Rx pair) is now being referred to as an Ultra Thin Pipe or by use of the x1 nomenclature. 10GBASE-KR, 1GBASE-KX, PCIe-x1.

PROFILES

SLOT PROFILES

VITA 6.5 defines OpenVPX in terms of four types of Profiles: Slot Profiles, Backplane Profiles, Module Profiles and Chassis Profiles. Slot profiles are differentiated by their type (payload, switch, peripheral, etc.) and the arrangement of planes and other communications ports, including apertures for blind-mate optical and/or coaxial connections. SOSA further refines VITA 6.5 by defining a specific subset of 3U and 6U slot profiles. These profiles can be described as Payloads, Switches, Radial Clocks, or External I/O. The standard also defines a set of approved protocols that can be implemented by Plug In Cards (PICs) for each of the define Pipes or general communications ports.

3U

IO Intensive: This is a general purpose single-board computer slot profile.

Primary and Secondary Payload or Compute Intensive: These are the main heavy-duty processing and payload profiles. The differ in the size of the coax/optical aperture and the number of Expansion Plane lanes.

Switches: These were chosen to address specific use cases required by SO-SA-based systems

External I/O: This was included in SOSA to address the need of bringing large numbers of legacy I/O into or out of the system. SOSA has specific rules on the use of this profile.

High-density coax/optical: This was introduced into SOSA primarily to provide a coaxial switching capability.

Radial Clock: Intended to drive common high-precision radial clocks (REF_CLK and AUX_CLK) across the back-plane.

6U

Payload: Two payload profiles, one with XMC mapped pins and one with extra expansion plane lanes.

Switch: Data Plane/ Expansion Plane switch slot profile

External I/O: Provides similar functionality and with the same rule set as the 3U version.

High-density coax/optical: Similar to the 3U variant

PROFILES

MODULE PROFILES

To capture what particular protocols are supported by a particular PIC, a mechanism called the Alternative Module Profile Scheme (AMPS) is used. AMPS defines a string that includes a set of protocol fields enumerated in a manner so that one can quickly determine what protocols a particular PIC can support. The AMPS string is constructed using the following format:

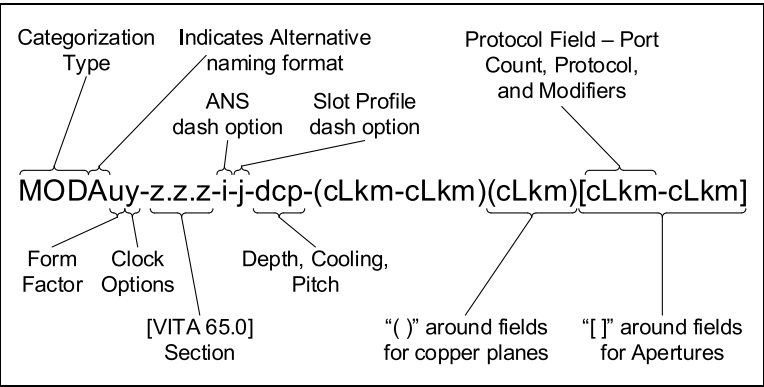


Figure 1: Alternative Module Profile Scheme (AMPS) String Construct. From SOSA Technical Standard, Version 1.0

Each code in this format has a set of values representing the approved protocols, with appropriate modifiers. The approved protocols include:

- Data Plane: PCI Express, Ethernet (1000BASE-KX, 10GBASE-KR, 10GBASE-KR4, 40GBASE-KR4, 25GBASE-KR, and 100GBASE-KR)
- Control Plane: Ethernet (1000BASE-KX, 10GBASE-KR, 25GBASE-KR)
- Expansion Plane: Dependent on the profile, but generally PCIe, Ethernet, S-FPDP, and LVDS
- Other ports such as USB, Serial UART, DisplayPort, etc.

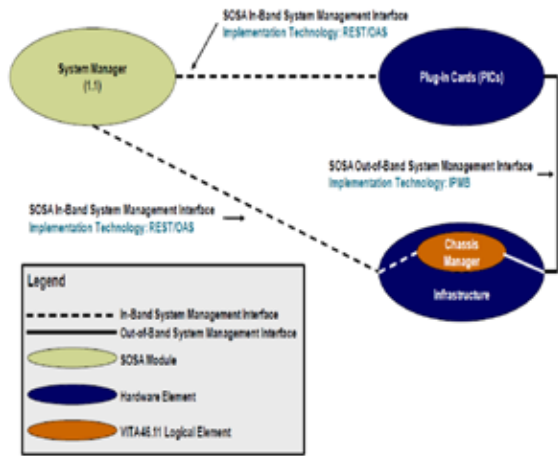
To learn about AMPS strings and the approved SOSA protocols see the SOSA Technical Standard.

