In recent years, dentistry has seen a dramatic increase in the number and capabilities of digital impression systems. While they were originally used for relatively simple cases like single unit restorations, inlays or onlays, today’s systems are capable of serving as a starting point for a much broader number of workflows, including clear aligners and other orthodontics, implant abutments, and both chairside and lab mills. But to take advantage of this variety, as well as position themselves to continue adapting in the future, dentists should keep one thing in mind when selecting a digital scanning system: open architecture.

Open Versus Closed

For those who are not familiar with the term, digital impression devices can be divided into two categories—open- and closed-architecture systems. The distinction is based on the way they do (or do not) share data with other systems. In a closed system, a manufacturer tightly controls the CAD and CAM components of the restorative process, and a digital impression made with the system’s scanner can only be used to produce restorations with that same manufacturer’s system. The advantage to this approach is that the manufacturer should be able to guarantee a smooth interface between the technology components involved. It can also be useful for a dentist who would like a high level of hand-holding in the transition to digital dentistry.

As the capabilities of digital scanners continue to expand, those who are locked into a closed system may watch as their peers are able to use scanners for a wider variety of indications, while they wait for their system to add the new capabilities—if they are added at all.
A hybrid between open and closed architecture is a “selectively open” system. With this approach, the manufacturer of a scanner enables the data to be used by a pre-approved list of outside companies. Typically, the scanner manufacturer will thoroughly vet these workflows prior to approving them so there is less chance for the dentist to encounter problems. While this type of system clearly offers more flexibility than a strictly closed system, dentists may still face limited choices outside of the manufacturer’s own solutions.

Finally, open architecture represents the opposite end of the spectrum. With an open system, the scanner generates STL files that can be sent to any lab or manufacturing partner. These files will work with any system that can read them, regardless of the manufacturer. This type of system gives dentists maximum flexibility to take advantage of their scanner in conjunction with the broadest range of workflows and products. As the list of manufacturing processes that utilize STL files continues to grow, dentists with these types of systems will have the most choice in the manufacturers and materials they work with.

As noted, one of the advantages to working with a closed or selectively open system is that dentists get some sense of assurance that the workflows they want to use have been thoroughly tested and proven. Therefore it may seem upon first glance that dentists using an open system forego this security. However, there are open systems that strike a convenient balance between providing the flexibility to take files anywhere, and the assurance of working with a proven workflow.

Open Architecture with Added Security

My office has worked with an open system, the 3M True Definition Scanner, for two and a half years. Prior to that, we used its predecessor, the 3M ESPE Lava Chairside Oral Scanner C.O.S. This experience has made digital scanning an everyday part of our practice, and the open architecture of the system is a key part of that.

While providing the flexibility of STL files that can be used with virtually any open CAD/CAM system, the scanner also has Trusted Connections, meaning these systems have been technically and clinically validated to work smoothly with the scanner and deliver high accuracy. With this model of open architecture, users of the scanner get both the proven connections of a closed system, and the flexibility of an open system.

continued on page 84
Choosing a system with open architecture was very important for my practice, as we did not want any restrictions placed on what we could or could not do with our digital scans. We currently use our scanner as the entry point for Invisalign and ClearCorrect clear aligners, partial and complete dentures, the IOS Technologies TS150 In-Office Milling Solution, and several types of lab-manufactured restorations. In addition, we also use our scanner to print SLA models and fabricate night guards and snore guards. In the future we are considering expanding to the E4D Chairside Mill as well as some advanced implant workflows with Straumann.

For any of these workflows, the digital scanner enables a level of efficiency and accuracy that simply would not be possible otherwise. The example shown here illustrates just how quickly a case can be completed with the scanner and its Trusted Connection to a chairside mill.

**Case Presentation**

The patient presented with a lingual fracture on #13 with recurrent decay under the existing composite restoration (Fig. 1). The composite and decay were removed (Fig. 2), and it was determined that an inlay would be the best treatment option, given the ability to control the emergence and design the most appropriate interproximal contact.

To prepare for scanning, a lip retractor was placed and a small amount of retraction paste was dispensed in the gingival sulcus on the distal of #13. The retraction paste was then rinsed and the area was dried and lightly powdered with titanium dioxide (Fig. 3). The scanner was used to capture the digital impression, with the prep scan taking approximately one minute, the opposing scan captured in about 40 seconds, and the bite scan taking approximately 10 seconds (Fig. 4).
Following capture of the scan, the file was imported into the IOS Technologies FastDesign CAD Station, and the software was used to design the inlay (Fig. 5). The data was then sent to the TS150 Mill and the inlay was milled from Lava Ultimate Restorative (Fig. 6). The material selected for this case enabled extra time savings due to the fact that it does not require firing.

Once milling was completed, a dry fit was done to confirm the fit of the inlay and the interproximal contact between 13 and 14 (Fig. 7). After verifying this, the inlay was polished and prepared for bonding. A selective etch was done on the enamel surfaces of the prep, and Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement were then used for final seating (Fig. 8).

The entire case was completed in approximately one hour, and the patient was very satisfied with the final result, as well as the fact that the procedure was completed in one office visit.

Conclusion
The workflow shown here is only one example of the efficiency that is made possible with an open architecture scanner. In this case, the scanner’s Trusted Connection to the design and milling system helped create a very seamless restorative process. Whether we are utilizing workflows with Trusted Connections or simply sending STL files to the lab or a manufacturer, the flexibility of an open system is something that is invaluable to our practice. We look forward to the continued expansion of workflows for our system and the added efficiency it will bring to everyday dental procedures.

Author’s Bio
Dr. Nick Marongiu graduated from the University of California, San Diego, with a Bachelor of Science in Animal Physiology and Neuroscience. He earned his Doctorate from Loma Linda University School of Dentistry where he served as President of the Dental Student Association and Chair of the California Dental Association Student Delegation. He graduated with Honors in Implant Dentistry and was recipient of several awards, most notably, Clinical Excellence Award, Student Excellence Award, Prosthodontic Scholar Award, and Excellence in Cosmetic Dentistry Award.

Following graduation, he completed a general practice residency at the West Los Angeles Wadsworth Veterans Association Hospital and post graduate training at University of California, Los Angeles, School of Dentistry.

He currently practices full-time and is a co-owner and director at the Scripps Center for Dental Care. He serves on the board of directors of the AACD, is on the medical staff of the Scripps Memorial Hospital, and is also an adjunct faculty at the University of California, San Diego, School of Medicine.