POWER AND SYSTEM MANAGEMENT

SOSA refined the rules from VITA 46.0 and VITA 65.0 regarding power. Specifically, it calls out that only the VS1 rail (12VDC) is to be used by SOSA aligned plug-in cards for primary power, while 3.3V_AUX is limited to system management functions and VBAT to powering real-time clocks. This is an important feature of SOSA. Prior to this rule, vendors could use whatever ratio of the three input power rails (VS1=12VDC, VS2=5VDC, and VS3=3.3VDC). The result was that for any particular integrated system there was an unpredictable consumption ratio of these three rails, making it difficult for power supply vendors to offer truly COTS power supplies. SOSA solved this, and there is a growing selection of VITA 62 and stand-alone power supplies available on the market.

3U Plug-in Module Power Supplies		
Pin name	2017 usage	Proposed Recommendations
VS1	+12 VDC	+12 VDC
VS2	+3.3 VDC	Not used
VS3	+5 VDC	Not used
+12V AUX	+12 VDC	Not used
-12V AUX	-12 VDC	Not used
3.3V AUX	+3.3 VDC	+3.3 VDC
VBAT	+3 VDC	+3 VDC

SYSTEM MANAGEMENT



An important element in the SOSA architecture is System Management. Not only is there a SOSA module named System Manager (Module 1.1), but it defines both an in-band and out-of-band communication and control mechanism. The out-of-band mechanism is based on the VITA 46.11 standard.

The Intelligent Platform Management Controller (IPMC) found on each SOSA Plug-in Card, along with the Chassis Manager Module (CMM) which interfaces with the System Manager and provide the overall hardware control and monitoring function are two key elements of the System Manager subsystem. Elma offers a range of products to address both of these functions, all SOSA aligned.

As a leading contributor to open standards like SOSA that support the DoD’s MOSA initiatives, Elma’s backplanes are designed in alignment with The Open Group® Sensor Open Systems Architecture™ Technical Standard, or SOSA™, in slot counts from 2 to 12.

They provide the foundation for high-performance mission-critical systems requiring lower life-cycle costs and rapid technology insertion. They enable complex, high speed signal processing systems with the latest optical fiber and RF connectivity as well as slot profiles for SBCs and payload expansion.

The backplanes support high-speed signals on all data paths and VITA 67.3 connectors and VITA 66.5 optical connectors.

Developers can use the development backplanes as configured or work with Elma to identify your specific profile configuration needs.

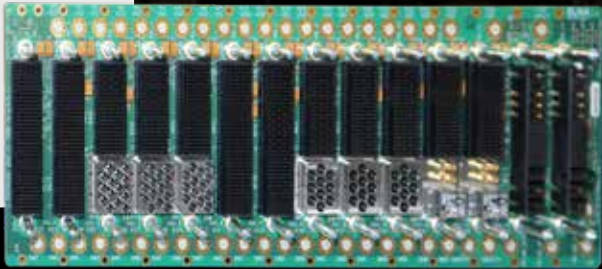
As the leader in open standards backplane design and manufacturing, our cutting-edge signal integrity analysis informs the designs of our high-speed backplanes, handling critical data at high performance speeds.



Signal Integrity is the backbone of our Backplane designs

At speeds up to 100GBASE-KR4, every feature of backplane design can influence signal integrity (SI) – every trace, layer separation, turn bend, via, via transition, etc. Elma’s signal integrity analysis and simulations consider every element in the channel to ensure optimal performance.

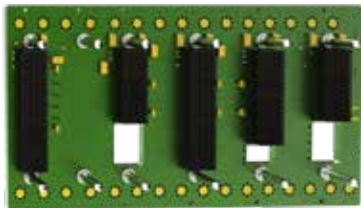
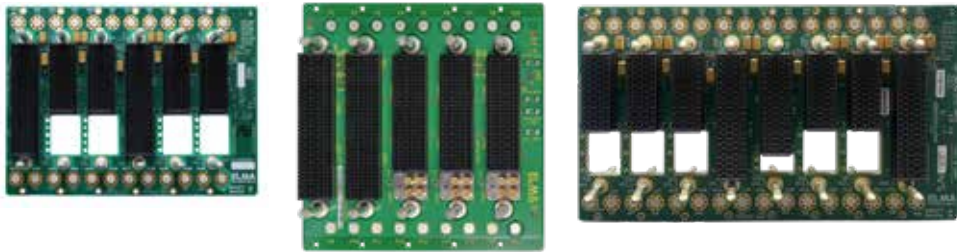
We focus on each feature individually to model the complete channel and optimize the return loss for each. Once modeled, they are concatenated together along with the trace and connector models to create the complete channel. Today’s critical high-speed systems require nothing less than reliable, repeatable solutions - every time.



SOSA BACKPLANES

3U Backplanes

Available in standard or customized configurations of any or all with any slot profile for PICs aligned to SOSA.



Backplanes for Specific Cooling Schemes

VITA 48.x calls out specific configurations to accommodate specialty cooling methods. 3U backplanes are available in wider spacing for cooling standards such as VITA 48.8 for air flow-through (AFT) or VITA 48.2 for liquid flow-through.

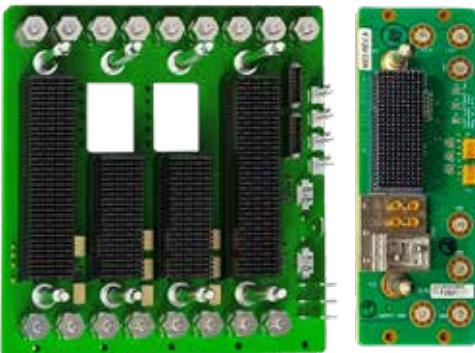
6U Backplanes

6U backplanes are part of the standard and are available by request.

POWER AND GROUND

Power & Ground Only Backplanes

Elma’s wide selection of power and ground only backplanes provide a cost-effective solution those who are developing their own cards or haven’t decided on the slot configuration of their system. The only assigned pins are 3.3V, 5V, 12V, GND, and utility plane signals. The remaining pins are user-defined and pass through from front to rear. The rear connectors are all fully populated and can be accessed with Elma’s slot-to-slot or slot-to-I/O bulkhead cable assemblies or rear transition modules for system development.



Power Interface Boards (PIBs)

Designed to facilitate the use of pluggable VITA 62.x power supply modules in systems requiring them. Elma’s standard backplanes use power studs which are typically wired to standalone (frame) power supplies. With PIBs, customers can choose between Elma’s standalone (frame) power supplies and pluggable VITA 62.x supplies.

Find What You Need with Interactive Backplane Charts

Our backplane charts are designed to show a list of the profiles included in each available backplane configuration. Mouse over the backplane model number, and it will show you the backplane topology at a glance.





Accelerate your time to deployment with our development chassis for 3U OpenVPX plug-in cards aligned to SOSA™

Our lineup of easy access development platforms significantly enable fast and efficient system design and integration as well as testing of plug-in cards (PICs) aligned to SOSA.

Features include open frame formats for probing and quick board changes; 3U VPX backplane with 1-12 profiles aligned to SOSA (or power and ground only for board development); rear transition slots; chassis management; fixed or plug-in power; choice of air- and/or conduction-cooled card guides, VITA 48.x cooling, and more.

Choose the Development Platform That Best Fits Your Needs:



CompacFrame

Lightweight and compact, this platform family comes in a Slimline unit for 1-4 slots, or or a mid-range unit for up to 8 slots or 5 AFT (VITA 4.8) wide slots.



E-Frame Platform

This full-sized platform ships with a 12-slot backplane that includes all SOSA 1.0 & CMOSS slot profiles. Optional 2-slot PIB for VITA 62 plug-in power supplies.



D-Frame Platform

When space is at a premium, or you need take it on the road, the D-Frame is the smallest platform available. It can accommodate up to four 3U PICs.



Developing high-speed signal processing equipment for harsh SWaP constrained installations requires a holistic design approach in which Elma excels. Optimal chassis designs must consider the payload power envelope in conjunction with extremes in temperature, shock, vibration, ingress, EMC and other environmental factors. Elma supplies chassis for use across a range of defense programs serving on land, sea or air. Our standard and custom chassis designs are available with a range of cooling choices: conduction cooling, air cooling, or hybrid conduction and air-cooled models, and liquid cooling. Choose from aluminum or composite chassis construction.



SOSA ALIGNED DEPLOYABLE ATRs

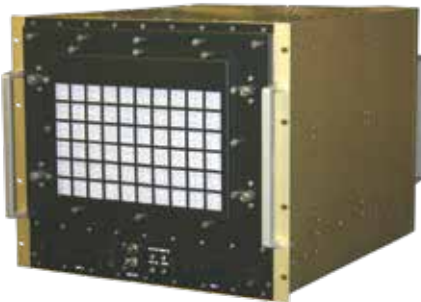
RUGGED ENCLOSURES



This family of rugged enclosures has been specifically designed to accommodate 3U 25Gb dual domain backplanes and plug-in cards aligned to SOSA. Unit is conduction-convection cooled to maximize airflow and cooling (other cooling methods supported). VITA 46.11 Tier 3 out of band (OoB) chassis manager. Designed to meet most environmentally rugged MIL standards.

19" CHASSIS - MIL RUGGED

TYPE 12R1 & 12R2 CHASSIS FAMILIES



The COTS 12R1 and 12R2 19" rackmount chassis are high-quality and cost-efficient rugged enclosures for defense applications. It includes up to 14U high models for 3U and 6U Plug-In Cards. Intended to withstand the demands of a military environment, the 12R1 (lightweight rugged) and 12R2 (fully rugged) are designed to meet benchmark military standards.

CMFF

This enclosure family is designed to meet the dimensional requirements of the CMOSS Mounted Form (CMFF) and Standard A-Kit Vehicle Envelope (SAVE) trays. This fieldproven platform ships in multiple PIC slot configurations of 3U backplanes aligned to SOSA.





Plug-In Cards (PICs) Aligned to SOSA

Elma platforms aligned to SOSA are functionally tested and proven to work with top tier plug-in card suppliers, an essential step in building mission-critical systems for use in defense applications.

Elma can help select or ensure that the complement of boards for your system are functionally interoperable in your development or deployed system.

PLUG-IN CARDS

Our COTS sub-system embedded designs are realized through a combination of best in class partner products and Elma’s field-proven chassis management, I/O and networking boards. – integrated with renowned Elma packaging solutions. Elma has established, long-term relationships with highly qualified industry leaders, teaming to deliver the best solutions for mission critical applications the world over. As a trusted provider of integrated COTS solutions and board products to the defense industry, we support long-term defense programs with leading-edge technologies and crucial legacy solutions that keep systems up and running.

IO-Intensive Payload Cards (SBCs)

These cards are general purpose single board computers with Intel or ARM-based CPUs for high performance processing.



Compute-Intensive Payload Cards (SBCs)

High performance processing features on leading-edge single board computers and GPGPU processors. Other boards that fit this profile are FPGA cards, RF transceivers, microwave tuners, and software-defined radio (SDR) cards.



Networking

High-performance Ethernet switches are the communication building blocks of a system. Elma offers boards supporting either single or dual planes, up to 100 Gbps on copper or optical interfaces, with field-proven software management of Layer 2 & 3 configurations.





Modular Interoperability Comes in Many Functions

Elma works with many partners in the community that SOSA has enabled. Whether it's high performance networking or storage, or support for legacy and discreet I/O interfaces, we are well connected to the community in order to support unique requirements.



EMBEDDED BOARDS

FIELD-PROVEN PERFORMANCE

Our COTS sub-system embedded designs are realized through a combination of best in class partner products and Elma's field-proven chassis management, I/O and networking boards – integrated with renowned Elma packaging solutions. Elma has established, long-term relationships with highly qualified industry leaders, teaming to deliver the best solutions for mission critical applications the world over. As a trusted provider of integrated COTS solutions and board products to the defense industry, we support long-term defense programs with leading-edge technologies and crucial legacy solutions that keep systems up and running.

Radial Clock Cards (PNT)

The Radial Clock profile supports cards that provide accurate position, navigation, and timing (PNT) solutions. It is critical to precise navigation solutions.



Power Supply cards

VITA 62 defines a the power connector for the backplane or interface board and the module that can be plugged into a SOSA aligned system. PSUs currently support up to 750W each.



Cabling for Development

Compliant to the latest VITA 46 specifications, cabling assemblies are ideal for backplane and system development. They can be used to make I/O and slot-to-slot connections.



Chassis Management

Maximizing system uptime is critical. Elma's chassis management products provide Tier 3 and Out-of-Band features to ensure proper operation of platforms aligned to SOSA.



External I/O & High-Density Coax/Optical Cards

This slot profiles address legacy I/O commonly found in aircraft discreets and well as commonly found RF switching boards.

SERVICES AND CAPABILITIES

Open standards architectures form the backbone of our embedded computing designs. Our team of mechanical and electrical design engineers are experts in enclosure configuration, complex thermal management, I/O interconnects, EMC, shock & vibration, system monitoring, as well as lifecycle management and reliability considerations.

We perform rigorous design and test with in-house design verification and testing, including thermal chambers and vibration tables. The lab enables Elma engineers to thoroughly test and verify performance each step of the way.

We use the latest in 3D modeling, thermal analysis, structural analysis and signal integrity software, and apply a modular building block approach to leverage proven designs for new system concepts. Combine all this with a proactive product life-cycle management system for the long-term support and reliability you need.

Quality - Assured

Elma is an ISO 9001: 2015 and AS9100 certified supplier. All of our quality procedures are implemented and maintained in accordance with those standards. At Elma, we strive for excellence by practicing completeness, accuracy, timeliness, and by exceeding expectations in everything we do.



Program Management

Elma provides program oversight from initial project definition through final delivery. Project level activity tracking is managed by a designated individual who serves as a communication hub for status updates. The goal of our experienced program management team is to ensure on-time delivery of systems that meet project specifications.

An Experienced Approach



SERVICES AND CAPABILITIES

Elma hires the best teams for all phases of the customer journey – from initial design with the product and engineering teams, to manufacturing and project management, our people are experts in providing every process along the way. Below are some of the services and capabilities we offer.

- › Signal integrity and simulation
- › EMC and ESD experience
- › Cooling and thermal simulations
- › Shock and vibration mitigation
- › Integration of displays and touch screens
- › Digital printing technologies
- › Front panel and enclosure customization
- › Sub-system integration and assemblies





**Elma Electronic AG,
Switzerland**

Hofstrasse 93
CH-8620 Wetzikon
T: +41 44 933 41 11
F: +41 44 933 42 15
sales@elma.ch

**Elma Electronic GmbH,
Germany**

Stuttgarter Strasse 11
D-75179 Pforzheim
T: +49 7231 97 34 0
F: +49 7231 97 34 97
info@elma.de

Elma Electronic France SA

16 rue de Hannah Arendt
Parc des Forges
F-67200 Strasbourg
T: +33 38 85 67 25 0
sales@elma-electronic.fr

Elma Electronic UK Ltd.

Solutions House
Priory Business Park
Fraser Road
Bedford MK44 3BF
Great Britain
T: +44 1234 838822
F: +44 1234 836650
sales@elma.co.uk

Elma Electronic Romania SRL

Chisoda, DN 59 km8 + 550m
RO-307221 Judetul Timis
T: +40 374 480 400
F: +40 256 249 820
sales@elma.ch

Elma Electronic Israel Ltd.

34, Modi'in St., I.Z.Sgula
IL-49271 Petach-Tikva
T: +972 3 930 50 25
F: +972 3 931 31 34
sales@elma.co.il

Elma Electronic Inc., USA

44350 S. Grimmer Blvd
Fremont, CA 94538, USA
T: +1 510 656 3400
F: +1 510 656 3783
sales@elma.com

Optima Stantron, USA

2305 Newpoint Parkway
Lawrenceville, GA 30043, USA
T: +1 770 496 4000
F: +1 770 496 4026
sales@elma.com

**Elma Electronic Private Ltd.,
India**

Green Arch
3rd Phase 1st Main
J.P. Nagar
Bangalore 560078
sales@elma.com

**Elma Asia Pacific Pte. Ltd.,
Singapore**

8 Ubi Road 2
07-14 Zervex Building
SG-408538 Singapore
T: +65 6479 8552
F: +65 6479 8662
sales.elmaap@elma.com

Your local solution partner